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Effects of *Trichoderma harzianum* and chemical fertilization on growth and nutrient uptake of Cucumber (*Cucumis melo* L., var. flexuosus)

FALIH H. SAEED, PhD[1]
SADEQ J. H. DWENEE, PhD
USAMA A. ALWAN, PhD
QASIM M. ZAMIL, MSc
HAMEED S. MUGIER, MSc
Ministry of Science and Technology
Agric. Research Director., Baghdad, Iraq

Abstract:

An experiment was carried out during 2016 to investigate effect of N , P and K fertilizers and bio-stimulant Trichoderma harzianum (T.26) to growth and nutrient uptake of cucumber (Cucumis melo L., var. flexuous) under field condition. The results revealed that application of 100% NPK + T.26 was significantly superior for growth parameters such as maximum vine length, number of leaves, number of branches per plant, relative chlorophyll, shoot system dry weight which were (202), (121), (6.3), (48.3) and (147g) respectively and nutrient uptake per plant parameters like nitrogen (426.3), Phosphorus (64.8), Potassium (307), Iron (35.2), Manganese (4.6) and Zinc (3.93) was on par with plants provided with 75 NPK % +T.26 bio-fertilizer. The results confirm that the integrated nutrient management system offers an alternative to the organic, chemical and bio-fertilizer individually and achieve higher production yields not differ significantly from the full treatment dose of mineral fertilizers and less environmental damage.

[1]Corresponding author : falihss@yahoo.com

Key words: Cucumber, Trichoderma harzianum, growth, Chemical fertilization.

INTRODUCTION

Snake cucumber (*Cucumis melo* L., var. flexuosus) belongs to the family Cucurbitaceae. It has of high moisture content and rich in vitamins (A, C and B complex) and minerals (calcium, iron, magnesium, phosphorus, potassium and zinc), in addition to sugars and other carbohydrates [1], it is grown in southeastern Anatolia, Azerbaijan, Iraq, Palestine, and Central Asia [2 , 3].

Many efforts were directed to improve growth and nutrient uptake of plants through breeding, fertilization and genetic engineering. Bio-fertilizers are inputs containing microorganisms which are capable of mobilizing nutritive elements from non-usable form to usable form through biological processes, they include mainly the nitrogen fixing, phosphate solubilizing and plant growth– promoting microorganisms [4 , 5].

Application of heavy doses of chemical fertilizers without organic manures or bio-fertilizers causes deterioration of soil health in terms of physical and chemical, properties of soil, declining of soil microbial activities [6] reduction in soil humus, increased pollution of soil, water and air. Hence, integrated nutrient management is the need of the hour [7], Growing of high value vegetables like cucumber under green houses has been reported to give high yield of good quality produce in developed countries [8]. Hence there is a need to standardize the integrated nutrient management practices for cucumber growing under Convertible farming conditions to increase productivity under Iraq conditions.

Fungal species belonging to the genus *Trichoderma* spp. are common filamentous imperfect saprophytic fungi in soil and

rhizosphere ecosystem that have been known not only for their potential to control several commercial phytopathogens that caused soil-borne [9], air-borne and post harvest [10] diseases in a wide range of crops by different mechanisms, but also for their ability to promote plant growth [11 ,12, 13] and improve nutrient uptake [14], Plant growth enhancement by Trichoderma isolates is as a result of different mechanisms such as exudation of plant growth regulators and/or their similarity with the fungi [15 , 16], solubilization of phosphates, micronutrient and minerals such as Fe, Mn and Mg plays an important role in plant growth [17], secretion of exogenous enzymes, sidrophores [18] and vitamins [19], as well as indirectly with the control of the major and minor root infesting pathogens [20] in rhizosphere. The variety of of these mechanisms indicate multiple modes of action [12 , 20] that lead to increase in nutrient availability and uptake, resulting in the stronger nutrient uptake by plant, and thereby developing the root system.

The aim of this study to evaluate the effect of N, P and K fertilizer and bio-fertilize *Trichoderma harzianum* (T.26) to growth nutrient uptake of cucumber (*Cucumis melo* L., var. flexuosus) under field condition.

MATERIALS AND METHODS

This study carried out in laboratories and fields of the Ministry of Science and Technology - Baghdad - Iraq, during Spring sesen 2016, The soil of the experimental field was sandy loam of 7.1 PH. some chemical and physical Soil properties are given on Table 1. The experiment was laid out in Randomized Completely Block Design(RCBD) with three replications involving 10 treatments. The plot size was 3.5 x 2.0 m. A spacing of 150 x 90 cm was followed, The recommended dose of Urea, triple super phosphate and potassium sulphate (260: 340

:100 kg/ha), Cows manure Degradable (5 v/v) and *T. harzianum* (T.26) (4gm/plant) were applied as per the treatments, the *T. harzianum* were mixed with soil and organic manure. added fertilizer superphosphate a single dose and add with the first batch of nitrogen, While the second batch of nitrogen fertilizer was added after two weeks from seed germination.

The field experiment were 10 treatments combinations of chemical fertilizer (N,P, k) and *T. harzianum* (T.26) fungi, were including: control (T1), *T.harzianum*(T.26) (T2), 100% recommended dose of fertiliser (72:60:96 kg NPK ha-1) (T3), 75% recommended NPK (T4), 50% recommended NPK (T5), 25% recommended NPK (T6), 100% recommended dose NPK + *T.harzianum* (T7), 75%recommended dose NPK + *T.harzianum* (T8), 50% recommended dose NPK + *T.harzianum* (T9), 25% recommended dose NPK + *T.harzianum* (10).

The observations on growth characters like plant length, leaf number, branch number, relative chlorophyll and shoot system dry weight and the content of nutrients were estimated by following standard procedures as outlined by [21].Uptake of (N,P,K,Fe,Mn and Zn) nutrients were calculated by multiplying their nutrient concentration with shoot system dry weight.

Table 1 . Physical and Chemical properties of the soil test.

Character	sandy $g.kg^{-1}$	Silts $g.kg^{-1}$	Clay $g.kg^{-1}$	pH	EC	Available elements					
						%			ppm		
						N	P	K	Fe	Mn	Zn
value	870	74	56	71	2.4	39	28	157	2.3	1.2	1.3

RESULTS AND DISCUSSION:

Plants provided with 100% N,P + T.26 register the maximum number (202 cm and 121 leaf) vine length and leaves value respectively to each plant that had provided with 75% +T26 which registered 196 cm and 116 leaf, the results could be attributed to vigorous vine growth which helped in synthesis of

hormones like GA which induced production of more plant high and leaves number, Combination of inorganic and bio-fertilizers helped in enhanced nutrients uptake which promotes to increase plant growth which leading to increase plant high and leaves number, The results are in conformity with the findings of [22] in cucumber .

Table 2. Effects of *T.harzianum* (T.26) fungi and chemical fertilization on growth of cucumber (*Cucumis melo* L., var. flexuous)

Treatment	Vine length (cm)	Leaves number	Branch Number	Chlorophyll relative	dry weight (g.Plant^{-1})
Control	110	53	4.3	37.0	51.0
T.26	122	59	5.0	42.1	65.0
25% NPk	137	68	5.0	43.6	74.1
50% NPk	159	93	5.3	45.1	102.0
75%NPk	180	106	6.0	45.9	123.3
100%NPk	197	114	6.0	47.0	136.0
25% NPk + T.26	148	77	5.3	45.3	84.1
50% NPk + T.26	170	99	6.1	47.9	106.6
75%NPk + T.26	196	116	6.3	48.1	138.0
100%NPk +T.26	202	121	6.3	48.3	147.0
L.S.D	6.77	5.72	0.33	0.431	9.16

For branch number and chlorophyll relative plants fertilized with 100% NPk +T.26 recorded high branch number and relative chlorophyll (63 and 48.3) respectively which was each with treatments (75 NPk % + T.26) and (50% NPk + T.26), This could be attributed to vigorous growth of the plants due to balanced nutrient levels with bio-fertilizers. N, P, k is an important element and essential for initiation of growth, *T.harzianum*(T.26) along with NPK known to increase the availability of phosphorus and nitrogen resulted in increasing of growth. This finding is in line with [23] reported that application of 150 kg N plus 50 kg each of P and K per hectare produced significantly highest vine length (180 cm), number of branches per vine (5.50) and relative of chlorophyll initiation in cucumber.

Significant differences were observed in total dry matter production due to varying fertility levels (Table 2). application of 100% NPk +T.26 recorded significantly higher dry

matter(147)g.plant^{-1} which was *on par* with treatments (75%NPK + T.26) which recorded 138 g.plant^{-1}. The increased in dry matter accumulation is related to better uptake of nutrients due to the influence of bio-fertillizers supplied along with chemical fertilizers (Table 3). Similar results were also reported by Umamaheshwarappa et al (2005).

Uptake of N,P and K nutrients was significantly influenced by the integrated nutrient management practices (Table 3), The plants provided with 75% N.PK +T.26 (*T.harzianum*) recorded higher total nitrogen, phosphors and potassium (426.3 , 64.8 and 307) mg.plant $^{-1}$ uptake, which was on par with of 75% NPK +T.26 and 50%NPK + T.26 treatments respectively. The maximum total Fe, Mn and Zn uptake (35.2 and 4.6 and 3.93 mg.plant $^{-1}$) respectively was observed in treatments 100% N.P +T.26. This was on par with 75% NPK +T.26 treatment, similar results were also noticed by [18,] in sweet corn. This could be attributed to better availability of nutrients when plants received in combination of inorganic and bio-fertilizers, similar results were also noticed by [23 , 24] in chilli.and [25] in tomato.

Table 3. Effects of *T.harzianum* (T.26) fungi and chemical fertilization on nutrient uptake(mg.plant $^{-1}$) of cucumber (*Cucumis melo* L., var. flexuosus)

Treatment	N	P	K	Fe	Mn	Zn
Control	109.1	..6.83	102	5.3	1.40	0.91
T.26	138.2	10.25	117	12.5	1.98	1.75
25% NPK	136.0	16.67	135	13.1	1.42	1.48
50% NPK	220.3	24.48	183	19.1	2.40	2.16
75%NPK	273.0	41.20	221	22.6	3.12	.2.96
100%NPK	402.0	56.12	243	24.8	4.41	3.38
25% NPK + T.26	168.2	24.60	180	15.2	2.28	1.76
50% NPK + T.26	254.4	36.04	215	23.6	2.93	2.75
75%NPK + T.26	400.0	47.60	294	32.5	3.79	3.53
100%NPK +T.26	426.3	64.80	307	35.2	4.60	3.93
L.S.D	13.44	7.52	9.77	4.633	0.82	0.481

These results confirm the superiority effect of all bio fertilization treatments on growth and nutrient uptake of cucumber plant can be attributed to the important role played by these N fertilizer to provide this available element to plant and biofertilizers (*T.harzianum* T.26) to increase the Solubility of many nutrients to the roots and the production of some plant hormones stimulating plant growth [20] and play to increase growth and increase the root area to absorb nutrients of the soil, which reflected positively on the increasing of plant growth and number of leaves per plant and this means increasing leaf area effective in the photosynthesis process and increase the susceptibility of plants to manufacture carbohydrates and thus increase holds the dry matter of the plant , thereby increasing quotient yield and its components that these findings are consistent with several previous research , which confirmed the effectiveness of both biologists working in stimulating the growth of various types of crop plant has confirmed the [26] Who confirmed ability of isolates of the fungus *Trichoderma* spp. to produce hormones Auxin, gibberellins' and Cytokainin and colonize the roots of seedlings bitter orange , which is reflected in the stimulation of plant growth and increase the concentration of many elements of the Greater and Lesser Securities , as well as consistent with the results of [13].

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