Effectof *Tricoderma*viride.*Tricoderma*harzianum and humic acid on vegetative growth and economics of garlic (*Allium sativum* L.) CV. G-282

ABSTRACT

The present investigation was carried out to investigate ????? (Aim of the study, solve economically improvement and scientifically development)not title.(with title **"Effect of tricoderma and humic acid on growth, yield and quality of garlic (Allium sativum L.) CV. G-282"** at Research field of DepartmentofVegetable Science, College of Horticulture and Forestry, Jhalrapatan city, Jhalawar.during the year 2020-21).The experiment was conducted in Factorial Randomized block Design (FRBD). Under this experiment, the two factors?were T_0 Control, T_1*Trichodermaviride* T_2*Trichodermaharzianum and* H_0 Control, H_1 Humic acid 1%, H_2 Humic acid 2%, H_3 Humic acid 3% which were replicated thrice. On the basis of results obtained during the present investigation T2 (*Trichodermaharzianum*)) along with the interaction of H_3 Humic acid 3% was found superior in terms of growth and economy. Treatment T_2 (*Trichodermaharzianum*) registered maximum value of 314918 /ha. with highest B: C ratio (2.69) and minimum value of 248258 /ha. under control with lowest B: C ratio (2.14). (Reformulation all abstract)

Keywords:*Humic Acid, Trichodermaviride, Trichodermaharzianum, CV. G-282.*

INTRODUCTION

Garlic (Allium sativum L.), is the second most cultivated allium species after onions worldwide. Garlic is a popular crop that is widely used among peoples because it contains multiple nutritional and medicinal substances. Garlic is consumed as an essential part of many diets as a form of spices, flavoring dishes, pickles and sauces, which has led to its increasing popularity among people (Ref.).Also, dehydrated cloves and extracts are speedy replacing fresh bulbs (What is thisand What is the relation) for industrial and home usage in the production of medicines, insecticides, plant nourishments and explosives (H.S. Abdel-Razzak and G.A. El-Sharkawy, 2013). Rrwrite and reformulation as a whole with modern references

Humic acid is a product contains many elements which improve the soil fertility and increase the availability of nutrient elements by holding them on mineral surfaces and, consequently, affect plant growth and yield (Ref.). Humic substances are the subjects of studies in various areas of agriculture such as soil chemistry, fertility, plant physiology and environmental sciences, as the multiple roles played by these materials can greatly improve plant growth and nutrient uptake. Many investigators (How many ???) reported that, application of humic substances led to a remarkable increment in soil organic matter which improve plant growth and increase crop production (Mahmoud and Hafez, 2010one old ref.).Add modern references.

Fungi (It is preferable to give a brief overview of fungi in general before going into the type used) such as *Trichodermaviride*are often used as growth promoting agents and biofertilizers. Extensive research has focused on its physiological and biological properties (References). They produce enzymes such as complex cellulase, xylanase, chitinase, amylase, and pectinase that enable efficient decomposition of soil organic matter, thus supplying plants with nutrients. According to (López-Bucio et al. 2015), the best studied *Trichoderma*species with regard to their mechanisms of action are *T. asperullum*and *T. artoviride*and *T. harzianum*and *T. virens*and *T. viride*, most of which also show a high percentage of biostimulants.

MATERIALSANDMETHODS

The present investigation entitled"Effect of tricoderma and humic acid on growth, yield and quality of garlic (*Allium sativum L.*) CV. G-282"was conducted at protected cultivation unit, Department of Vegetable Science, College of Horticulture and Forestry, Jhalrapatan City, Jhalawar during *rabi*season 2020-21.What is this here ??????

The present investigation the design used for analysis of variables were Factorial Randomized Block Design (FRBD)with12treatment and comprises 3 replication in term of days of storage with the objective of growth and economics of the garlic cultivation.What is thishere ??????

Data collection

Five tagged plant (Plant names) were chosen from each treatment and the result are being recorded for the following growth parameters: number of leaves per plant, length of leaves, plant height and chlorophyll content and economy.

Number of leaves per plant

The number of leaves of five tagged plants were counted from each plants 60 days and 90 days after transplanting and the average number of leaves per plant was calculated (Equation or erference).

Length of leaves

Leaf length of all the observational plants from each plot was recorded with scale in centimeter (cm) and alter computing mean was considered as length of leaves (cm) at 60 and 90 DAS (Ref.).

Plant height (cm)

Plant height was recorded at 60 days and 90 days after transplanting. Height of five tagged plants was recorded from the base level to tip of the leaf with the help of meter scale and average was calculated (Ref.).

Chlorophyll content

SPAD value in leaves of five tagged plants were estimated from each plot with using chlorophyll meter (SPAD) by simple clamping the device over the leaf tissue at 60 days after transplanting (Ref.).

Economics of treatments

The economics of the treatments is the most important consideration for making any recommendation to the farmers for its wide adoption. For calculating economics, the average treatment yield along with prevailing market rates of the produce and cost of inputs were used.

RESULTS AND DISCUSSION

The Effect of *Tricodermaviride*and humic acid on growth, of garlic (*Allium sativum* L.) CV. G-282.The result of the experiment are summarized below.

Growth parameters

Effect of *Trichoderma*viride*on*Soil application of *Trichodermaviride*had significant effect on growth attributes compared to control. The treatment T2 (*Trichodermaharzianum*) increased the

number of leaves per plant, leaf length, plant height and chlorophyll content in leaves over control. T1 (*Trichodermaviride*) was found statistically at par with T2 (*Trichodermaharzianum*).

The maximum value of growth parameters *i.e.*, number of leaves per plant both at 60 and 90 DAS (8.11 and 9.90), length of leaves at 60 and 90 DAS (41.36cm and 52.04cm), plant height both at 60 and 90 DAS (48.77cm and 69.48cm) and chlorophyll content at 90 DAS (0.80 mg/g in leaves), was recorded under application of (*Trichodermaharzianum*) and the minimum value of growth parameters *i.e.* number of leaves per plant both at 60 and 90 DAS (6.40 and 7.76), length of leaves at 60 and 90 DAS (33.78 cm and 42.95 cm), plant height both at 60 and 90 DAS (41.85 cm and 67.91 cm) and chlorophyll content (0.57 mg/g in leaves), were recorded under control, respectively. (Compare with other studies)

Plant growth enhancement by Trichoderma as a result of plant growth enhancement of different mechanisms such as exudation of plant growth regulators and/or their similarity with the fungi (Vinale*et al.,* 2008), solubilization of phosphates, micronutrient and minerals such as Fe, Mn and Mg that have important role in plant growth (Altomare *et al.,* 1999), secretion of exogenous enzymes, siderophores and vitamins, as well as indirectly with the control of the major and minor root infesting pathogens (Harman *et al.,* 2004) in rhizosphere. The variety of some of these mechanisms indicate multiple modes of action (Harman, 2006; Harman *et al.,* 2004) that lead to increase in nutrient availability and uptake, resulting in the stronger nutrient upt1 ake by plant, and thereby increasing its growth attributes. These results are in close proximity with earlier research of Nagata *et al.,* (2005),used tomato, Kumar *et al.,* (2019), Manoranjitham *et al.,* (2000)used cucumber.

Effect of Humic acid on

The result of present study clearly indicates that number of leaves per plant, leaf length, plant height and chlorophyll content of leaves increased significantly due to application of humic acid. The maximum value of growth parameters *i.e.* number of leaves per plant both at 60 and 90 DAS (8.10 and 10.15), length of leaves at 60 and 90 DAS (42.46cm and 52.36cm), plant height both at 60 and 90 DAS (49.92cm and 70.92cm) and chlorophyll content at 90 DAS (0.81 mg/g in leaves), was recorded with treatment H3 (Humic acid 3%) and the minimum value of growth

parameters *i.e.* number of leaves per plant both at 60 and 90 DAS (6.10 and 7.25), length of leaves at 60 and 90 DAS (32.99cm and 42.91cm), plant height both at 60 and 90 DAS (40.15cm and 60.28cm) and chlorophyll content at 90 DAS (0.59 mg/g in leaves), were recorded under control (H0), respectively.

The positive influence of Humic acid fertilization appears to be due to improve nutritional environment both in the root zone and plant system. Thus, adequate supply of humic acid as soil drenching in different doses resulted in greater availability of nutrients particular in crop root zone. Increased availability of nutrients in the root zone coupled with increased metabolic activity at the cellular level might have increased the nutrient uptake and accumulation in the vegetative plant parts which in turn resulted in improved plant growth attributes. These results are in close proximity with earlier researches of Abdel-Razzak *et al*., (2013) in garlic, Samy *et. al*., (2015) in Jerusalem artichoke.

Interaction effect of *Trichoderma*viride and humic acid.

The combined effect of different levels of trichoderma and humic acid (T x H) on number of leaves per plant at 60 and 90 days after sowing exhibited non significant.

Economics

The result of present investigation shows that the net returns and B: C (Complete names) ratio has been increased with Trichoderma. and Humic acid. This result can be directly correlated with the corresponding increase in the yield of garlic due to *Trichodermaviride*and Humic acid as a direct effect on net returns and benefit cost ratio.

Treatment T2 (*Trichodermaharzianum*) registered maximum value of 314918 /ha. with highest B: C ratio (2.69) and minimum value of 248258 /ha. under control with lowest B: C ratio (2.14).

The foliar application of Humic acid reduced the net return and B: C ratio as compared to control. Maximum net returns were observed treatment H1 (Humic acid 1%) and B: C ratio was observed treatment H0 (control).

In interaction effect of *Trichoderma* and Humic the maximum net returns was found treatment T2H1 (*Trichodermaharzianum* + Humic acid 1%) 325947 /ha and maximum B: C ratio in treatment T2H0 (*Trichodermaharzianum* + No Humic acid) 3.89 and minimum net returns and B: C ratio were found under treatment T0H0 (control) and T0H3 (No Trichoderma + Humic acid

3%). The reason for minimum net return and B: C ratio is due to the fact treatment cost of Humic acid was very high.

CONCLUSION

It was concluded from the experiment that individual application of *Trichodermaharzianum*and Humic acid 3% exhibited maximum number of leaves per plant, length of leaves, plant height, total chlorophyll content of leaves, respectively. However, *Trichodermaviride*and Humic acid 2% were found statistically atpar with *Trichodermaharzianum*and Humic acid 3%.

In terms of net return and B:C ratio the individual application of Trichoderma and Humic acid treatment (*Trichodermaharzianum*) registered maximum value of net returns 314918 with highest B:C ratio (2.69) and foliar application of Humic acid reduced the net return and B:C ratio as compared to control. Maximum net return was observed treatment H1 (Humic acid 1%) and B: C ratio was observed treatment H0 (control).

ACKNOWLEDGEMENT

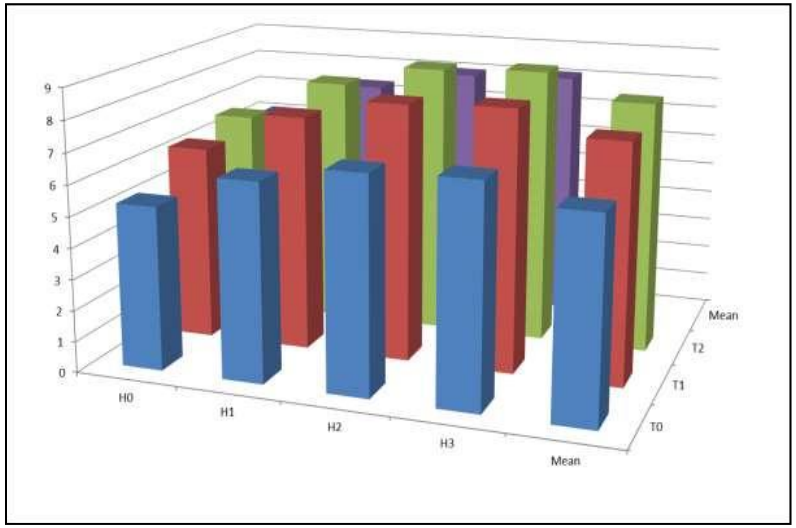
The author thanks the Advisor, the Head of Department, the SAC members and the Horticulture Non-Teaching Staff at College of Horticulture and Forestry, Jhalawar Agriculture University, Kotafor providing all of the necessary facilities and resources.

Table 1: Effect of different treatment in term of number of leaves per plant, length of leaves of garlic.

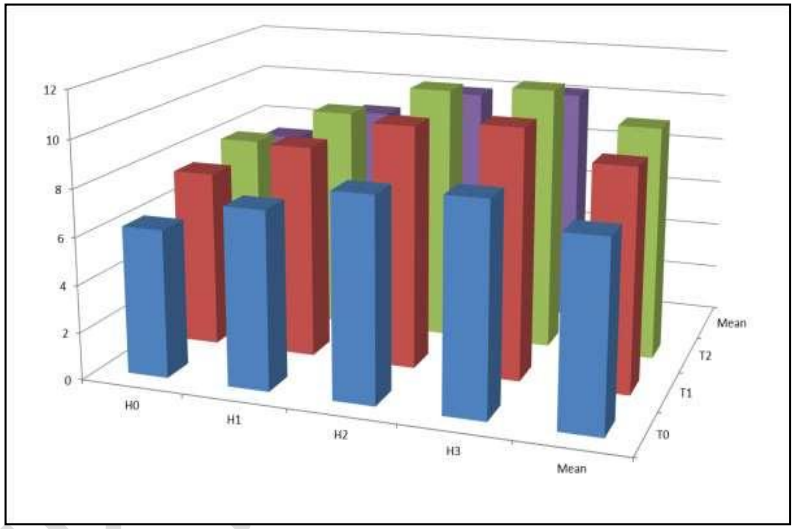
	No. of leaves at 60 Days				No. of leaves at 90 Days				Length of leaves at 60 days				Length of leaves at 90 days			
Trihoderma viride / **Humicacid**	**T_0**	**T_1**	**T_2**	**Mean**	**T_0**	**T_1**	**T_2**	**Mean**	**T_0**	**T_1**	**T_2**	**Mean**	**T_0**	**T_1**	**T_2**	**Mean**
H_0	5.28	6.32	6.70	6.10	6.25	7.51	7.98	7.25	28.81	34.88	35.28	32.99	38.01	44.67	46.05	42.91
H_1	6.37	7.61	8.07	7.35	7.50	9.00	9.57	8.69	32.88	39.81	40.26	37.65	42.08	49.46	50.99	47.51
H_2	6.92	8.27	8.77	7.99	8.52	10.24	10.88	9.88	36.35	44.01	44.5	41.62	45.35	53.3	54.95	51.2
H_3	7.02	8.39	8.90	8.10	8.76	10.52	11.18	10.15	37.08	44.9	45.4	42.46	46.38	54.51	56.19	52.36
Mean	6.40	7.65	8.11		7.76	9.32	9.90		33.78	40.9	41.36		42.95	50.49	52.04	
	SEm±	**CD(P=0.05)**			**SEm±**	**CD(P=0.05)**			**SEm±**	**CD (P=0.05)**			**SEm±**	**CD (P=0.05)**		
T	0.110	0.319			0.202	0.583			0.71	2.05			0.84	2.43		
H	0.127	0.368			0.233	0.673			0.82	2.37			0.97	2.81		
Tx H	0.221	NS			0.403	NS			1.42	NS			1.68	NS		

Table2: Effect of different treatment in term of Plant height, chlorophyll content and benefit cost ratio of garlic.

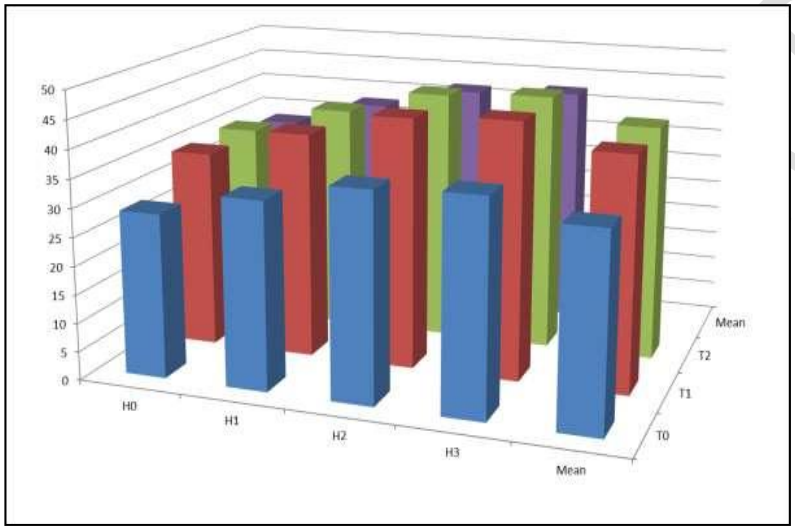
	Plant height at 60 Days				**Plant height at 90 Days**				**Chlorophyll Content**				**Benefit Cost Ratio**			
Trihoderma viride **Humicacid**	**T_0**	**T_1**	**T_2**	**Mean**	**T_0**	**T_1**	**T_2**	**Mean**	**T_0**	**T_1**	**T_2**	**Mean**	**T_0**	**T_1**	**T_2**	**Mean**
H_0	36.48	41.47	42.51	40.15	57.19	61.12	62.53	60.28	0.48	0.629	0.676	0.595	2.81	3.84	3.89	3.51
H_1	41.14	46.77	47.94	45.28	62.54	66.84	68.38	65.92	0.542	0.709	0.762	0.671	2.60	2.69	2.92	2.73
H_2	44.44	50.53	51.79	48.92	67.15	71.76	73.43	70.78	0.618	0.809	0.87	0.766	1.83	2.03	2.23	2.03
H_3	45.35	51.56	52.85	49.92	67.28	71.9	73.57	70.92	0.654	0.856	0.92	0.81	1.34	1.51	1.75	1.53
Mean	41.85	47.58	48.77		63.54	67.91	69.48		0.574	0.751	0.807		2.14	2.51	2.69	
	SEm±	**CD (P=0.05)**			**SEm±**	**CD (P=0.05)**			**SEm±**	**CD (P=0.05)**			**SEm±**	**CD (P=0.05)**		
T	0.95	2.76			1.44	4.15			0.014	0.04			0.06	0.18		
H	1.1	3.18			1.66	4.8			0.016	0.046			0.07	0.21		
Tx H	1.91	NS			2.88	NS			0.028	NS			0.13	0.36		



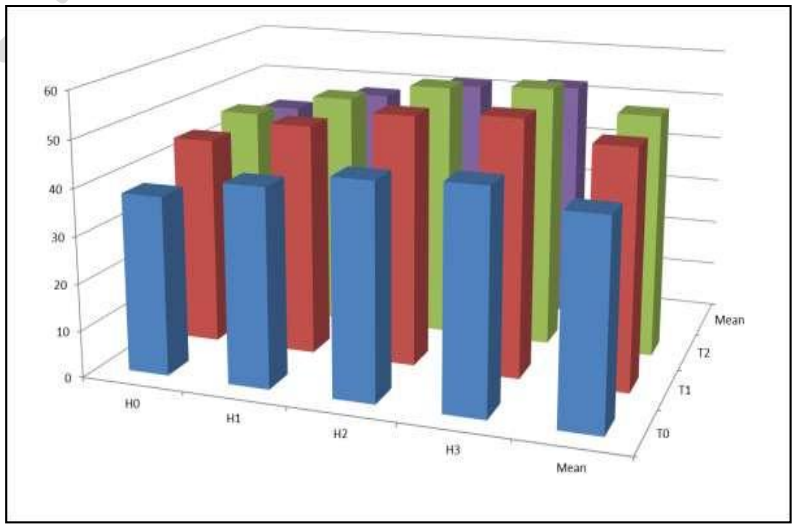
No. of leaves at 60 DAS



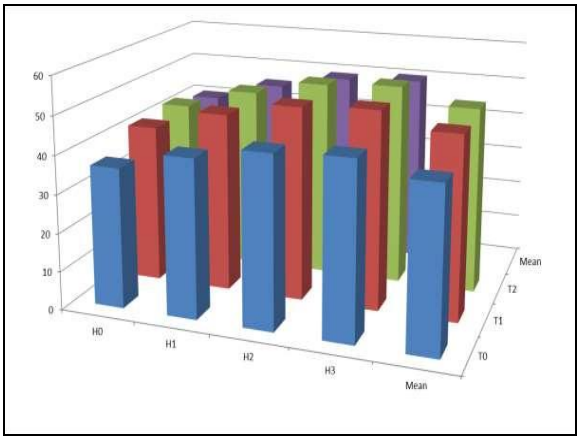
No. of leaves at 60 DAS



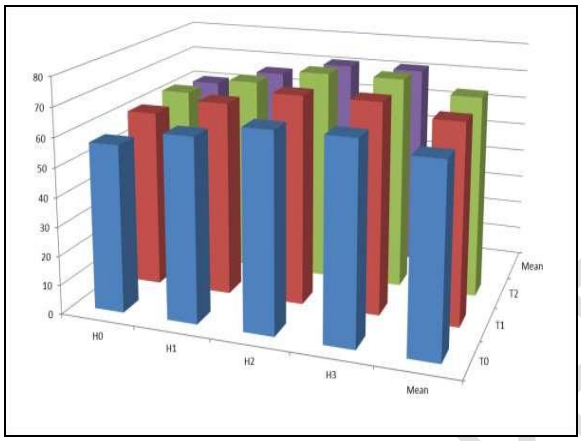
Length of leaves at 60 DAS



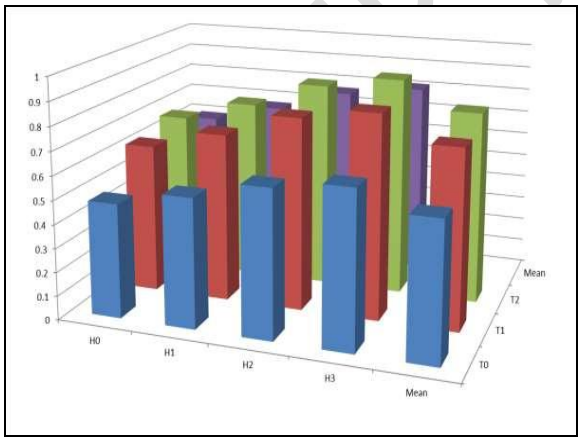
No. of leaves at 90 DAS



Plant height at 60 DAS



Plant height at 90 DAS



Chlorophyll Content

Fig 1. Effect of different treatment in term ofLength of leaves, Plant height and Chlorophyll Content

REFERENCES

Abdel-Razzak, H.S., EI-Sharkawy, G.A. (2013). Effect of biofertilizer and Humic acid applications on growth, yield, quality and storability of two garlic (*Allium sativum* L.) cultivars. *Asian Network for Scientific Information*, 48-64.

Altomare, C., Norvell, W.A., Bjorkman, Thomas, and Harman, G. (1999). Solubilizationof phosphates and micronutrients by the plant-growth-promoting and biocontrolfungus *Trichodermaharzianum*Rifai 1295-22. *Applied and environmentalmicrobiology*, **65**(7), pp.2926-2933.

Harman, G.E. (2006). Overview of mechanisms and uses of *Trichoderma* species*Phytopathology*, **96**(2): 190-194.

Harman, G.E., Howell, C.R., Viterbo, A., Chet, I., and Lorito, M. (2004). *Trichoderma*species-opportunistic, avirulent plant symbionts. Nature Reviewer, **2**: 43-56.

Hoitink, H.A.J., Madden, L.V., and Dorrance, A.E. (2006). Systemic resistance induced by *Trichoderma*spp; Interactions between the host, the pathogens, the biocontrol agent and soil organic matter quality. *Phytopathology*, 96(2):186-189.

H.S. Abdel-Razzak and G.A. El-Sharkawy, 2013.Effect of Biofertilizer and Humic Acid Applications on Growth, Yield, Quality and Storability of Two Garlic (*Allium sativum* L.) Cultivars. *Asian Journal of Crop Science, 5: 48-64.(Repea*

Kumar, A., Patel, A., Singh, S. N. and Tiwari, R. K. (2019). Effect of *Trichoderma*species In Plant Growth Promotion in Chilli. *International Journal of CurrentMicrobiology and Applied Sciences*,**8**(3): 1574-1581.

Mahmoud, A.R. and M.M. Hafez, 2010. Increasing productivity of potato plants (*Solanum tuberosum* L.) by using potassium fertilizer and humic acid application. Int. J. Acad. Res., 2: 83-88.

López-Bucio J., Pelagio-Flores R., Herrera-Estrella A. *Trichoderma* as biostimulantExploiting the multilevel properties of a plant beneficial fungus. *Sci. Hortic.* 2015;196:109–123.doi: 10.1016/j.scienta.2015.08.043.

Nagata, N., Tanaka, R., Satoh, S. and Tanaka, A. (2005). Identification of a vinylreductase gene for chlorophyll synthesis in Arabidopsis thaliana and implicationsfor the evolution of *Prochlorococcus* species. *The Plant Cell*, 17(1): 233-240.

Samy, M., Mohamed, N. and El-Aziz, A. (2015). Effect of boron, copper and Humic acidtreatments on vegetative growth, yield and storability of Jerusalem artichoketubers. *Journal of Productivity and Development*, **20**(3), pp.325-342.

Vinale, F., Sivasithamparam, K., Ghisalberti, E.L., Marra, R., Barbetti, M.J., Li, H., Woo, S.L., and Lorito, M. (2008). A novel role for Trichoderma secondary metabolites in the interactions with plants. *Physiological and molecular plant pathology* 72: 80-86.