ISSN (Print): 2476-8316
ISSN (Online): 2635-3490
Dutse Journal of Pure and Applied Sciences (DUJOPAS), *Vol. 5 No. 2a December 2019*

Effect of *Trichoderma harzianum* on the Incidence of *Fusarium* Wilt Disease, Growth, and Yield of Selected Tomato (*Lycopersicon esculentum)* Varieties

***[1]Yahaya, N., [1]Hayatu, M.**
[1]Department of Plant Biology,
Bayero University, Kano

Abstract
The research was conducted in the Screen house of the Department of Plant Biology, Bayero University, Kano in 2016, to study the effect of Trichoderma harzianum on incidence of Fusarium wilt disease, growth and yield of selected tomato varieties infested with Fusarium wilt pathogen. Three Tomato varieties, Roma VF, UC82B and Rukuta varieties were used. The treatments consisted of three different concentrations of T. harzianum conidial suspension (10^6, 10^4 and 10^2 conidia per ml) and controls. Tomato plants were artificially infested with 10^6 conidia per ml of F. oxysporum and treated with different level of T. harzianum conidial suspension using soil inoculation method. The experiments were arranged in complete randomize design (CRD) and all treatments and controls were replicated three times. Parameters measured included Plant height, number of leaves, leaf area, yield, shoot dried weight, number of diseased leaves and disease incidence. Results obtained showed that Roma VF variety recorded the highest plant height (103.26cm), number of leaves (132.56) and also recorded the least disease incidence. Tomato plants treated with 10^6 and 10^4con/ml of T. harzianum conidial suspension produced higher yield and also exhibited the least disease incidence. In conclusion, application of high level of T. harzianum conidial suspension to the soil not only reduced Fusarium wilt disease incidence but also enhanced plant growth and yield. This strategy could be adopted as an efficient biological control method for Fusarium wilt in tomato field as well as promoting plant growth and yield.

Keywords: *Fusarium oxysporum F.sp. Lycopersici, Fusarium* wilt, Tomato, *Trichoderma harzianum,*

INTRODUCTION
Trichoderma is a genus of fungi which include many species that can be used to control phytopathogenic fungi. *Trichoderma* species are generally soil dwelling saprophytes. They have a rapid growth rate, sporulate abundantly, compete well with other soil microorganism, show resistance to chemical pesticides and produce various antibiotic such as gliotoxin and viridian (Francis 2011). *Trichoderma* species have been investigated for the control of many infecting soil borne fungal pathogens (Francis 2011). Antagonists of phytopathogenic fungi have been used to control plant diseases, and 90% of such applications have been carried out with different strains of the fungus *Trichoderma* (Monte 2001).The success of *Trichoderma* strains as BCAs is due to their high reproductive capacity, ability to survive under very unfavorable conditions, efficiency in the utilization of nutrients, capacity to modify the rhizosphere, strong aggressiveness against phytopathogenic fungi, and efficiency in promoting plant growth and defense mechanisms. These properties have made *Trichoderma* a

**Author for Correspondence*

ubiquitous genus present in any habitat and at high population densities (Chet and Inbar 1994). Root colonization by *Trichoderma* strains frequently enhances root growth and development, crop productivity, resistance to abiotic stresses and the uptake and use of nutrients (Arora *et al.,* 1992). Crop productivity in fields can increase up to 300% after the addition of *Trichoderma hamatum* or *Trichoderma koningii*. In experiments carried out in greenhouses, there was also a considerable yield increase when plant seeds were previously treated with spores from *Trichoderma (*Chet *et al.,* 1997). The same increase was observed when seeds were separated from *Trichoderma* by a cellophane membrane, which indicates that *Trichoderma* produces growth factors that increased the rate of seed germination (Benitez *et al.,* 1998).

However, there are very few reports on strains that produce growth factors which have been detected and identified in the laboratory (auxins, cytokinins and ethylene), despite the identification of many filamentous fungi that produce phytohormones, such as indol acetic acid (IAA) and ethylene, whose metabolic pathways have been identified. *Trichoderma* strains that produce cytokinin-like molecules, e.g. zeatyn and gibberellin GA3 or GA3-related have been recently detected. The controlled production of these compounds could improve biofertilization (Osiewacz, 2002). Together with the synthesis or stimulation of phytohormone production, most *Trichoderma* strains acidify their surrounding environment by secreting organic acids, such as gluconic, citric or fumaric acid. These organic acids results from the metabolism of other carbon sources, mainly glucose, and, in turn, are able to solubilize phosphates, micronutrients and mineral cations including iron, manganese and magnesium (Harman *et al.,* 2004). Therefore, the addition of *Trichoderma* to soils where these cations are scarce results in biofertilization by metal solubilization and an increase in crop productivity; the poorer the soil, the more significant the subsequent yield increase is.

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important vegetables worldwide. It belongs to the *Solanaceae* family and it has its origin in the South American Andes. Tomatoes contribute to a healthy, well-balanced diet. They are rich in minerals, vitamins, essential amino acids, sugars and dietary fibres and is gaining importance because it contains lycopene, a food component known to reduce the incidence of prostate cancer, heart and age related diseases (AVRDC, 2003).

The demand for tomato and its by-products far outweighs the supply. The low per acre yield of tomato coupled with the low production output recorded in Nigeria could be attributed to the various constraints among which are decrease in fertility of most savannah soils due to intensive cropping, inadequate vegetation cover, overgrazing, excessive use of chemical fertilizers which increases pollution, decreases soil productivity which resulted to nutrient imbalance (Jibrin 2013) as well as pests and diseases (Bawa, 2016),which reflects negatively on plant growth and the produced yield (Sandaramoorthy 2013). Among the diseases which affect the tomato *fusarium* wilt caused by species of *Fusarium* remain to be a challenging task in terms of management. Wilt of tomato caused by *Fusarium oxysporum* is the major limiting factor in the production of tomato (Amel *et al.,* 2010) and also one of the most economically important disease worldwide (Sandaramoorthy 2013). As *Fusarium* wilt is soil borne in nature controlling this disease mainly depends on fungicides treatments. However, fungicidal application pose serious hazard to human health, increase environmental pollution, leaves residues on the crop, affects non target organisms especially beneficial ones and lead to development of pathogens resistant to fungicides.

Therefore, alternative eco- friendly approaches treatment for control of plant diseases as well as promoting plant growth and yield are needed. This study was undertaken to evaluate the potentiality of *T. harzianum* to manage *fusarium* wilt of tomato as well as to determine its effect on growth and yield of the selected tomato varieties.

MATERIALS AND METHODS

Experimental Site

The research was conducted in the Screenhouse of the Department of Plant Biology, Bayero University, Kano, which lies on latitude 11^0 58^1 N and longitude 8^0 30^1 E with altitude of 44m above the sea level, a typical sudan savanna belt of Nigeria.

Seed Collection

Three tomato *(Lycopersicum esculentum)* varieties seeds were collected from Kano Agricultural and Rural Development Authority (KNARDA) Kano, and Department of Agronomy, Bayero University Kano. The seeds comprised of Roma *VF* which is resistant to *Fusarium* wilt disease, UC82B which is improved variety and Rukuta which is a local variety.

Isolation and Identification of Fungi

Trichoderma harzianum was isolated according to the method adopted by Ahsanur Rahman *et al.,* (2011). It was isolated from healthy Tomato rhizosphere and field soil of Yan Barau Tomato farm in Dawakin Kudu Local Government Area, Kano State. The fungi was isolated by soil plate method using potato dextrose agar (PDA) medium.

Isolate of *Fusarium oxysporum f.sp. Lycopersici* used in this study was isolated from vascular tissues of infected tomato showing wilt symptoms grown at Yan Barau Tomato farm in Dawakin Kudu Local Government Area, Kano State. Tissue bits were surface sterilized using 1% sodium hypochlorite for 3-5 minute and they were rinsed with sterile distilled water three times. They were placed on PDA medium separately and incubated at 25^0C for 5-7 days. The fungi was purified separately by transferring the tip of the mycelia into another fresh PDA plate or slant and maintained as pure cultures (Nirmaladevi and Srinivas, 2012).

T. harzianum and F. oxysporum f.sp. Lycopersici were identified based on macroscopic and microscopic appearance which comprised of pigmentation i.e, colour of aerial and substrate hyphae as well as mode of mycelial growth. The nature of hyphae, shape, size, arrangement of conidia and development of conidiophores were also used as guide for identification and finally they were compared with a taxonomic key (John and Brett, 2006).

Preparation of *Trichoderma harzianum and Fusarium oxysporum* Inocula

Different concentrations of *T. harzianum* conidial suspension as well as that of *F. oxysporum* were prepared as follows:

Fungal inocula (*T. harzianum and F. oxysporum*) were prepared from five to ten day old cultures of *T. harzianum and F. oxysporum.* Culture plates were flooded with distilled water (8-10 ml) and the conidia were scraped by using sterilized spatula. The conidial suspension were filtered through muslin cheesecloth and counted with Haemocytometer. The concentration was adjusted to 10^6*conidia* per ml, 10^4conidia per ml and 10^2conidia per ml (Nurain and Abdullah, 2008).

Soil Inoculation

Two weeks old tomato seedlings comprising of Roma*VF*, UC82B and Rukuta varieties were inoculated or infested with 10ml of 10^6conidia/ml of *Fusarium oxysporum f.sp. Lycopersici* conidial suspension and later in the afternoon they were re- inoculated with 10ml of 10^6, 10^4 and 10^2conidia per ml of *T. harzianum* conidia suspension. Both inocula were applied as water drench to the base of the seedlings (Lester *et al.*, 2008).

Experimental Design and Treatments

The experimental design used was Complete Randomize Design (CRD) with three treatments and a control. The treatments comprised of three different level of *T. harzianum* conidia suspension (10^6 conidia per ml, 10^4conidia per ml, and 10^2*conidia* per ml) used to treat three varieties of tomato plants infested with 10^6 conidial suspension of *F. oxysporum f.sp. Lycopersici* and a control (distilled water), Tomato plants inoculated with *T. harzianum* conidia suspension only and other tomato plants were inoculated with conidia suspension of *F. oxysporum f.sp. Lycopersici*. Both treatments and controls were replicated three times. Parameters taken were plant height, number of leaves, leaf area (cm^2), number of flowers shoot dried weight, number of diseased leaves and disease incidence. At fruit maturity, ripe fruits when reddish in colour were harvested and weighed to obtained fresh fruit weight per plant and fruit yield per treatment.

STATISTICAL ANALYSIS

The data collected were subjected to Analysis of Variance (ANOVA) and mean separation was done using Duncan Multiple Range Test (DMRT) at 0.05 level of probability using SAS 9.0 version.

RESULTS

At four weeks after treatment the result show that there were significant differences between Rukuta variety and the other two varieties interms of plant height, number of leaves and leaf area, but there were no significant differences between Roma *VF* and UC82B interm of plant height and leaf area, but there is significant differences between Roma *VF* and UC82B interm of number of leaves (Table 1). Rukuta variety recorded the highest values in term of plant height (27.04cm), number of leaves (33.00) and leaf area (20.90cm^2). It was followed by Roma *VF* which recorded the second higher values interm of plant height (24.32cm), number of leaves (24.00) and leaf area (18.77cm^2). UC82B recorded the least value as it had 23.72cm for plant height, 19.00 for number of leaves and 18.55cm^2 for leaf area (Table 1).

At sixteen weeks after treatment, there were significant differences between Roma *VF* variety and the other two varieties interms of plant height and for number of leaves there were no significant differences between Roma *VF* and Rukuta variety. However, for leaf area there were no significant differences across the varieties. Roma *VF* variety recorded the highest values in term of plant height (103.26cm) and 132.00 for number of leaves. This was followed by UC82B interm of plant height and Rukuta variety interm of number of leaves (Table 1).

Table 1: Effect of *Trichoderma harzianum* on Growth of Selected Tomato Varieties Infested with *Fusarium oxysporum*

	Plant Height (cm)				Number of leaves/plant				Leaf Area (cm^2)			
Variety	4WAT	8WAT	12WAT	16WAT	4WAT	8WAT	12WAT	16WAT	4WAT	8WAT	12WAT	16WAT
Roma VF	24.32^{b}	64.80^{b}	98.18^{a}	103.26^{a}	24.00^{b}	44.00^{b}	125.00^{a}	132.00^{a}	18.7^{b}	37.41^{a}	44.80^{b}	51.52^{a}
Rukuta	27.04^{a}	73.52^{a}	89.11^{b}	95.11^{b}	33.00^{a}	56.00^{a}	123.00^{a}	131.00^{a}	20.9^{c}	35.22^{ab}	52.72^{a}	53.56^{a}
UC82B	23.72^{b}	69.20^{b}	90.90^{b}	95.85^{b}	19.00^{c}	39.00^{b}	99.00^{b}	103.00^{b}	18.55^{a}	33.91^{b}	50.86^{a}	52.28^{a}
V x T	*	*	*	*	NS	NS	NS	NS	*	*	*	NS
V x I	NS	*	*	*	*	NS	NS	NS	*	*	*	NS
Treatment(con/ml)												
F.o., 10^6 + T.h. 10^6	26.22^{a}	78.70^{ab}	100.92^{a}	107.19^{a}	28.00^{ab}	54.00^{a}	136.00^{a}	140.00^{ab}	22.90^{b}	38.07^{b}	50.34^{bc}	57.70^{b}
F.o., 10^6 + T.h.10^4	27.03^{a}	74.82b^{c}	106.26^{a}	104.04^{a}	27.00^{ab}	49.00^{ab}	136.00^{a}	146.00^{a}	22.96^{b}	38.03^{b}	55.67^{ab}	57.71^{b}
F.o., 10^6 + T.h10^2	27^{a}	68.07^{c}	86.52^{b}	92.26^{b}	28.00^{ab}	46.00^{b}	123.00^{ab}	128.00^{ab}	20.18^{b}	36.32^{b}	44.86^{c}	43.75^{c}
F.o., 10^6 only	14.19^{b}	36.93^{d}	54.89^{c}	60.19^{c}	13.00^{c}	23.00^{c}	62.00^{c}	65.00^{c}	6.60^{d}	16.85^{c}	27.35^{d}	26.97^{d}
T.h., 10^6 only	29.03^{a}	83.70^{a}	108.96^{a}	114.96^{a}	31.00^{a}	54.00^{a}	125.00^{ab}	130.00^{ab}	28.58^{a}	49.28^{a}	61.75^{a}	69.41^{a}
Control	26.74^{a}	72.82b^{c}	98.85^{a}	104.82^{a}	25.00^{b}	53.00^{a}	114.00^{b}	121.00^{b}	15.33^{a}	34.51^{b}	56.78^{ab}	59.19^{b}

Keys:
Means followed by the same letter (s) in each column are not significantly different by Duncan Multiple Range Test at 5% probability level.
WAT = Week After Treatment, V = Variety, T = Treatment, * = Significant, NS = Not significant, F.o = *Fusarium oxysporum, T.h = Trichoderma harzianum*

The effect of different concentration of *Trichoderma harzianum* conidial suspension on growth of selected tomato varieties infested with *Fusarium oxysporum f.sp. Lycopersici* at four weeks after treatment the result show that there were no significant differences between the infested tomato plant treated with different concentration of *T. harzianum* conidial suspension but there were significant differences between the infested tomato plant treated with different concentration of *T. harzianum* conidial suspension and tomato plant inoculated with *Fusarium oxysporum* only, interm of plant height, number of leaves and leaf area (Table 1). Tomato plant treated with *T. harzianum* conidial suspension only recorded the highest value interms of plant height (29.03cm), number of leaves (31.00) and leaf area (28.58 cm^2).

This was followed by infested tomato plant treated with 10^4con/ml of *T. harzianum* in term of plant height (27.03cm) and infested tomato plant treated with 10^6con/ml of *T. harzianum* interms of number of leaves (28.00) (Table 1).

At sixteen weeks after treatment there were no significant differences between the infested tomato plant treated with 10^6 con/ml and the infested tomato plant treated with 10^4 con/ml of *T. harzianum* in term of plant height and leaf area. However, there were significant differences between the two aforementioned infested tomato plants and infested tomato plant treated with 10^2 con/ml of *T. harzianum* conidial suspension (Table 1).

Tomato plants treated with 10^6 con/ml of *T. harzianum* recorded the highest value interm of plant height (107.19 cm) and leaf area (57.70 cm^2). Tomato plants treated with 10^4 con/ml of *T. harzianum* recorded the second high values with 104.04 cm for plant height and 57.70 cm^2 for leaf area. Tomato plants treated with 10^2 con/ml of *T. harzianum* recorded the least values with 92.26 cm for plant height and 43.75 cm^2 for leaf area (Table 1).

Table 2 shows the effect of *Trichoderma harzianum* on yield and yield attributes of selected tomato varieties infested with *Fusarium oxysporum f.sp. Lycopersici*. In term of shoot dry weight, there were no significant differences between Rukuta and UC82B varieties. However, there were significant differences between the two aforementioned varieties and Roma *VF* variety. While for yield, there were no significant differences between UC82B and Roma *VF* variety. However, there were significant differences between the two aforementioned varieties and Rukuta variety.

Table 2: Effect of *Trichoderma harzianum* on Yield and Yield Attributes of Selected Tomato Varieties Infected with *Fusarium oxysporum.*

Variety	**S.D.W(g) 18WAT**	**Y/T(Kg/ha) 18WAT**
Roma VF	18.46[b]	32.7[a]
Rukuta	22.78[a]	22[b]
UC82B	19.24[a]	40.56[a]
V x T	*	NS
V x I	NS	NS
Treatment(con/ml)		
F.o., 10^6 + T.h. 10^6	23.52[b]	45.84[a]
F.o., 10^6 + T.h.10^4	21.99[bc]	41.16[a]
F.o., 10^6 + T.h10^2	19.96[c]	22.09[b]
F.o., 10^6 only	8.71[d]	2.84[c]
T.h., 10^6 only	26.99[a]	54.96[a]
Control	19.81[c]	25.06[b]

Mean followed by the same letter (s) in each column are not significantly different by Duncan Multiple Range Test at 5% probability level. Key: WAT = Weeks after Treatment, S.D.W = Shoot Dried Weight, Y/T = Yield per Treatment, V = Variety, T = Treatment, I = Inoculation, * = Significant, NS = Not Significant, F.o = *Fusarium oxysporum, T.h = Trichoderma harzianum*

For shoot dry weight, Rukuta variety recorded the highest shoot dry weight (22.75g), while UC82B has second high shoot dry weight (19.24g) and Roma*VF* recorded the least shoot dry weight (18.46g). As for yield, UC82B recorded the high yield (40.56Kg/ha), Roma *VF* recorded the second high yield (32.70Kg/ha) and Rukuta variety recorded the least yield (22.00Kg/ha). On the effect of different concentration of *T. harzianum* on yield attributes of selected tomato varieties there were significant difference across the concentrations for shoot dry weight.

Infested tomato plants treated with 10^6 con/ml of *T. harzianum* recorded the highest value for shoot dry weight (23.52g) and yield (45.84Kg/ha). Tomato plants treated with 10^4 con/ml of *T. harzianum* recorded the second higher values with 21.99 for shoot dry weight and 41.16Kg/ha for yield. Tomato plants treated with 10^2 con/ml of *T. harzianum* recorded the least values with 19.96g for shoot dry weight and 22.09Kg/ha for yield.

On the effect of different concentration of *T. harzianum* inoculation on disease incidence of Fusarium wilt disease of tomato infested with *Fusarium oxysporum* conidial suspension, the results show that at four weeks after treatment there were significant differences between the infested tomato plants treated with 10^2con/ml of *T. harzianum* conidial suspension and the other two i.e infested tomato plants treated with 10^6 and infested tomato plants treated with 10^4con/ml. But there were no significant differences between the two aforementioned infested tomato plants. The infested tomato plants treated with 10^2 con/ml of *T. harzianum* conidial suspension recorded the highest value of disease incidence (11.40%) and it was followed by the infested tomato plant treated with 10^4con/ml of *T. harzianum* conidial suspension (6.28%). Infested tomato plants treated with 10^6con/m of *T. harzianum* conidial suspension recorded the least value of disease incidence (5.27%) (Table 3).

Table 3: Effect of *Trichoderma harzianum* Inoculation on the Disease Incidence of *Fusarium* Wilt Disease of Tomato Infested with *Fusarium oxysporum* Conidial Suspension at Different Days after Treatment.

	Number of diseased leaves				Disease Incidence (%)			
Treatments (con/ml)	4WAT	8WAT	12WAT	16WAT	4WAT	8WAT	12WAT	16WAT
F.o., 10^6 + T.h., 10^6	1.00^b	14.00^a	23.00^b	27.00^c	5.27^{ab}	29.43^b	17.44^b	20.37^b
F.o., 10^6 + T.h.,10^4	1.00^b	14.00^a	30.00^a	35.00^{ab}	6.28^{ab}	29.48^b	22.55^b	23.10^b
F.o., 10^6 + T.h.,10^2	2.00^a	14.00^a	30.00^a	36.00^a	11.48^b	35.33^b	33.76^c	37.00^c
F.o., 10^6 only	2.00^a	13.00^a	23.00^b	29.00^{bc}	36.71^c	61.60^c	55.85^d	58.10^d
T.h., 10^6 only	1.00^b	5.00^b	7.00^c	10.00^d	2.31^a	13.02^a	5.97^a	7.99^a
Control	1.00^b	5.00^b	9.00^c	11.00^d	6.06^{ab}	11.44^a	8.91^a	9.97^a

Means followed by the same letter(s) in each column are not significantly different by Duncan Multiple Range Test at 5% probability level. WAT = Week After Treatment, Con/ml = Conidia per milliliter, *F.o.= Fusarium oxysporum, T.h = Trichoderma harzianum,** = Significant, NS = Not significant

Similarly, at sixteen weeks after treatment, there were significant differences between the infested tomato plants treated with 10^2con/ml of *T. harzianum* conidial suspension and infested tomato plant treated with 10^6 and 10^4con/ml of *T. harzianum* conidial suspension. However, there were no significant differences between the infested tomato plants treated with 10^6 and 10^4con/ml of *T. harzianum* conidial suspension. The infested tomato plants treated with 10^2con/ml of *T. harzianum* conidial suspension recorded the highest value (37.00%) and it was followed by infested tomato plants treated with 10^4con/ml of *T. harzianum* conidial suspension (23.10%). Infested tomato plants treated with 10^6 con/ml of *T. harzianum* conidial suspension recorded the least value of disease incidence (20.37%).

DISCUSSION

The result on the effect of *T. harzianum* inoculation on growth and yield of selected Tomato varieties infested with *Fusarium oxysporum f.sp. Lycopersici* show that there were significant differences in growth and yield between the infested tomato plants treated with *T. harzianum* conidial suspension and the infested control. The result of the present study is similar to those of Elad *et al.* (1980), Sundaramoorthy and Balabaskar (2013) on the biocontrol efficacy of *Trichoderma* spp., against damping off diseases of Bean and wilt of tomato respectively. They reported that *Trichoderma* spp,. improved plant growth and yield. The increase in plant growth was associated with secretion of auxin, gibberellins and cytokinins. The increase in biomatter production was due to the production of plant growth promoters or through indirect stimulation of nutrient uptake and by producing siderophore or antibiotics that protect plants from deleterious Rhizosphere organisms (Sundaramoorthy and Balabaskar, 2013).

The infested tomato plants treated with 10^6 and 10^4 conidial suspension of *Trichoderma harzianum* grew significantly better than the infested tomato plants treated with 10^2conidial suspension of *T. harzianum*. The result is similar to the findings of Wani *et al.,* (2009) who reported an increase and improvement in plant growth parameters with an increase in the doses of *T. harzianum* inoculums on tomato plants. The improvement in plant growth was related to the decrease in the infection by *Fusarium* wilt fungus (Wani *et al.*, 2009). The enhanced plant growth by *T. harzianum* might be due to production of secondary metabolites which may act as an auxin like compound. These materials may lead to the development of the root system and an exploration of a large volume of soil (Vinale *et al.,* 2008). Development of root system with production of organic acids in the rhizosphere such as gluconic, citric acid and /or fumaric acid by *Trichoderma* decrease soil pH, which lead to increased solubility of the insoluble compound and availability of micronutrient (Akladious and Abbas 2012). Fravel *et al.* (2003) reported that there was an increase in the availability of phosphorous and several micro nutrients associated with enhanced solubility in the plants treated with *Trichoderma* strains. Hexon *et al*., (2009) showed that *Trichoderma* spp. produced indole-3-acetic acid (IAA) that promoted lateral root formation in *Arabidopsis thaliana*. The root system development is important for plant fitness. Harman (2006) suggested that *Trichoderma* parasitizes fungal pathogen and produced antibiotics, beside this is opportunistic plant colonizers that have many positive effects on plant, that include promoting abundant and healthy plant root, increase growth and yield, increase nutrient uptake, increased fertilizer utilization efficiency, increased percentage and rate of seed germination, as well as, induced systemic resistance to plant diseases. This beneficial effects were related to the control of deleterious soil microflora, the degradation of toxic compounds, the direct stimulation of root development by the production of hormone like compound (Benitez *et al,*, 2004). Findings from different studies revealed that *Trichoderma* strains stimulate plant growth at least in part by increasing the nutrient uptake and efficiency of minerals use (Yedidia *et al.,* 2000; Akladious and Abbas 2012; and Alwathnani *et al.,* 2012).

CONCLUSION

It is concluded; from this study that *Trichoderma harzianum* was found to promote the growth and yield of the infested tomato plant treated with different concentration of its conidial suspension. Higher level or higher concentrations of the fungal conidial suspension (10^6 and 10^4) were found to be the most effective for the enhancement of plant growth and yield. The result of the study also shows that application of higher level of *T. harzianum* conidial suspension through soil reduces the disease incidence of *Fusarium* wilt under pot culture study. This shows the potentials of the use of *T. harzianum* as an alternative to chemical pesticides and inorganic fertilizers.

RECOMMENDATION

Further studies should be carried out to isolate, identify and purify the specific compounds produces by *T. harzianum* which are responsible for growth inhibition of soil borne pathogens as well as growth and yield promotion of plants.

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