Plant Archives Vol. 20 Supplement 1, 2020 pp. 2131-2134 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF MANUFACTURED IRON OXIDES IN CONTROL OF TOMATO YELLOW LEAF CURL VIRUS (TYLCV)

Abdulkareem Kassim Jabar[1], Hashim Haneen K. Aldhahi[2] and Hussein Ali Salim[3*]

[1,2]College of Agriculture, University of Misan, Iraq.
[3*]Directorate of Diyala Agriculture, Ministry of Agriculture, Iraq.

Abstract

The aim of this study was to evaluate the antiviral activity of four concentrations of iron oxides 0, 0.5, 1 and 1.5% against Tomato yellow leaf curl virus (TYLCV) -infecting tomato plants. The results of experiments showed that no significant differences in plant height and branches number among treatments, while the disease severity of TYLCV virus was decreased by using concentrations of iron oxides 0.5, 1.0, 1.5 % to 0.5, 0.3, 1.6 %, respectively, compared with control 2.8%, where concentrations 1.0% and 0.5% were significantly superior in decreasing of disease severity with no significant differences between them followed by concentration 1.5%.

***Key words*:** TYLCV, iron oxides, *Bemisia tabaci.*

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important vegetables in the world and is second in significance after potatoes in numerous countries (Salim and Jasim, 2016). The main restrictions that effect on production of tomato are diseases caused by viruses, fungi and bacteria (Salim *et al.,* 2017, Jones *et al.,* 2016, McGovern, 2015). Tomato yellow leaf curl virus (TYLCV) is one of the most devastating viruses of cultivated tomatoes in tropical and subtropical districts. The virus is a monopartite begomovirus. the genome of the virus contains a single-stranded circular DNA and the length of the DNA is in all cases about 2800 nucleotides (Glick *et al.,* 2009). TYLCV is transmitted by the whitefly *Bemisia tabaci* in a persistent manner whose severe population outbreaks are usually associated with high incidence of the disease. Symptoms of TYLCV are appearing on infected plants that include yellowing between the veins, wrinkling of leaves, stunting, leaf margins curl upward, giving cup shape and flowers dropping occurs before fruit set (Melzer *et al.,* 2009). Control of TYLCV depends on intensive using of insecticide against vectors, but this method leads to environmental pollution and occurs insecticide-resistant, or cultivation of resistant varieties. In spite of all attempts to reduce the infection of this virus on the tomato crop, the problem of the virus is still continue, therefore other alternative methods need to be investigated. The (TYLCV) causes huge economic losses in the production of tomatoes in Iraq, therefore it is important to search for a new approach to virus control as compared with using of insecticides against whitefly (*Bemisia tabaci*) (Jabar *et al.,* 2020). This study aimed to use some iron oxides which have been manufactured in laboratory which possess a high density of positive charge due to height of its specific surface area, which gives it the ability and effectiveness to interact with viruses in infected plants and thus lead to inhibition of effectiveness and intensity of Infection and spread of this virus under protected cultivation conditions.

***Author for correspondence :** E-mail: h_salim11111@yahoo.com

Materials and methods

Preparation of plant samples

Infected tomato plants with wrinkling and yellowing symptoms were collected from Al-Kahla fields, specifically from the nursery of the Directorate of Agriculture of Misan province, then transported in plastic pots diameter 22 cm and height 25 cm and placed inside the plastic house in the fields of plant protection department, Faculty of Agriculture, University of Misan. The virus isolate (Tylcv-Bsr) was obtained from Dr. Abdulkareem Kassim

Jabar, Faculty of Agriculture, University of Misan which preserved on the Tomato plants under muslin protected cages, whereas the seedlings (*cv*. Huda) were obtained from Misan nursery.

Preparation of iron oxides

The used method was described by Towe and Bradley, (1967), where the amount of aqueous ferric nitrate ($Fe(NO_3)_3.9H_20$) at a concentration of 0.2 molar was dissolved in distilled water at 70°C with continuous and rapid shaking, Leave the solution 10 minutes to reach to the equilibrium and cool in the refrigerator, then placed in Dialysis Bags (these are semi-permeable bags that allow of ions to passage and do not allow of molecules and colloids to passage) these bags with their contents were put in a container containing distilled water and which replacing every 12 hours until the suspension pH changes from 1.8 to about 6. Dialysis is used to get rid of nitrates and only ferric hydroxides remains, this process takes 10-20 days to begin deposition of ferrihydrite ($(Fe^{3+})_2O_3.0.5H_2O$, then collected in plastic bottles and stored in laboratory heat.

Preparation of ferrihydrite solution for spraying of tomato plants

Four concentrations of iron oxides 0, 0.5, 1 and 1.5 g / liter of distilled water were prepared by taking of 0, 12.5, 25 and 50 mL of the original solution and diluting it in a standard flask 500 mL until the mark.

Pots experiment

This experiment was carried out at the Faculty of Agriculture, University of Misan, Iraq under the greenhouse conditions during October 2017-June 2018. Seedlings of the tomato at age 60 days were transplanted into plastic pots (20×20 cm) containing 2 kg of sterilized soil with Peat moss 3:1 under muslin protected cages. Three concentrations of iron oxides 0.5, 1.0, 1.5% and control 0% with six replicates for each concentration were used to be 24 experimental units by using a complete randomized design (CRD) and each replicate contain one plant, the control plants (0%) were treated with distilled water. The data was analyzed using two ways Analysis of Variance (ANOVA) (Fisher and Yates, 1968). Adults of white flies (*Bemisia tabaci*) that virus-free were reared on cotton plants *Gossypium hirsutum* under muslin protected cages (100 × 100 × 100 cm). Numbers of white flies were given an acquisition feeding period for 24 hrs on infected tomato plants by virus Tylcv-Bsr, then transferred to healthy plants (10 insect / plant) at 2 leaf stage for a duration 24 hrs feeding period. The plants were sprayed according to the used concentrations when the plant height reached to 15 cm after the emergence of yellowing and wrinkle symptoms by using a hand sprayer on all parts of the plant with complement the full spraying of 500 ml on the plants to each treatment for two days respectively, all the plants were maintained in insect proof cages in the greenhouse. The following measurements such as plant height, branches number, disease severity were recorded 40 days post symptoms appearance. The symptom severity scale described by (Friedmann *et al.,* 1998) as follows:

0= no visible symptoms, inoculated plants show same growth and development as non-inoculated plants, 1= very slight yellowing of leaflet margins on apical leaf, 2= some yellowing and minor curling of leaflet ends, 3= a wide range of leaf yellowing, curling and cupping with some reduction in size, yet plants continue to develop, 4= very severe plant stunting and yellowing, pronounced leaf cupping and curling and plant growth stops. Disease severity index was calculated by the following formula (Raupach *et al*., 1996).

$$Diseaseseveritindex = \frac{(Diseasegrade \times no.of\ plantsineachgrade)}{Totalno.of\ plants \times highestDiseasegrade} \times 100$$

Disease severity index = (Disease grade × number of plants in each grade) / (Total number of plants × highest disease grade) × 100

Inoculated tomato plants were tested by ELISA to confirm TYLCV infection (Clark Adams,1977).

Results and Discussion

There is no significant differences in plant height and branches number among treatments (Fig. 1 and 2), whereas the presented data in fig. 3, showed that concentrations of iron oxides (0.5, 1.0, 1.5%) significantly decreased of disease severity of TYLCV virus which reached 0.5, 0.3, 1.6%, respectively, compared to control 2.8%, where concentrations 1.0% and 0.5% were

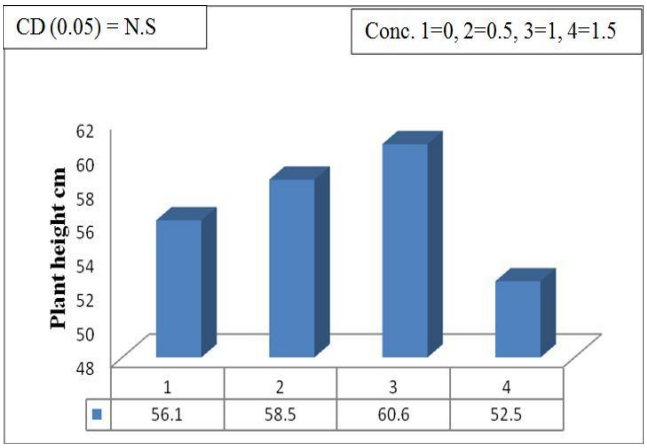

Fig 1: Effect of different concentrations of iron oxides on infected tomato plant height by TYLCV virus.

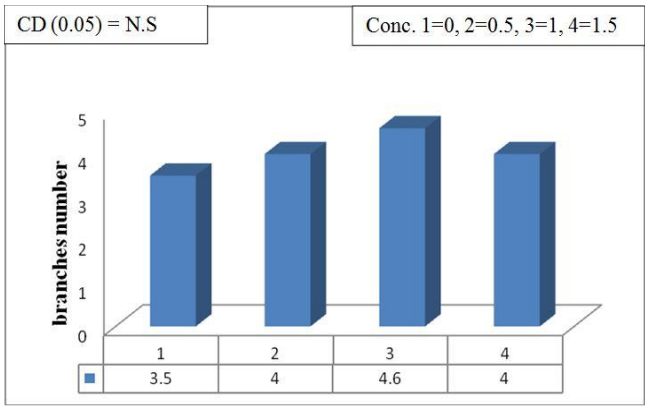

Fig 2: Effect of different concentrations of iron oxides on branches number in infected tomato plants by TYLCV virus.

significantly superior in decreasing of disease severity with no significant differences between them followed by concentration 1.5%. The iron oxides nanoparticles (Fe_2O_3 NPs) showed enhancement of tomato growth parameters *via*. seed germination, root and shoot lengths and there is no adverse effect (toxicity) (Shankramma *et al*., 2016). Iron contents in the shoots and roots increased with increasing concentration of Fe_2O_3 nanoparticles, where absorption of Fe_2O_3 nanoparticles and their aggregation in the roots were apparent, the antioxidant enzyme activity of plant reasonably increased in root and shoot, which indicates that the Fe_3O_4 nanoparticles are not toxic to wheat plant under the experimental conditions, the Fe_2O_3 nanoparticles led to increase root length, height and biomass of the plant by regulating of phytohormones and antioxidant enzyme activity, applying of Fe_2O_3 with different concentrations (100, 150, 200 mg) led to increase of spinach stalks lengths to 1.45, 1.91 and 2.27 respectively that greater than those of the control after 45 days (Siddiqi and Husen , 2017). Entry of positively-charged iron oxides into the plant and their interaction with negatively-charged virus particles lead to inhibit or reduce the virus activity

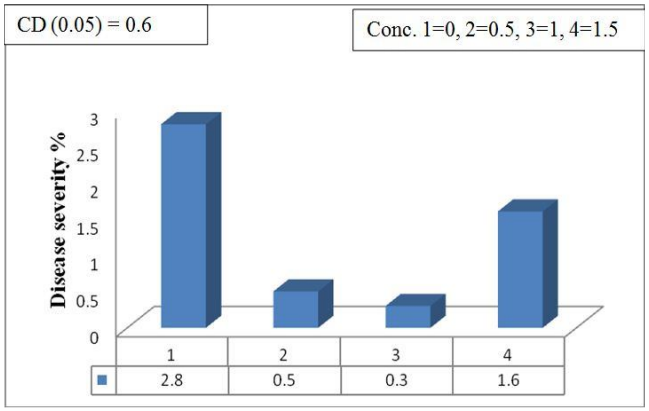

Fig 3: Effect of different concentrations of iron oxides on plant disease severity in infected tomato plants by TYLCV virus.

and thus improve of tomato growth characteristics, which result in an increase of productivity (AL-Janabi, 1984, Harrison, 1985).

Conclusion

The results of the present investigation indicated that, spraying of iron oxides with four concentrations 0, 0.5, 1 and 1.5 resulted in reducing the severity of tomato yellow leaf curl virus infection in addition to improve some of traits, such as plant height and number of branches in tomato plants.

References

Clark, M.F. and N.E. Adams (1977). Characterization of the microliter plate method of enzyme-linked immunoassay (ELISA), for the detection of plant viruses. *J. Gen. Viro.*, **37:** 475-483.

Fisher, R.A., Yates (1968). Statistical method for research workers. Oliver and Boyd Ltd. Edinburgh and London, 10. http://www.ccari.res.in/wasp/index.php.

Friedmann, M., M. Lapidot, S. Cohen and M. Pilowsky (1998). A novel source of resistance to tomato yellow leaf curl virus exhibiting a symptomless reaction to viral infection. *J. Am. Soc. Hortic. Sci*., **123:** 1004-1007.

Glick, E., Y. Levy and Y. Gafni (2009). The Viral Etiology of Tomato Yellow Leaf Curl Disease-A Review, *Plant Protect. Sci*., **45(3):** 81-97.

Harrison, B.D. (1985). Advances in Geminivirus research. *Ann. Rev. Phytopathology.*, **23:** 55-82.

Jabar, A.K., H.A. Salim and A.F. Ali (2020). Inhibition of tomato yellow leaf curl virus (TYLCV) by extract of algae *Cladophora crispate*, *Plant Archives.*, **20(1)** April.

Janabi, A.A.A. (1984). Master Thesis - College of Agriculture / University of Baghdad.

Jones, J.B., T.A. Zitter, T.M. Momol and S.A. Miller (2016). Compendium of Tomato Diseases and Pests, Second Edition. APS Publications.

McGovern, R.J. (2015). Management of tomato diseases caused by *Fusarium Oxysporum*. *Crop Protect*., **73:** 78-92.

Melzer, M.J., D.Y. Ogata, S.K. Fukuda, R. Shimabuku, W.B. Borth, D.M. Sether and J.S. Hu (2009). Tomato yellow leaf curl. *Plant Dis*., **70:** 1-2.

Raupach, G.S., L. Liu, J.F. Murphy, S. Tuzun and J.W. Kloepper (1996). Induced systemic resistance in cucumber and tomato against cucumber mosaic cucumovirus using plant growth-promoting rhizobacteria (PGPR). *Plant Dis.*, **80(8):** 891-894.

Salim, H.A. and B.N. Jasim (2016). Cost benefit ratio of infected tomato yield by fusarium wilt disease, *Journal of research in applied, natural and social sciences.*, **4(4):** 103-108.

Salim, H.A., A.F. Ali, H.A. Abbas, M.A. Galal, N.K. Gafer, H.T. Abrahim and H.F. Azeez (2016). Comparison of growth

and yield characteristics of tomato (*Lycopersicon esculentum* Mill.) varieties under greenhouse conditions, *Al-Anbar journal of Agriculture science.*, **14:** 1-7.

Salim, H.A., S. Simon and A.A. Lal (2017). Integrated diseases management (IDM) against tomato (*Lycopersicon esculentum* L.) fusarium wilt. *J. Environ. Agric. Sci*., **11:** 29-34.

Shankramma, K., S. Yallappa, M.B. Shivanna and J. Manjanna (2016). Fe_2O_3 magnetic nanoparticles to enhance *S. lycopersicum* tomato plant growth and their biomineralization, *Appl Nanosci.*, **6:** 983-990.

Siddiqi, K.S. and A. Husen (2017). Plant Response to Engineered Metal Oxide Nanoparticles, Nanoscale Research Letters **12:** 92.

Towe, K.M. and W.F. Bradley (1967). *J. Colloid Interface Sci*., **24:** 384-392.