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Effect of Difenoconazole and Azoxystrobin on Wheat and Radish Seeds Germination and Tomato Seedling Growth

Emam, Sekina, S. & Abd-Eldaim, Faten, A.
Central Agricultural Pesticides Laboratory, Agricultural Research Centre, Dokki, Giza,Egypt
*E-mail: sekinaemam18@gmail.com

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ABSTRACT

Fungicides are generally used for increasing the yield of the crop but they can induce harmful changes in seed germination and also seedling growth. Therefore, the present study was carried out to evaluate the effect of Difenoconazole and Azoxystrobin as fungicides on the germination of monocotyledonous seed (wheat; *Triticum aestivum* L.), and dicotyledonous seeds (radish; *Raphanus sativus*), then effect on Tomato (*Solanum lycopersicum* L.) seedling growth. Seeds of wheat and radish and seedling of tomato were treated with different concentrations of the tested fungicides; recommended, half and the double recommended dose compared with the untreated control. The results showed that the two tested fungicides significantly decreased seed germination%, root and shoot length of both wheat and radish seeds at the different applied doses compared to the control. The highly significant reduction in relative root and shoot length% and the relative germination% of wheat and radish seeds were observed when exposed to Difenoconazole or Azoxystrobin in which double recommended doses being 23.20, 27.88, and 43% or 13.20, 26.02, and 30.10% in wheat seeds, however, the reduction were 22.30, 37.69, and 63.0% or 17.67, 51.67, and 40.70% in radish seeds, respectively. In the case of tomato seedlings; carotene, chlorophyll a, chlorophyll b and total chlorophyll were significantly decreased after three weeks from both fungicides application by the double recommended doses, which recorded 0.04, 2.25, 0.15, 2.40 mg/g fresh weight for difenoconazole or 0.06, 1.66, 0.39, 2.05 mg/g fresh weight for azoxystrobin, respectively. Because Difenoconazole is less hazardous than Azoxystrobin, it might be advised that wheat and radish seeds be treated with it before sowing. Three weeks after being exposed to the fungicides, tomato plants treated with Azoxystrobin displayed a decrease in the a/b ratio at the indicated dose.

INTRODUCTION

A fungicide is a group of pesticides that controls fungal disease by either inhibiting or killing the fungus that causes the disease. During seed germination and seedling growth, the seed reserve is hydrolyzed and a change in the cellular and organellar constituents such as proteins, lipids and carbohydrates take place. However, the rate of change varies from crop to crop and species to species. Difenoconazole and Azoxystrobin are two foliar and

systemic fungicides. Azoxystrobin (25%EC) possesses a novel biochemical mode of action and its fungicidal activity results from the inhibition of mitochondrial respiration in fungi. Their biochemical mode of action is the inhibition of electron transport according to Hewitt (1998). Difenoconazole acts as a seed treatment, foliar spray and systemic fungicide. It is taken up through the surface of the infected plant and is translocated to all parts of the plant. It has a curative effect and a preventative effect. Difenoconazole can be applied to winter wheat, oilseed rape, brussels sprouts, cabbage, broccoli/calabrese and cauliflower. It controls various fungi including *Septoria tritici*, Brown Rust, Light Leaf Spot, Leaf Spot, Pod Spot, Ring Spot and Stem Canker. The mode of action of difenoconazole is a sterol demethylation inhibitor that prevents the development of the fungus by inhibiting cell membrane ergosterol biosynthesis according to Reuveni and Sheglov (2002). Combined with commercial azoxystrobin-, fludioxonil-, difenoconazole-, and tebuconazole-based fungicides commonly used to control early blight (Hatem *et al.*, 2022). Phytotoxicity is the ability of pesticides to cause temporary or permanent damage to vegetative or generative organs, which reduce or totally inhibit germination, and to cause other physiological and morphological changes in sensitive plant species, and/or to certain varieties or genetic lines. Damage occurs in various ways, mostly as chlorosis, i.e. partial or complete destruction of chloroplasts when leaves become chlorotic. Necrosis (burn) is another manifestation of phytotoxicity, which can lead to complete leaf drying or defoliation according to Vuković *et al.* (2013). Seed germination, shoot and root elongation measurements are quite rapid for use on acute phytotoxicity tests with several advantages: sensitivity, simplicity, low cost, and suitability for reactive chemicals and contaminated soil samples according to Munzuroglu and Geckil (2002). Seed germination and seedling growth are being widely used to test the phytotoxicity of many chemical species such as fungicides which may be released into the environment because it is a crucial stage in plant growth and it is also an important phenomenon in agriculture because it is regarded as a thread of life and plants that ensure its survival according to Iqbal *et al*. (2016). Therefore, this study aimed to clarify the influence of selected fungicides with different doses on seed germination of radish and wheat as well as seedling growth of tomatoes.

MATERIALS AND METHODS

1.Fungicide Solutions Preparation:

Azoxystrobin and difenoconazole were suspended individually in distilled water to make different doses; recommended dose (the Egyptian Ministry of Agriculture official: 50cm/100-liter water for each), half (½D), and double the recommended doses.

2. Tested Plants:

Two seed types; radish (*Raphanus sativus*) and wheat (*Triticum aestivum* L.) were used for the seed germination test. A Tomato seedling (*Solanum lycopersicum* L.), of super strain B cultivar (45 d., old) was used for the seedling growth test.

3.Seed Germination Assay:

Germination assay was carried out according to the ISTA test (1996). Seeds were immersed in sodium hypochlorite (10%) solution for 10 min to ensure surface sterility then rinsed three times with distilled water. One piece of filter paper was put into a Petri dish (10 mm) and 10 seeds of wheat or radish were put onto the filter paper. Five ml of distilled water (control), or the fungicide suspensions were added/dish. Each exposed dose/plant was replicated three times. The Petri dishes were covered and placed in an incubator for 7 days in the dark at 26±2ºC. After the incubation period, root and shoot length, germination percentage, relative elongation %, relative germination rate and germination index were recorded. The results were compared to the untreated control for each seed type. The relative

elongation %, relative germination rate and germination index were calculated according to AOSA (1991) as follows:

$$\text{Relative germination rate} = \frac{\text{Seeds germinated in test sample} \times 100}{\text{Seeds germinated in the control}}$$

$$\text{Relative root elongation} = \frac{\text{Mean root length in test sample} \times 100}{\text{Mean root length in control}}$$

$$\text{Germination Index} = \frac{\text{Relative germination rate} \times \text{Relative root elongation}}{100}$$

4.Seedling Growth Assay:

The experiment was conducted in the greenhouse to evaluate the phytotoxicity effects of the two fungicides on tomato seedlings' pigments and dry weight. Physical and chemical properties and the soil texture of the used soil are summarized in Table (1).

Table 1: Physical and chemical analyses of the tested soil.

Physical properties					SP%	EC DS/m	pH
Clay%	Silt%	Sand%	Total%	Texture			
33.5	35.6	30.9	100	Clay	50	3.85	7.93

Chemical properties														
Soluble cations (meq/L)				Soluble anions (meq/L)				Mineral elements (ppm)						
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{-2}	HCO_3^{-1}	Cl^{-1}	So_4^{-2}	N	P	K	Cu	Fe	Mn	Zn
10.5	6.7	19.9	0.9	-	1.9	33.2	2.9	66	0.61	236.2	3.21	6.72	2.67	1.42

Tomato seedlings (45 d. age), were transplanted in the prepared pots and fertilized by adding 1.50g/pot (NPK 20/20/20), weekly. The fungicide suspensions were sprayed on the plants after 2 weeks from transplanting, with six replicates for each dose meanwhile the untreated check was sprayed with water only. Tomato leaves were collected after 1, 2, and 3 weeks from application. After collection, samples were transferred directly to the laboratory for pigments determination.

1.Phytotoxicity Measurements:

1.1. Chlorophyll and Carotenoids Contents:

The procedure mentioned by Hiscox and Israelstam (1979) was followed. Ten mg of leaf tissue in fraction were placed in a test tube containing 5 ml dimethyl sulphoxide (DMSO). Chlorophyll and carotenoids were extracted into the fluid without grinding by incubating overnight at 65 °C. Absorbance was measured by Shanghai Lab-spectrum instrument Co., Ltd Model, Alpha-1102 at 644 and 662 nm for chlorophyll determination, and 470 nm for carotenoids.

Total chlorophyll (Chl. a+b), chlorophyll a (Chl. a), and chlorophyll b (Chl. b) were calculated by using the Arnon equation (1949), while Cañal *et al*. (1985) was used for carotenoids.

Arnon equation:

Chl. a = 12.7 x O.D 662 – 2.69 x O.D 644 mg/l

Chl. b = 22.9 x O.D 644 – 4.68 x O.D 662 mg/l

Chl. a+b = 20.2 x O.D 644 + 8.02 x O.D 662 mg/l

Cañal equation:

$$\text{Carotenoids} = \frac{\text{A470} - 1.28\ (\text{Chl. a mg/l}) + 56.7\ (\text{Chl. b mg/l})}{256 \text{ x } 0.906}$$

1.2. Dry Weights:

After 4 weeks from treatment, tomato plants were cut off and dried by an electric oven of Fisher Isotemp. (Senior model) at 60 °C for 2 days. Then dry matter content per tomato plant was recorded by the gram.

Statistical Analysis:

The statistical analysis was done by using a one-way ANOVA by SPSS statistical software according to Landau and Everitt (2004). The results were presented as mean ± SD (standard deviation). Each of the experimental values was compared to the corresponding control. Statistical significance was accepted when the probability of the result assuming the null hypothesis (p) is less than 0.05.

RESULTS AND DISCUSSION

1.Effects of Difenoconazole and Azoxystrobin Suspensions on Wheat Seeds Germination:

Data in Table (2) indicated that difenoconazole and azoxystrobin suspension showed a significant decrease in root and shoot lengths at all treated doses compared with control with a clear significant dose-dependent. The highest significant decrease effect on root and shoot length was obtained by difenoconazole and azoxystrobin when applied at the double recommended dose which recorded the lowest relative root/shoot length % compared to control being 23.20 and 27.88% or 13.20 and 26.02%, respectively.

Table 2. Effect of Difenoconazole and Azoxystrobin suspensions on wheat seeds germination**.**

Doses	Difenoconazole						Azoxystrobin					
	Root (cm)	Relative root length %	Shoot (cm)	Relative shoot length %	Relative Germ. %*	Germ. Index**	Root (cm)	Relative root length %	Shoot (cm)	Relative shoot length %	Relative Germ. %*	Germ. Index**
Control	09.70^{a} ± 0.09	100.00	11.30^{a} ± 0.01	100.00	100.00	100.00	09.70^{a} ± 0.09	100.00	11.30^{a} ± 0.01	100.00	100.00	100.0
½ R. Dose	04.86^{b} ± 0.01	50.10	06.84^{b} ± 0.06	60.53	58.80	29.46	02.56^{b} ± 0.01	26.39	04.87^{b} ± 0.02	43.10	53.00	13.99
R. Dose***	04.28^{c} ± 0.01	44.12	05.05^{c} ± 0.07	44.69	53.00	23.39	02.50^{b} ± 0.01	25.77	03.21^{c} ± 0.02	28.41	47.10	12.14
Double R. Dose	02.25^{d} ± 0.04	23.20	03.15^{d} ± 0.09	27.88	43.00	09.97	01.28^{c} ± 0.01	13.20	02.94^{d} ± 0.02	26.02	30.10	03.97
LSD	0.22		0.22				0.27		0.24			

Also, relative germination % and germination index (Fig. 1) Correlated negatively with increasing the applied dose being 43.00% and 9.97%, or 30.10% and 3.97 at the double dose treatment of difenoconazole and azoxystrobin, respectively. The results indicated that wheat seeds were more affected by azoxystrobin treatment and showed the lowest germination measurements than difenoconazole. This is in agreement with Tvaruzek *et al.* (1995) who indicated that some fungicides such as prochloraz have a severe phytotoxic effect on winter wheat. Also, it could be due to that azoxystrobin affected the membrane stability of plant tissue where the extent of damage was concentration-dependent. Conversely, difenoconazole showed no adverse effect on the integrity of the membrane. However, the loss of electrolytes from the wheat leaves stimulated at high concentrations according to Tripathi *et al*. (1982).

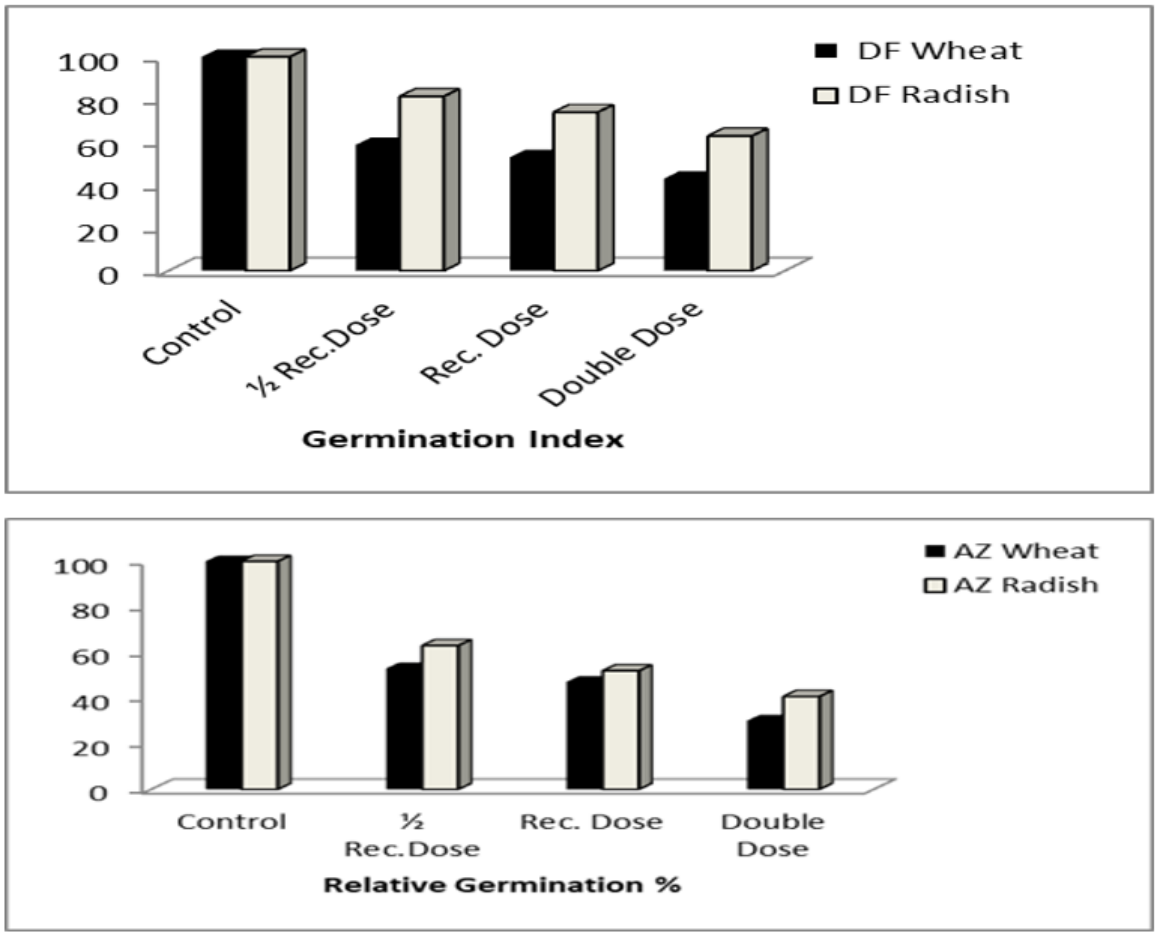

Fig. 1. Effects of Difenoconazole and Azoxystrobin suspensions on wheat and radish seed germination.

2.Effects of Difenoconazole and Azoxystrobin Suspensions on Radish Seeds Germination:

Data presented in Table (3) illustrated that difenoconazole and azoxystrobin showed a significant inhibition effect on the root and shoot length of radish seeds at all applied doses compared with the untreated control. Application of difenoconazole and azoxystrobin showed a significant inhibition effect on all tested parameters and the root was more affected than the shoot. The double recommended dose showed the highest significant inhibition effect and recorded the lowest relative root/shoot length% being 22.30 and 37.69% or 17.67 and 51.67%, respectively. Data of relative germination % and Germination index indicated that radish seeds were more sensitive to azoxystrobin than difenoconazole which showed the highest inhibition effect when treated with the double recommended dose, being 40.70% and 9.13 or 63.00% and 14.05, respectively. This is in agreement with Ratsch (1983) who concluded that inhibition of root elongation was a valid and sensitive indicator of environmental toxicity. However, the shoot elongation progressively decreased with increasing concentrations of tested fungicides according to Nithyameenaskshi *et al*. (2006).

Table 3. Effect of Difenoconazole and Azoxystrobin suspensions on radish seeds germination.

Doses	Difenoconazole						Azoxystrobin					
	Root (cm)	Relative root length %	Shoot (cm)	Relative shoot length %	Relative Germ. %*	Germ. Index**	Root(cm)	Relative root length %	Shoot (cm)	Relative shoot length %	Relative Germ. %*	Germ. Index**
Control	05.83^{a} ± 0.09	100.00	03.29^{a} ±0.08	100.00	100.00	100.00	05.83^{a} ±0.09	100.0	03.29^{a} ± 0.08	100.00	100.0	100.0
½ R. Dose	03.69^{b} ± 0.01	63.29	02.25^{b} ± 0.01	68.39	81.50	51.58	02.62^{b} ±0.02	44.94	02.59^{b} ± 0.04	78.72	63.00	28.31
R. Dose***	03.10^{c} ± 0.01	53.17	02.05^{c} ± 0.01	60.79	74.10	39.40	02.25^{b} ±0.01	38.59	02.26^{c} ±0.04	68.69	52.00	20.07
Double R. Dose	01.30^{d} ± 0.01	22.30	01.24^{c} ± 0.01	37.69	63.00	14.05	01.03^{c} ± 0.01	17.67	01.70^{d} ±0.04	51.67	40.70	09.13
LSD	0.49		0.22				0.84		0.12			

Values are means of three replicates of each parameter ± standard deviation.
Means within each column followed by the same letter are not significant at $p > 0.05$.
* Relative germination rate compared with control
**Germination Index = (Relative germination rate × Relative root length)/100
*** R. Dose: recommended dose by Egyptian Ministry of Agriculture.

3. Effects of Difenoconazole and Azoxystrobin Suspensions On Tomato Seedling Pigments:

Data presented in Tables 4-6, indicated that Difenoconazole showed a significant decrease effect when applied at the three application doses on Carotene and Chl.a content compared with the untreated control after 7 days from application, while it did not reveal any significant differences after 14 and 21 d., except that of double recommended dose treatment which showed a highly significant decrease in Chl.a after 21 days and recorded 2.25 mg/g fresh weight. All difenoconazole treatments showed a significant decrease in effect on Chl.b after 14 and 21 days of application. The highest effect was recorded by the double recommended dose compared to the other treatment, recording 0.5 and 0.15 mg/g fresh weight after 14 and 21 days, respectively. Chlorophyll total (Chl.a+b) and Chl.a/b ratio was affected significantly by all applied fungicide doses compared with the control and showed the highest significant value at the double recommended dose after 21 days from application, being 2.4 mg/g fresh weight and 15, respectively.

Azoxystrobin treatment in Tables (4-6), decreased all tested pigments i.e., Carotene, Chl.a, Chl.b, Chl.a+b and Chl.a/b ratio with significant values compared to control at the different tested times. The high significant values were recorded when the double dose was treated after 21 days from the application being 0.06, 1.66, 0.39 and 2.05 mg/g fresh weight, and 4.26, respectively.

Table 4. Effect of Difenoconazole and Azoxystrobin suspensions on tomato seedling pigments after one week from application.

Doses	Difenoconazole					Azoxystrobin				
	Carotene	Chl. a	Chl. b	Chl. Total	Chl. a/b Ratio	Carotene	Chl. a	Chl. b	Chl. Total	Chl. a/b Ratio
Control	0.13^{a} ±0.01	02.49^{a} ± 0.01	0.61^{a} ±0.01	03.10^{a} ± 0.1	04.08^{d} ± 0.01	0.13^{a} ± 0.01	02.49^{a} ± 0.01	0.61^{a} ± 0.01	03.10^{a} ± 0.1	04.08^{c} ± 0.01
½ R. Dose	0.10^{a} ± 0.5	02.47^{a} ±0.01	0.45^{b} ±0.01	02.92^{b} ± 0.01	05.49^{a} ± 0.01	0.12^{a} ± 0.01	02.38^{b} ± 0.01	0.60^{a} ± 0.01	02.98^{b} ± 0.01	03.97^{d} ± 0.01
R. Dose*	0.10^{a} ± 0.5	02.37^{b} ± 0.01	0.45^{b} ±0.01	02.82^{c} ± 0.01	05.27^{b} ± 0.01	0.120^{a} ± 0.01	02.20^{c} ± 0.1	0.53^{b} ± 0.01	02.73^{c} ± 0.01	04.15^{b} ± 0.01
Double R. Dose	0.09^{a} ± 0.01	02.21^{c} ± 0.01	0.44^{b} ±0.01	02.65^{d} ± 0.15	05.02^{c} ± 0.01	0.087^{a} ± 0.01	02.12^{c} ± 0.1	0.43^{c} ± 0.01	02.55^{d} ± 0.01	04.93^{a} ± 0.01
LSD	**	0.11	0.07	0.08	0.07	**	0.11	0.07	0.08	0.07

** Not significantly different at 0.05

Table 5: Effect of Difenoconazole and Azoxystrobin suspensions on tomato seedling pigments after two weeks from the application (mg/g fresh weight).

Doses	Difenoconazole					Azoxystrobin				
	Carotene	Chl. a	Chl. b	Chl. Total	Chl. a/b Ratio	Carotene	Chl. a	Chl. b	Chl. Total	Chl. a/b Ratio
Control	$0.13^{a} \pm 0.01$	$03.12^{a} \pm 0.01$	$0.79^{a} \pm 0.01$	$03.91^{a} \pm 0.01$	$3.95^{d} \pm 0.01$	$0.13^{a} \pm 0.01$	$03.12^{a} \pm 0.01$	$0.79^{a} \pm 0.01$	$03.91^{a} \pm 0.01$	$03.95^{d} \pm 0.01$
½ R. Dose	$0.13^{a} \pm 0.01$	$03.11^{a} \pm 0.01$	$0.63^{b} \pm 0.01$	$03.74^{b} \pm 0.01$	$4.94^{c} \pm 0.01$	$0.12^{b} \pm 0.15$	$03.00^{b} \pm 0.1$	$0.71^{b} \pm 0.01$	$03.71^{b} \pm 0.25$	$04.23^{c} \pm 0.01$
R. Dose*	$0.12^{a} \pm 0.01$	$03.10^{a} \pm 0.01$	$0.57^{c} \pm 0.01$	$03.67^{c} \pm 0.01$	$5.44^{b} \pm 0.01$	$0.11^{b} \pm 0.01$	$02.90^{c} \pm 0.1$	$0.56^{c} \pm 0.01$	$03.46^{c} \pm 0.21$	$05.18^{a} \pm 0.01$
Double R. Dose	$0.10^{a} \pm 0.01$	$02.98^{a} \pm 0.06$	$0.50^{d} \pm 0.01$	$03.48^{d} \pm 0.01$	$5.96^{a} \pm 0.01$	$0.10^{c} \pm 0.025$	$02.46^{d} \pm 0.01$	$0.55^{d} \pm 0.01$	$03.01^{d} \pm 0.50$	$04.47^{b} \pm 0.01$
LSD	0.02	0.09	0.02	0.02	0.24	0.02	0.09	0.02	0.02	0.24

Values are means of three replicates of each parameter ± standard deviation.
Means within each column followed by the same letter are not significant at $p > 0.05$.
* R. Dose: recommended dose by the Egyptian Ministry of Agriculture

Table 6. Effect of Difenoconazole and Azoxystrobin suspensions on tomato seedling pigments after three weeks from application (mg/g fresh weight).

Doses	Difenoconazole					Azoxystrobin				
	Carotene	Chl. a	Chl. b	Chl. Total	Chl. a/b Ratio	Carotene	Chl. a	Chl. b	Chl. Total	Chl. a/b Ratio
Control	$0.09^{a} \pm 0.01$	$03.96^{a} \pm 0.01$	$0.52^{a} \pm 0.01$	$04.48^{a} \pm 0.01$	$07.62^{d} \pm 0.01$	$0.09^{a} \pm 0.01$	$03.96^{a} \pm 0.01$	$0.52^{a} \pm 0.01$	$04.48^{a} \pm 0.01$	$07.62^{a} \pm 0.01$
½ R. Dose	$0.07^{b} \pm 0.01$	$03.38^{b} \pm 0.01$	$0.39^{b} \pm 0.01$	$03.77^{b} \pm 0.01$	$08.66^{c} \pm 0.01$	$0.08^{a} \pm 0.01$	$02.94^{b} \pm 0.01$	$0.41^{b} \pm 0.01$	$03.35^{b} \pm 0.01$	$07.17^{b} \pm 0.01$
R. Dose*	$0.057^{c} \pm 0.001$	$02.91^{c} \pm 0.01$	$0.29^{c} \pm 0.01$	$03.20^{c} \pm 0.10$	$10.03^{b} \pm 0.01$	$0.07^{b} \pm 0.01$	$02.43^{c} \pm 0.01$	$0.40^{b} \pm 0.01$	$02.83^{c} \pm 0.01$	$06.08^{c} \pm 0.01$
Double R. Dose	$0.04^{d} \pm 0.01$	$02.25^{d} \pm 0.01$	$0.15^{d} \pm 0.01$	$02.40^{d} \pm 0.1$	$15.00^{a} \pm 0.06$	$0.06^{c} \pm 0.01$	$01.66^{d} \pm 0.01$	$0.39^{c} \pm 0.01$	$02.05^{d} \pm 0.01$	$04.26^{d} \pm 0.01$
LSD	0.017	0.03	0.02	0.35	2.86	0.017	0.03	0.02	0.35	2.86

Values are means of three replicates of each parameter ± standard deviation.
Means within each column followed by the same letter are not significant at $p > 0.05$
* R. Dose: recommended dose by Egyptian Ministry of Agriculture.

Dry weight:

Data presented in Table (7) indicated that difenoconazole and azoxystrobin showed no marked differences between their effects on tomato seedling dry weight. Meanwhile, the seedling's dry weight was significantly decreased by all exposed doses compared with the control. The double recommended dose showed the highest effect and recorded the lowest weight value being 0.76 and 0.76 g/plant for difenoconazole and azoxystrobin, respectively. Moreover, there was no significant difference between the other two treated doses. This is in agreement with the reports showing decreases in biomass production in benomyl fungicides-exposed plants which reduced the growth of *Gossypium hirsutum*, *Helianthus decreannuus*, *Cucumis sativus*, *Lactuca sativa* and *Pinus taeda* (Garcia *et al*., 2003). Also, many fungicides showed phytotoxicity to different field crops under various conditions of their application according to **Singh *et al*. (2003)**.

Table 7. Effect of Difenoconazole and Azoxystrobin suspensions on tomato seedling dry weights (g/plant).

Doses	Difenoconazole Mean± SD	Azoxystrobin Mean± SD
Control	$0.94^{a} \pm 0.04$	$0.94^{a} \pm 0.04$
½ R. Dose	$0.83^{b} \pm 0.03$	$0.81^{b} \pm 0.03$
R. Dose*	$0.82^{b} \pm 0.03$	$0.81^{b} \pm 0.03$
Double R. Dose	$0.76^{c} \pm 0.01$	$0.76^{c} \pm 0.02$
LSD	0.13	0.12

Values are means of three replicates of each parameter ± standard deviation.
Means within each column followed by the same letter are not significant at $p > 0.05$.
* R. Dose: recommended dose by Egyptian Ministry of Agriculture.

Fungicides (difenoconazole and azoxystrobin) applied at one, two and three times the recommended rates, decreased the plant-growth-promoting attributes of *P. putida* in the strain PS9 and affected the PGP activities in a concentration-dependent manner. Fungicides at the recommended dose had a minor reducing effect while the doses higher than the recommended dose significantly reduced the PGP activities (phosphate solubilization, salicylic acid, 2,3-dihydroxy benzoic acid, and indole-3-acetic acid production except for exo-polysaccharides, hydrogen cyanate and ammonia production) according to Ahemad and Khan (2012).

Vuković *et al*. (2014) showed the effects of the fungicides: azoxystrobin (Quadris, 0.75 l/ha), mancozeb (Dithane M-70, 2.5 kg/ha) and thiamethoxam (Actara 25-WG, 0.07 kg/ha) by measuring the diameter of chlorosis and/or necrosis around puncture sites and were expressed in mm^2 and found significant differences between treatments.

Difenoconazole (0.3845 mg/L) and Azoxystrobin (2.6019 mg/L) were effective when tested using in vitro assays to control wheat Fusarium crown rot and grain yields were increased (Zhang**,** *et al.*, 2022).

Conclusion

When wheat and radish seeds are to be treated before planting difenoconazole must be used at the recommended dose because it is less toxic than azoxystrobin. After planting no significant differences between the two fungicides within two weeks from the application were evidenced, whereas after three weeks of the fungicides exposed tomato plants treated with azoxystrobin showed a decrease in a/b ratio at the recommended dose to control.

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ARABIC SUMMARY

تأثير دايفينوكونازول و أزوكسيستروبين علي إنبات بذور القمح والفجل ونمو بادرة الطماطم

سكينه سيد امام وفاتن انور عبدالدايم [1]
قسم سمية المبيدات للنباتات- المعمل المركزي للمبيدات- مركز البحوث الزراعية [1]

تستخدم المبيدات الفطرية عامة لزيادة إنتاجية المحصول ولكن قد تحدث تغيرات ضارة في إنبات البذور ونمو البادرة. تمت هذه الدراسة لتقيم تأثير كلا من المبيدين دايفينوكونازول وأزوكسيستروبين علي نمو بذور نبات ذات فلقة واحدة (القمح) وبذور نبات ذات فلقتين (الفجل) ودراسة تأثيرهم علي إنبات بادرات الطماطم. تم معاملة البذور و البادرات بتركيزات مختلفة من المبيدين بالجرعة الموصي بها ونصف الجرعة و ضعف الجرعة ومقارنتها بالكنترول.

أوضحت النتائج أن المبيدين المستخدمين قد سجلوا إنخفاض معنوي في النسبة المئوية للنمو وطول الجذر والساق لكلا من القمح والفجل في جميع الجرعات المعامل بها البذور مقارنتا بالكنترول.

سجل إنخفاض كبير معنوي للطول النسبي للجذر والساق% وأيضا للنمو النسبي % لبذور القمح والفجل المعاملين دايفينوكونازول و ازوكسيستروبين بضعف الجرعة الموصي بها وكانت 23،2و 27،88و43% أو 13،2 و 26،02 و 30،1 % للقمح في حين كان 22،3 و 37،69 و 63 % أو 17،67و 51،67 و 40،70 % لبذور الفجل علي التوالي.

أما في حالة بادرة الطماطم حدث انخفاض معنوي لكلا من الكاروتين وكلوروفيل أ وكلوروفيل ب والكلوروفيل الكلي بعد ثلاث اسابيع من المعامله بضعف الجرعه الموصي بها لكل من المبيدين وسجلت 0،04و 2،25و 0،15و 2،40 مللي جرام /جرام وزن رطب للبادرات المعاملة بدايفينوكونازول أو 0،06و 1،66و 0،39و 2،05 مللي جرام /جرام وزن رطب للبادرة المعامله ازوكسيستروبين على التوالي.

نوصي بضرورة معاملة بذور القمح والفجل قبل الزراعة بالديفينوكونازول بالجرعة الموصى بها لأنها أقل سمية من أزوكسيستروبين. بعد ثلاثة أسابيع من استخدام بالديفينوكونازول وازوكسيستروبين، أظهرت نباتات الطماطم التي تم معاملتها بالأزوكسيستروبين انخفاضًا في نسبة كلوروفيل أ و ب بالجرعة الموصى بها عن الكنترول.

الكلمات المفتاحية:قمح- فجل طماطم- ديفينوكونازول -ازوكسيستروبين