

Effect of Insecticides, Folimat 800 and Tricel EC 20% (Organophosphate) on Wheat (*Triticum aestivum*) Plant Growth under two Different Soils in Sudan

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Abstract

The experiment was carried out during the successive seasons of 2016/2017 at Shambat Agricultural Farm (East), College of Agricultural Studies, Sudan University of Science and Technology. The aim of the study is to investigate the effect of Folimat 800 and Tricel EC 20% insecticides on wheat plant growth parameters under two types of soil. Both insecticides were added at concentrations of; Tricel recommended dose (2 ml/L), overdose (3 ml/L) and under dose (1 ml/L) as well as Folimat recommended dose (1 ml/L), overdose (1.5 ml/L) and under dose (0.5 ml/L), in addition to control without insecticides. Treatments were arranged in a complete randomized block design. The growth parameters investigated in this study included plant height, number of leaves; stem diameters, fresh and dry weight. The results obtained revealed that, both insecticides affected wheat vegetative growth at variable level. However, the plant height showed steady increase with intervals ranged from 4.9 to 8.3 with the two insecticides and at all concentrations. This increase was found to be remarkable in case of Folimat at all concentrations to reach significant level, 8.3 and 8.0 at 105 days and 90 days interval at Shambat and East Gezira soil respectively at all concentrations compared with Tricel and control. Similar significant effect was expressed by Folimat in case of fresh weight but its effect on dry weight in Shambat and East Algezira soil was found to be inconsistent compared to all other treatments. However, the results indicated that the increasing trend of plant height with interval between Tricel at different rates and control was not significant. Negligible and inconsistent effect of both insecticides at different concentrations and at two types of soils on plant diameter leaves numbers and NPK percentages were also observed.

Key words: Folimat, Tricel, Wheat

INTRODUCTION

Wheat (*Triticum spp.*) is a cereal grain, originally from the Levant region of the Near East but now cultivated worldwide. In 2013, world production of wheat was 713 million tons, making it the third most-produced cereal after maize (1,016 million tons) and rice (745 million tons).. Wheat was the second most-produced cereal in 2009; world production in that year was 682 million tons, after maize (817 million tons), and with rice as a close third (679 million tons) (FAO, 2015).

The wheat crop like any other plants is subject to a large number of pests and diseases from time of emergence to harvest and storage (FAO, 2015).

The agricultural environment can support a variety of unwanted organisms that reduce the yield and value of crops. Thus herbicides, insecticides, fungicides, nematicides, and biocides, collectively called Insecticides are used to kill weeds, insects, fungi, nematodes and everything respectively. Unfortunately leaching into the soil, run-off, and volatilization move these chemicals into ground and surface waters, and into the atmosphere (Gafar, *et al*, 2012).

Abdel Muntalab, A.S.(2007) Soil is the center where the plant, one of the surrounding components of the environment such as temperature, humidity, light, and other factors are considered factors which affect one way or another on the plant, the soil susceptible to contamination with toxins, especially insecticides and fungicides as well as herbicides that link to it directly or indirectly.

MATERIALS AND METHODS

Study area:

The experiment was carried out for one season of 2016 at the Demonstration Farm of Collage of Agricultural Studies Sudan University of Science and Technology at Shambat. Shambat is located (LAT: 15° 40'N LONG: 32° 32'E and ALT.: 380 M), and altitude 380 m above sea surface, it climate it semi-desert region (Adam, 2002).

Soil analysis:

Soils from the plots were chemically analyzed before experiment onset. Samples were air dried in an open bench at ambient temperature in the soil laboratory for 72 hours. Soil pH was determined using a pH meter, model (3510) with glass electrode according to the method of (Richard, 1954). Electrical conductivity of the saturation extract (EC_e) was determined

using electrical resistance bridge model (M35) as described by (Richard, 1954). Soluble cations (Na^+ , K^+ , and $\text{Ca}^{++} + \text{Mg}^{++}$) and soluble anions (CO_3 , HCO_3^- , Cl^- and SO_4^-) were determined according to (Richard, 1954). Sodium adsorption ratio was calculated as follows:

$$\text{SAR} = \text{Na} / \left(\frac{\sqrt{\text{Ca} + \text{Mg}}}{2} \right)$$

Total nitrogen was determined by Kjeldhal method (Ryan *et. al.*, 2001). Available phosphorus was determined using Olsen method (1954). Organic carbon was determined by Walkley and Black (1934).

Mechanical analysis was determined using the hydrometer method (Days, 1956). Texture class was determined according to the American system using textural triangle.

Pots experiment

The pot experiment was conducted in 2016 during the Winter season (November to February) on two clay soils (Shambat and Algzira East), Sudan. Wheat plant was hand planted in a pots. Five seeds were placed in each hole.

The treatments applied for the Wheat experiment were as follows: Tricel Insecticides recommended dose (2 ml/L), overdose (3 ml/L) and Under dose (1 ml/L). Folimat Insecticides recommended dose (1 ml/L), overdose (1.5 ml/L) and under dose (0.5 ml/L). Control without Insecticides. (Hatim, 2016).

Source of seeds

Cultivar Hudiba (1), used in the experiment was obtained from Environmental Natural Resources and Desertification Research Institute, Khartoum, Sudan.

Plant parameters

Plants height was measured in (cm) from the soil surface up to the collar of the last leaf on the plant, from three selected plants, then the mean plant height was calculated for each pot. Stem diameter (cm): measured was using Vernier caliper tool, number of leaves, fresh weight and dry weight at 60,75,90 and 105 days intervals.

Plant tissue analysis

Plant samples were further dried to a constant weight in a forced-air oven at 72°C for 48 h. The top dry and root weights were determined. For ash content of the different samples, the standard method as described by (Ryan, *et. al.*, 1996). Plant samples were extracted using 10 ml hydrochloric acid (5N) in a sand bath for 15 minutes. The extract was filtered and made to 50- ml volume. potassium were determined using a Flame photometer (Ryan *et. al.*, 1996). Phosphorus was determined using a Spectrophotometer (Ryan *et. al.*, 1996). Nitrogen content determined using kjeldal method (Ryan *et. al.*, 1996).

Statistical analysis

The design of experiment was a Completely Randomized Block Design (CRBD) with three replications. The means were separated using MSTAT-C version 1.42.

Results and Discussions

Results:

Table (1) Chemical and physical properties of soil experiment

Lab No.	Field No.	pH Paste	ECe dS/m	Soluble Cations Meq/L			SAR	Soluble Anions Meq/L		
				Na	K	Ca+Mg		CO ₃	HCO ₃	Cl
1	Shambat	8.0	4.69	13.9	3.6	28.8	4	1.0	2.4	1.2
2	Algazira East	7.9	1.3	4.8	0.9	7.0	3	1.0	4.8	3.0

Lab No.	Field No.	N %	P ppm	O.C %	Exchangeable Cations Meq/100g			CEC Meq/100g	ESP	CaCO ₃ %	Texture %		
					Na	K	Ca+Mg				Clay	Silt	Sand
1	Shambat	0.001	3	0.01	3.8	0.6	30.6	35	11	5	39	11	50
2	Algazira East	0.002	4	0.01	2.9	0.9	26.2	30	10	3	40	23	37

Effect of the two insecticides on wheat plant growth (plant height- stem diameters- number of leaves) at different sampling intervals and concentrations, planted on soil from Shambat

The treatments on soil obtained from Shambat showed in table (2). The effect of the two insecticides at different concentrations and in different sampling periods was variable. There were no clear differences between treatments. The only effect which remained was the increase of plant height with days of interval periods at all concentrations of the two

chemicals. The table also showed that the effect of the two chemicals on stem diameter and leaves numbers, at all concentrations and at different sampling intervals was absent.

Table (2) Effect of the two insecticides on wheat plant growth (plant height- stem diameters- number of leaves) at different sampling intervals and concentrations, planted on soil from Shambat

Treatments	Plant Height				Stem diameters				Number of Leaves			
	60 days	75 days	90 days	105 days	60 days	75 days	90 days	105 days	60 days	75 days	90 days	105 days
F ₁	5.0 ^b	7.3 ^a	8.2 ^{ab}	8.3 ^a	1.9 ^{ab}	2.0 ^{ab}	2.0 ^a	2.0 ^{ab}	4.6	5.0	3.3 ^a	3.0 ^b
F ₂	5.3 ^{ab}	7.6 ^a	8.2 ^{ab}	8.2 ^a	1.9 ^a	2.0 ^a	2.0 ^{ab}	2.0 ^{ab}	5.0	5.0	3.3 ^a	3.0 ^b
F ₃	5.6 ^a	7.7 ^a	8.3 ^a	8.3 ^a	2.0 ^a	2.0 ^a	2.0 ^a	2.0 ^a	5.0	5.0	3.0 ^a	3.6 ^a
T ₁	5.1 ^{ab}	6.5 ^a	7.4 ^c	7.6 ^b	1.8 ^{bc}	2.0 ^{ab}	1.9 ^b	1.9 ^b	4.6	5.0	3.6 ^a	3.0 ^b
T ₂	5.0 ^b	6.5 ^a	7.4 ^c	7.6 ^b	1.8 ^{bc}	2.0 ^{ab}	1.9 ^b	1.9 ^b	4.3	5.0	3.0 ^a	3.0 ^b
T ₃	5.1 ^{ab}	6.9 ^a	7.7 ^{bc}	7.7 ^b	1.7 ^c	1.9 ^b	1.9 ^{ab}	1.9 ^b	4.3	5.0	3.0 ^a	3.0 ^b
C	4.9 ^b	6.5 ^a	7.7 ^{bc}	7.9 ^b	1.7 ^c	2.0 ^{ab}	1.9 ^{ab}	1.9 ^{ab}	4.3	5.0	3.3 ^a	3.0 ^b
LSD	0.57 37	1.4 04	0.50 63	0.33 75	0.11 25	0.079 56	0.97 44	0.079 56	0.0	0.0	0.82 30	0.38 98

*Means for each column having the same letter are not significantly different according to LSD 5%.

F₁: Folimat Over dose, F₂: Folimat Under dose, F₃: Folimat Recommended dose

T₁: Tricel Over dose, T₂: Tricel Under dose, T₃: Tricel Recommended dose

C: Control

Effect of two insecticides on wheat plant growth (Fresh and dry weight) planted on soil from Shambat

Table (3) presents the results of the effect of the treatments on soil from Shambat. There was significant effect of Folimat on fresh weight of wheat at F₁, F₂ and F₃; 2.2, 2.3 and 2.3 respectively compared with 1.9 with Tricel at all concentrations and control 1.9. The effect of Folimat on dry weight was also prominent which was 1.7, 1.7 and 1.8 for F₁, F₂ and F₃ compared with 1.5 at all concentrations of Tricel respectively. Obviously, there was no significant difference between all treatments and control in both parameters. Moreover, the negative impact of Tricel at all concentrations on both parameters was demonstrated in this result.

Table (3) Effect of two Insecticides on wheat plant growth (Fresh weight- Dry weight) on Shambat soil

Treatments	Fresh weight	Dry weight
F ₁	2.2 ^{ab}	1.7 ^{ab}
F ₂	2.2 ^{ab}	1.7 ^{abc}
F ₃	2.3 ^a	1.8 ^a
T ₁	1.9 ^{bc}	1.5 ^{bc}
T ₂	1.9 ^c	1.5 ^c
T ₃	1.9 ^c	1.5 ^{bc}
C	1.9 ^{bc}	1.6 ^{abc}
LSD	0.2813	0.2639

*Means for each column having the same letter are not significantly different according to LSD 5%.

F₁: Folimat Over dose, F₂: Folimat Under dose, F₃: Folimat Recommended dose

T₁: Tricel Over dose, T₂: Tricel Under dose, T₃: Tricel Recommended dose

C: Control

Effect of the two insecticides on N P K percentages in wheat plant on Shambat North soil

The results in table (4) show the effect of the two insecticides on N P K levels in wheat plant on Shambat North soil. Obviously, the level of the three elements was prominent. Concerning N %, generally, there was no significant difference between the two chemicals at all concentrations and the control. The effect of the two chemicals on P % in this soil was inconsistent. Likewise, the impact of the two chemicals on the elements was variable and showed no significant differences compared with the control except with F₂, F₃ and T₁ (0.034, 0.34 and 0.18) respectively compared with control 0.130.

Table (4) Effect of the two insecticides on N P K percentages in wheat plant on Shambat soil

Treatments	N (%)	P (%)	K (%)
F ₁	0.500 ^a	0.005	0.088 ^{ab}
F ₂	0.500 ^a	0.017	0.034 ^{bc}
F ₃	0.500 ^a	0.020	0.034 ^{bc}
T ₁	0.500 ^a	0.015	0.018 ^c
T ₂	0.467 ^a	0.006	0.117 ^a
T ₃	0.467 ^a	0.007	0.120 ^a

C	0.667 ^a	0.034	0.130 ^a
LSD	0.3081	0.0	0.05626

*Means for each column having the same letter are not significantly different according to LSD 5%.

F₁: Folimat Over dose, F₂: Folimat Under dose, F₃: Folimat Recommended dose

T₁: Tricel Over dose, T₂: Tricel Under dose, T₃: Tricel Recommended dose

C: Control

Effect of the two insecticides on wheat plant growth components (plant height- stem diameters- number of leaves) at different sampling intervals and concentrations, planted on soil from Algazira East

The results obtained (Table, 5) show that the two insecticides at different concentrations and in different sampling periods were invariably continued exhibiting their effects on plant components. The degree of this effect on plant parameters measured vary according to; 1) insecticide used, 2) degree of concentration of the chemical tested and 3) the days of sampling period. Among insecticides, the effect of Folimat excelled that of Tricel especially on plant height where Folimat gave 4.9, 5.2 and 5.3 at F₁, F₂ and F₃ concentrations respectively compared with 4.3, 4.1 and 4.2 in 60 days sampling period at T₁, T₂ and T₃ concentration respectively whereas in 75 days sampling period, Folimat gave 4.4, 6.8, 7.0 and 7.3 at F₁, F₂ and F₃ concentration compared with 5.6, 5.0 and 5.4 at T₁, T₂ and T₃ concentration respectively and in 90 days sampling period Folimat gave 7.9, 8.0 and 8.0 at F₁, F₂ and F₃ concentration compared with 6.9, 7.4 and 7.2 at T₁, T₂ and T₃ concentration respectively. This effect was significantly different on plant height at all concentrations of Folimat used which were 4.9, 5.2 and 5.3 in 60 days sampling period at F₁, F₂ and F₃ respectively compared with control 4.4, in 75 days gave 6.8, 7.0 and 7.3 at F₁, F₂ and F₃ respectively compared with control 5.3, and at 90 days gave 7.9, 8.0 and 8.0 at F₁, F₂ and F₃ respectively compared with control 6.8. However, this superior effect of Folimat continued to decrease with sampling period and plant component, till it became not significant at 105 sampling period for plant height as well as on plant diameters and leaves. However, regard less of the insecticides used and there concentration, there is a trend of increase in plant height with sampling periods.

In fact, the two insecticides at different concentrations and at different sampling periods gave variable effect on plant stem diameter which range from significant with Folimat F₁, F₂ and

F3 at 60 days that gave 1.9, 2.0 and 2.0 respectively compared with control 1.8, to no significant effect at all concentrations and sampling periods of the two chemicals where they gave an effect between 1.7 to 2.0 compared with control 1.8 to 2.0.

However, the effect of the two chemicals on number of leaves was decreasing with intervals periods, where the two chemicals expressed a trend that varies from significant increase at 75 days interval in almost all chemicals concentrations (5.0 compared with 4.3 in control), to negative effect or decrease in number of leaves (3.0 compared with 4.0 in control) at 90 days to reach no significant difference at 105 days across the different concentrations of the two chemicals where the leaves numbers vary from 3.0 to 3.6 compared with control 3.0.

Table (5) Effect of the two insecticides on wheat plant growth component (plant height- stem diameters- number of leaves) at different sampling intervals and concentrations, planted on soil from Algazira East

Treatments	Plant Height				Stem diameters				Number of Leaves			
	60 days	75 days	90 days	105 days	60 days	75 days	90 days	105 days	60 days	75 days	90 days	105 days
F ₁	4.9 ^b	6.8 ^a _{bc}	7.9 ^a	7.9 ^a	1.9 ^a	2.0 ^a	2.0 ^{ab}	2.0 ^a	4.8	5.0 ^a	3.0 ^c	3.3 ^a
F ₂	5.2 ^a	7.0 ^a _b	8.0 ^a	8.0 ^a	2.0 ^a	1.9 ^a	2.0 ^a	2.0 ^a	5.3	5.0 ^a	3.0 ^c	3.0 ^a
F ₃	5.3 ^a	7.3 ^a	8.0 ^a	7.9 ^a	2.0 ^a	2.0 ^a	2.0 ^{ab}	1.9 ^{ab}	5.3	5.0 ^a	3.0 ^c	3.3 ^a
T ₁	4.3 ^{cd}	5.6 ^a _{bcd}	6.9 ^{cd}	7.2 ^a _b	1.8 ^b	1.9 ^a	1.9 ^b	1.9 ^b	3.6	4.6 ^{ab}	4.0 ^{ab}	3.0 ^a
T ₂	4.1 ^d	5.0 ^d	7.4 ^b	6.3 ^b	1.7 ^b	1.9 ^a	1.9 ^{ab}	2.0 ^a	3.6	4.0 ^b	3.6 ^b	3.0 ^a
T ₃	4.2 ^{cd}	5.4 ^b _{cd}	7.2 ^{bc}	6.8 ^a _b	1.7 ^b	1.9 ^a	1.9 ^{ab}	1.9 ^b	3.6	4.3 ^{ab}	4.3 ^a	3.3 ^a
C	4.4 ^c	5.3 ^c _d	6.8 ^d	7.3 ^a _b	1.8 ^b	1.8 ^a	1.9 ^{ab}	2.0 ^a	4.0	4.6 ^{ab}	4.3 ^a	3.3 ^a
LSD	0.28 69	1.70 1	0.32 80	1.3 44	0.13 78	0.21 05	0.12 58	0.079 56	0.0	0.97 76	0.59 27	0.72 70

*Means for each column having the same letter are not significantly different according to LSD 5%.

F₁: Folimat Over dose, F₂: Folimat Under dose, F₃: Folimat Recommended dose

T₁: Tricel Over dose, T₂: Tricel Under dose, T₃: Tricel Recommended dose

C: Control

Effect of two insecticides on wheat plant growth (Fresh and dry weight) planted on soil from East Algazira

Results on table (6) presents the effect of the two insecticides at different concentrations on wheat plant growth (Fresh and dry weight) planted on soil from East Algazira. Obviously, among the concentrations of each chemical, the effect on dry and fresh weight was not significant compared to control. Likewise, among chemicals the effect on fresh was not significant. However, the effect of Folimat on dry weight was significantly different from that of Tricel. It ranges from 1.6 to 1.7 in case of Folimat compared with 1.3 to 1.4 for Tricel and 1.5 for control.

Table (6) Effect of two insecticides on wheat plant growth (Fresh and dry weight) planted on soil from Algazira East

Treatments	Fresh weight	Dry weight
F ₁	1.9 ^{ab}	1.7 ^a
F ₂	2.3 ^a	1.6 ^{ab}
F ₃	1.8 ^{ab}	1.7 ^a
T ₁	1.5 ^b	1.3 ^d
T ₂	1.8 ^{ab}	1.4 ^{cd}
T ₃	1.6 ^b	1.4 ^{cd}
C	1.9 ^{ab}	1.5 ^{bc}
LSD	0.6085	0.1591

*Means for each column having the same letter are not significantly different according to LSD 5%.

F₁: Folimat Over dose, F₂: Folimat Under dose, F₃: Folimat Recommended dose

T₁: Tricel Over dose, T₂: Tricel Under dose, T₃: Tricel Recommended dose

C: Control

Effect of the two insecticides on N P K percentages in wheat plant on Algazira East soil

The results in table (7) showed the effect of the two insecticides on N P K levels in wheat plant on Algazira East soil. The effect was at variable level. It was not significant on N percentage or on P or K elements. In fact, the effect of the two chemicals on these elements was inconsistent where there no clear trend of their effects in this soil.

Table (7) Effect of the two insecticides on N P K percentages in wheat plant on East Algazira soil

Treatments	N (%)	P (%)	K (%)
F ₁	0.500 ^{ab}	0.013	0.017 ^b
F ₂	0.433 ^b	0.017	0.109 ^a
F ₃	0.500 ^{ab}	0.011	0.010 ^b
T ₁	0.400 ^b	0.008	0.017 ^b
T ₂	0.667 ^a	0.015	0.122 ^a
T ₃	0.467 ^{ab}	0.011	0.035 ^b
C	0.500 ^{ab}	0.014	0.017 ^b
LSD	0.2250	0.0	0.05626

*Means for each column having the same letter are not significantly different according to LSD 5%.

F₁: Folimat Over dose, F₂: Folimat Under dose, F₃: Folimat Recommended dose

T₁: Tricel Over dose, T₂: Tricel Under dose, T₃: Tricel Recommended dose

C: Control

DISCUSSION

Wheat (*Triticum* spp.) is the most important food grain source for humans, providing 20% of the calories and 25% of the protein consumed globally by humankind (Curtis, *et. al.*, 2002). Sudan has known the cultivation of wheat for thousands of years and as a result of the growth of urban societies, the change in food habits of the Sudanese citizen, the demand for wheat as an alternative to other grains increased.

The crop like any other plants is subject to a large number of hazards from time of emergence to harvest and storage (Agrios, 2005). Generally, the application of synthetic chemical substances represents a significant constraint to wheat growth and production due to the change that may cause to the metabolism of plants. Among these are the irrational applications of insecticides which could alter structural or modifying hormone balance in plant or hinder up take of nutrients (Chauhan *et. al.*, 2009b). The aim of the study is to investigate the effect of Folimat 800 and Tricel EC 20% Insecticides on wheat plant growth parameters. Both Insecticides were added at concentrations of; Tricel recommended dose (2 ml/L), overdose (3 ml/L) and under dose (1 ml/L) as well as Folimat recommended dose (1 ml/L), overdose (1.5 ml/L) and under dose (0.5 ml/L), in addition to control, without

insecticides. Treatments and control were arranged in a complete block design with three replications.

Generally, the results presented in this study showed that the application of the two insecticides at different doses gave variable effects on plant growth parameters measured. Both insecticides affected wheat vegetative growth at variable level to reach significant effect from Folimat at different doses on plant height. Similar results were obtained by Elhadi, I. 2015 in studying the effect of these insecticides on Radish indicating that these pesticides significantly increased Radish vegetative growth at the recommended doses (shoot dry weight, shoot fresh weight, leaf area, plant height), but on contrary, negatively affected at the excessive doses. However, Folimat was significantly expressed higher plant height and stem diameter as compared with Tricel and control. This result is in agreement with Elhadi, I. 2015 who studied the effect of Folimat 800 on Radish. Similar significant effect of Folimat was also recorded on fresh and dry weight as compared with Tricel and control. The effect of the two insecticides on wheat leaves was variable; where Folimat gave more number of leaves in 60 to 75 day after planting, Tricel gave a higher number of leaves after 90 days. This increase in number of leaves reached and equal figure after 105 day. Similarly, Altyeb, M. 2015 in studying the effect of these insecticides on Garden Rocket leaf area. Generally, the results show that there were no significant differences in N, P and K, concentrations in plant due to application of the insecticides and their doses. This could be probably due to the negative effect of application of these insecticides on availability of N, P and K in soil depriving the plant from obtaining it and thus remained unchanged in plant tissue. However, the study conducted by Altyeb M. 2015 indicated that applying both pesticides decreased K⁺, Na⁺ and P contents in soil.

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