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Compatibility and phytotoxicity nature of Azoxystrobin on Chilli

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Abstract
Azoxystrobin is a strobilurin group of biomolecule can act as broad spectrum fungicide. In the physical compatibility study, it was found that the fungicidal biomolecule azoxystrobin physically compatible with all the tested insecticides *viz.*, Dichlorvos 76% EC, Profenophos 50% EC, Triazophos 40% EC, Quinalphos 25% EC, Dimethoate 36% EC, Imidacloprid 17.8% EC and Thiamethoxam 25% WG. Under *in vitro*. The biological compatibility of azoxystrobin in chilli revealed that the combination of azoxystrobin (Willowood) with dichlorvas showed severe phytotoxic symptoms, it was recorded 91.36 per cent leaf damage on chilli followed by combination with profenophos, which showed 69.72 per cent leaf injury. The other insecticides such as dimethoate and quinolphos showed 26.15 and 17.67 per cent phytotoxicity on chilli. The individual application of azoxystrobin showed no phytotoxic symptoms.

Keywords: azoxystrobin, insecticides, phytotoxicity, compatibility

1. Introduction
Combined applications of insecticides and fungicides may result either in synergism (compatible) or antagonism (incompatible) between them (Duta *et al.*, 2017) [6]. Compatible means, no negative effects on crops when it is combinedly applied with different pesticides which can be physically mixed together. Incompatible refers to the reaction of pesticides that cannot be mixed safely without impairing the effectiveness of one or more of the chemicals. Incompatibility of pesticides leads to developing undesirable physical or chemical properties, or causing plant injury (Prakash, 1992) [11]. There are two basic types of incompatibility: chemical and physical. It is possible to get one or both from the same mix. Chemical incompatibility involves the breakdown and loss of effectiveness of one or more products in the spray tank and possible formation of one or more new chemicals that are insoluble or phytotoxic. Physical incompatibility involves an unstable mixture that settles out, flocculates foams excessively or disperses poorly and reduces efficiency and causes the clogging of sprayer nozzles and screens. This type of incompatibility may result from the use of hard, soft, or cold water or fertilizer solutions for mixing (Amin *et al.*, 2013) [1]. As most of the pesticides are specifically toxic either to insect pest or disease causing pathogen, management of both with any single pesticide is not practicable. Therefore it is necessary to mix an insecticide with the fungicide and apply on a crop. Application of two or more chemicals can save time, labour, energy and equipment cost provided there are no adverse effects on the plant, non-target organisms and on the efficacy of the chemicals in combating the problems (Lakshminarayana, 2000) [8]. Hence, in the present study the compatibility and phytotoxicity nature of azoxystrobin was tested on chilli.

2. Materials and methods
The physical and biological compatibility of azoxystrobin with different insecticides were tested by following the methodologies furnished below. The physical compatibility of azoxystrobin with insecticides was tested using emulsion stability test (ISI, 1964).

Preparation of standard hard water
Standard hard water was prepared by dissolving 304 mg of anhydrous calcium chloride and 139 mg of magnesium chloride in distilled water. This solution was used to prepare insecticide solution for all the tests conducted.

Physical compatibility test

The physical compatibility test was conducted by mixing azoxystrobin 0.2 per cent with different insecticides such as Dichlorvos 76% EC, Profenophos 50% EC, Triazophos 40% EC, Quinalphos 25% EC, Dimethoate 36% EC, Imidacloprid 17.8% EC and Thiamethoxam 25% WG at 0.1 per cent concentration and adding in 100 ml of standard hard water kept in a beaker at 30 ºC. The insecticide and fungicide mixture was directly poured to the standard hard water without touching the side wall of the beaker. The contents in the beaker were stirred four times per second with a glass rod. Then the beaker with its contents was kept at 30 ºC in a thermostat for 30 min. The creaming layer at the top and sedimentation at the bottom were observed. The cream/sedimentation layers above 2 ml were considered unstable.

Biological Compatibility of Azoxystrobin with Insecticides

Biological compatibility of azoxystrobin with insecticides was tested under glass house condition. Azoxystrobin @ 0.2 per cent was mixed separately with different insecticides *viz*., Dichlorvos 76% EC, Profenophos 50% EC Triazophos 40% EC, Quinalphos 25% EC, Dimethoate 36% EC, Imidacloprid 17.8% EC and Thiamethoxam 25% WG at the rate of one ml l^{-1} and used in this study. The plants were sprayed with the mixture, incubated in glass house and observed for the phytotoxicity symptoms up to 3 d. Three replications for each treatment were maintained (Anand, 2005).

Treatment details are as follows:

T1- Azoxystrobin 250 g a.i @ 2 ml l^{-1} + Dichlorvos @ 1 ml l^{-1}

T2- Azoxystrobin 250 g a.i @ 2 ml l^{-1} + Dimethoate@ 1 ml l^{-1}

T3- Azoxystrobin 250 g a.i @ 2 ml l^{-1} + Profenophos 50% EC @ 1ml l^{-1}

T4- Azoxystrobin 250 g a.i @ 2 ml l^{-1} + Imidacloprid 17.8% EC @ 1ml l^{-1}

T5- Azoxystrobin 250 g a.i @ 2 ml l^{-1} + Trizophos 40% EC@1ml l^{-1}

T6- Azoxystrobin 250 g a.i @ 2 ml l^{-1} + Quinalphos EC 25% 1ml l^{-1}

T7- Azoxystrobin 250 g a.i @2 ml l^{-1} + Thiamethoxam 25% WG @ 0.4 g l^{-1}

T8- Control

3. Results and Discussion

The knowledge about the compatibility of agrochemicals is very essential for the effective management of pests and diseases. Combined application of pesticides is a labour saving short cut method. But, wrong pesticide combinations may show physical, chemical or phytotoxic incompatibility, which leads to undesirable results (Dakshinamoorthy *et al.*, 1980) [4]. Fungicides and insecticides are routinely tank mixed and applied as foliar sprays to protect the crops from pest and diseases. This strategy is efficient because it saves time and energy by reducing the number of sprays (Vidhyadhari *et al.*, 2016) [15]. But the physical incompatibilities of pesticides could result in lumping and foaming which could damage the equipments by blocking the nozzle. Insolubility also results in reduced efficacy (Flores *et al.*, 2014) [7]. Physical incompatibilities resulted when granular formulation and wettable powders were mixed together in oil and water based fillers (Douglas, 1981) [3]. While mixing the insecticides with azoxystrobin no slimy layer, clots, flocculation were observed at the top of the mixture and no precipitations were observed at the bottom of the flask at any of the concentration. Hence, it has been concluded that the fungicide azoxystrobin is physically compatible with all the tested insecticides *viz*., Dichlorvos 76% EC, Profenophos 50% EC, Triazophos 40% EC, Quinalphos 25% EC, Dimethoate 36% EC, Imidacloprid 17.8 % EC and Thiamethoxam 25% WG.

Phytotoxicity due to incompatible pesticides combinations have already been reported by several scientists. Mixture of Sencor (metribuzin) and Tilt (propiconazole) was incompatible and highly phytotoxic resulting in low yield when sprayed against foliar diseases of wheat (Tewari *et al.*,2003) [12]. Manohar (2005) [9] reported that the combinations of carbendazim with thiodocarb; chlorothalonil with thiodocarb; and hexaconazole with thiodocarb were phytotoxic to chilli plants resulting in scorching of leaf tip. In the present investigation, the result of biological compatibility study reveals that, among the various treatments, combination of azoxystrobin with dichlorvas showed severe phytotoxic symptoms on chilli. It was recorded 91.36 per cent leaf damage on chilli followed by combination with profenophos showed 69.72 per cent leaf injury. The other insecticides such as dimethoate and quinolphos showed 26.15 and 17.67 per cent phytotoxicity respectively on chilli. The individual application of azoxystrobin showed no phytotoxic symptoms.

Table 1: Physical compatibility of azoxystrobin with insecticides

Insecticides	Azoxystrobin (ppm)			
	500	1000	1500	2000
Dichlorvos 76% EC	+	+	+	+
Imidacloprid 17.8% EC	+	+	+	+
Profenophos 50% EC	+	+	+	+
Thiamethoxam 25% WG	+	+	+	+
Triazophos 40% EC	+	+	+	+
Quinalphos 25% EC	+	+	+	+
Dimethoate 36% EC	+	+	+	+

+= Compatible, - = incompatible

Table 2: Biological compatibility of azoxystrobin with selected insecticides

Treatment	Per cent leaf injury		
	Day after spraying		
	First	Second	Third
Azoxystrobin 250 g ai. @2 ml l^{-1} + Dichlorvos @ 1 ml l^{-1}	87.68 ^{g} (69.45)	92.94 ^{g} (74.59)	91.36 ^{g} (72.90)
Azoxystrobin 250 g ai. @2 ml l^{-1} + Dimethoate@ 2 ml l^{-1}	21.26 ^{e} (27.45)	24.93 ^{e} (29.95)	26.15 ^{e} (30.75)
Azoxystrobin 250 g ai. @2 ml l^{-1} + Profenophos 50% EC @ 1ml l^{-1}	59.27 ^{f} (50.34)	64.37 ^{f} (53.35)	69.72 ^{f} (56.61)
Azoxystrobin 250 g ai. @2 ml l^{-1} + Trizophos 40% EC@1ml l^{-1}	3.42 ^{b} (10.65)	5.28 ^{b} (13.28)	9.27 ^{c} (17.72)
Azoxystrobin 250 g ai. @2 ml l^{-1} + QuinalphosEC 25% 1ml l^{-1}	10.16 ^{d} (18.58)	18.64 ^{d} (25.57)	17.67 ^{d} (24.85)
Azoxystrobin 250 g ai. @2 ml l^{-1}+ Imidacloprid 17.8% EC 1ml l^{-1}	3.24 ^{b} (10.37)	5.32 ^{b} (13.33)	7.71 ^{b} (16.12)
Azoxystrobin 250 g ai. @2 ml l^{-1}+ Thiamethoxam 25% WG 1g l^{-1}	5.86 ^{c} (14.00)	6.24 ^{c} (14.46)	9.75 ^{c} (18.19)
Control	0.00 ^{a} (0.58)	0.00 ^{a} (0.58)	0.00^{a} (0.58)

Mean of three replications

Values in parentheses are arcsine-transformed
In a column, means followed by same letter are not significantly different at the 5 per cent level
By DMRT

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