Research Article

The Effect of Pars Humic (Ammonium humate) on Reducing Damage Caused by Potato Virus Y in Cultivars Agria

Vahid Mollasadeghi[1,2]* and Samaneh Elyasi[1,2]

[1]Department of Agronomy and Plant Breeding, Ardabil branch, Islamic Azad University, Ardabil, Iran; [2]Young Researchers Club, Ardabil Branch, Islamic Azad University, Ardabil, Iran.

Abstract | This paper investigated the effect of Pars Humic on potato *cultivars Agria* in Rezvanshahr city in 2020-2021 in greenhouse conditions in order to reduce the damage caused by Virus Y in potato. Pathogen-free seedlings of potatoes were propagated and grown and then transferred to sterile plastic pots with suitable soil. The *randomized complete block* design (RCBD) was performed in three replications. Pars Humic treatment (Ammonium Humate) was treated with control concentrations (zero), 1, 2 and 3 per thousand. PVY-activated tobacco leaf extract was used to infect the potato plant. This paper measured chlorophyll a, b, leaf area, number of leaves, stem length and tuber weight. The results showed that the symptoms of PVY were completely distinguishable on the leaves of tobacco plants compared to PVY on the leaves of Agria. PVY-infected leaves were more curled and paler than healthy leaves of cultivars Agria. The results of analysis of variance of the evaluated traits showed that the effect of PVY virus treatment was significant on chlorophyll a, b, leaf area and stem length at 1% and 5%, respectively. In addition, the effect of Pars Humic seven on chlorophyll a, b, leaf area and stem length was significant at 1% level. The results of the interaction effect of PVY virus treatment in Pars Humic were significant only for chlorophyll a, b and leaf area at 1% level. Pars Humic treatment with concentrations of 2 and 3 per thousand caused a significant reduction in PVY damage.

Received | December 01, 2021; **Accepted** | January 09, 2022; **Published** | January 13, 2022
***Correspondence** | Vahid Mollasadeghi, Department of Agronomy and Plant Breeding, Ardabil branch, Islamic Azad University, Ardabil, Iran; **Email:** Vahidmollasadeghi@gmail.com
DOI | https://dx.doi.org/10.17582/journal.hv/2022/9.1.1.6
Citation | Mollasadeghi, V. and S. Elyasi. 2022. The effect of pars humic (Ammonium humate) on reducing damage caused by potato virus Y in cultivars agria. *Hosts and Viruses*, 9: 1-6.
Keywords: Potato, PVY Virus, Pars Humic (Ammonium humate)

Introduction

The potato with the scientific name (*Solanum tubersum* L) is one of 900 species of the genus Solanum, from the family Solanacea (Dahal *et al.*, 2019). Potatoes as the most important food products in the world (Mohaddesi *et al.*, 2013) and the fourth crop after wheat, corn and rice (FAOSTAT, 2017), are very important in terms of nutritional value and production of protein and energy per unit area (Bach *et al.*, 2012). In Iran, after wheat, it ranks second in terms of food production and annual potato production is reported to be 275 million tons (Zadeh and Ehsanpour, 2012). More than 125 countries around the world cultivate potato and it is considered as the main daily food of more than one billion people. Annually, potatoes are cultivated in about 5.19 million hectares around the world with about 368 million tons potato yield. The largest producer in the world is China, followed by India, Russia, Ukraine and the United States. In terms of production, Iran ranks 12th to 13th in the world, and among Asian countries, after China and India, Iran ranks third (FAO, 2017). Potato plant is attacked by a large number of pests and plant diseases with a wide geographical area and for this reason, among crops, the highest rate of pesticide consumption is seen in this crop. Cultivation of potato seed tubers, as well as successive cultivation of this plant from an initial seed mass, after a few years leads to a significant reduction in yield. The cause is called potato seed degradation that is the result of infection of seed tubers with plant pathogens, especially viruses (Thomas-Sharmaa *et al.*, 2016). Viruses are very small pathogens that can only be seen under an electron microscope and can only function and survive within a living host. Unlike other pathogens, viruses do not have a cellular structure and therefore neither feed nor grow. The only characteristic that distinguishes them from inanimate organisms is reproduction, which occurs when the virus is alive inside the cell. The body of viruses consists of a series of nucleic acids that make up the genetic material (genome) of the virus and a protein coat whose main function is to protect the genetic material of the virus (Figure 1).

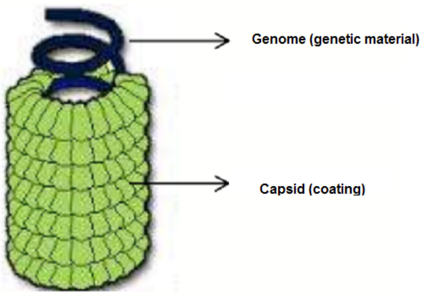

Figure 1: *General diagram of virus pigment.*

At least 4 types of viruses affect potato crop (Valkonen, 2007), among which Y potato virus is one of the most widespread and important viral diseases of this crop and in most areas where potatoes are grown. Grows, is common (Danesh *et al.*, 1995; Zinati and Nasrullah, 2013; Nikan, 2016) PVY virus attacks potatoes, peppers, tomatoes and tobacco and causes a lot of damage in this plants (Agrios, 2005). PVY virus is spread all over the world (Quenouille et al., 2013) and is of great economic importance (Karasev and Gray, 2013) and at its maximum pathogenicity causes damage to 80% of crops. Surveys of potato fields in Iran showed the prevalence of this virus at approximately 34% of the sample (Pourrahim and Farzadfar, 2007). Therefore, one of the most important viral diseases in the country is PVY (Peyman et al., 2004). Maghsoudi *et al.* (2004) reported that Y virus is the most common potato virus in farms in Khorasan, Gilan and Mazandaran provinces. Pourrahim and Farzadfar (2007) examined the status of this virus in 11 provinces of the country including: Ardabil, Azerbaijan, Isfahan, Tehran, Chaharmahal and Bakhtiari, Khuzestan, Zanjan, Kerman, Lorestan and Hamedan by random sampling and they showed that on average, 34.4% of the samples were infected with this virus. Zinati and Nasrollah (2011) examined the spread of the virus in potato fields in Golestan province using ELISA test and found that about 60% of the samples were infected with the virus. Infection with this virus reduces the quantity and quality of potato crop (production of dead tissue on the skin or in the flesh of the tuber in some cultivars (Nikan, 2016). One of the most important strategies to fight against plant viruses is to use resistant varieties by improving the resistance of existing cultivars using different methods from the Journal of the application of effective materials in creating resistance such as organic fertilizers such as Humic acids by foliar application on the plant. Humic acid as an acid humus other natural sources, through effects nutrient absorption in increased roots and shoots biomass. This substance has a pseudo-hormonal activity, so that increases plant growth and absorption of nutrients and thus increases plant resistance to stresses including drought stress. Humic acid does not operate only as a limited source of nutrients, but this organic acid can be used as a growth regulator to adjust the level of hormones and improve plant growth (Nardi *et al.*, 2000).

There are many cases for the effect of humic acid in reference books, including the formation of complex bonds between humic acid and mineral ions, the decomposition of humic acid to enzymes in plant tissues, the effect of humic acid on respiratory and photosynthesis processes and stimulating the metabolism of nucleic acids (Chen *et al.*, 2004). This paper aimed at investigating the effect of Pars Humic seven (Ammonium humate) on reducing the damage caused by potato virus Y in cultivars agria in rezvanshahr.

Materials and Methods

This paper investigated the effect of Pars humic on some evaluated traits of potato cultivars Agria in Rezvanshahr in 2020-2021 in greenhouse conditions in order to reduce the damage caused by potato Y virus. Pathogen-free seedlings of potatoes were propagated were propagated (light intensity 55 µmol/

m2/ light cycle 16 hours light and 8 hours' dark to grow) and seedlings were grown and then planted in sterile 3-liter plastic pots, in a seedling per pot with a suitable soil with a mixture (2 clays: 1 composite). The experiment was performed as a factorial experiment in the form of randomized complete blocks with three replications. Pars Humic treatment (Ammonium humate) which had 65% Humic and 5% nitrogen with control concentrations (zero), 1, 2 and 3 per thousand was sprayed on the leaves of the plants in the same amount in a pot. PVY-infected tobacco active leaf extract was used to infect the potato plant according to the method of Crosslin et al. (2005). The current paper calculated chlorophyll a, and b traits, and leaf area, by Arnon method (Arnon, 1956), Delta-T devices in terms of square centimeter, respectively. Also number of leaves, stem length, and tuber weight in each pot were measured after harvests. Analysis of variance after normalization of data was performed based on a randomized complete block design with three replications. The mean of the measured traits was compared using LSD test at 5% probability level. SAS 9.1 and SPSS-22 computer software were used for statistical calculations.

Results and Discussion

Viral symptoms usually appear on the leaves of the plant two to three weeks after infection. These symptoms are usually different and in this study the symptoms of PVY were completely distinguishable on the leaves of tobacco plants compared to PVY on the leaves of Agria. PVY-infected leaves were more curled and paler than healthy leaves of cultivars Agria. The results of analysis of variance of the evaluated traits showed that the effect of PVY virus treatment was significant on chlorophyll a, b, leaf area and stem length at 1% and 5%, respectively. Plants make adaptive changes to withstand any biological and abiotic stress. Also, the effect of Pars Humic on chlorophyll a, b, leaf area and stem length was significant at 1% level. The results of the interaction effect of PVY virus treatment on Pars Humic were significant only for chlorophyll a, b, and leaf area at 1% level (Table 1).

Chlorophyll a and b

The results of comparing the mean interaction of PVY virus treatment in Pars Humic on chlorophyll a and b (Figure 2) showed that the composition of PVY virus in Pars Humic 3 per thousand had the highest and the combination of PVY virus in control had the lowest chlorophyll a (Figure 2). Also, in terms of chlorophyll b, the normal composition in Pars Humic 3 had the highest per thousand and the normal composition in the control had the lowest amount of chlorophyll b (Figure 3). Chlorophyll is the main pigment responsible for receiving light energy for use in photosynthesis. Changes in chlorophyll concentration are considered as a short-term reaction to stress. Mehrinfar *et al.* (2014) reported that the effect of stress on chlorophyll a and carotenoids was quite significant. He also stated that chlorophyll a had the highest amount in the absence of stress and decreased under stress. Pars Humic caused an increase and decrease of chlorophyll a and b, this increase and decrease may increase or decrease by interfering with the biosynthetic pathway of chlorophyll or plays a protective role by interfering with and increasing the production of antioxidant enzymes in disease conditions in plants (Tuzun and Bent, 2006). Wang *et al.* (2001) reported a decrease in chlorophyll content in soybean under stress conditions.

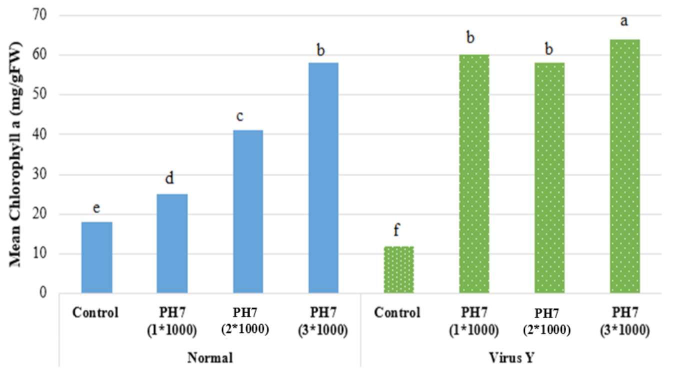

Figure 2: *Comparison of the mean bilateral effect of PVY virus treatment in Pars Humic for chlorophyll a. The means with at least 1 common letter with no significant difference in 5% sig. level (Duncan test).*

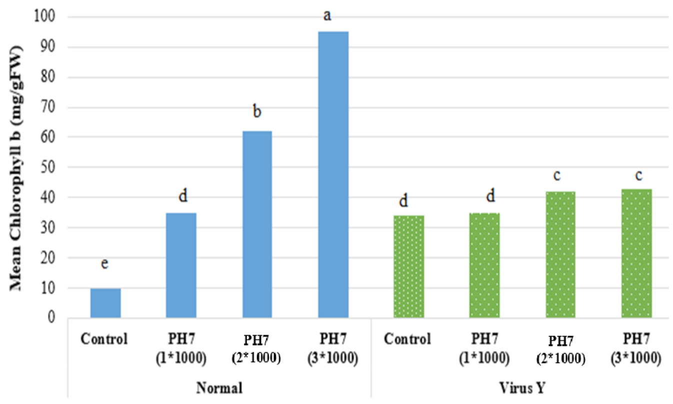

Figure 3: *Comparison of the mean bilateral effect of PVY virus treatment in Pars Humic for chlorophyll b. The means with at least 1 common letter with no significant difference in 5% sig. level (Duncan test).*

Table 1: *Results of variance of evaluated traits.*

Gland weight	Stem length	Number of leaves	Leaf surface	Chlorophyll b	Chlorophyll a	df	SOV
ns	*	ns	**	**	**	1	Effect of virus treatment (VY)
ns	**	ns	**	**	**	3	The effect of Humic (H)
ns	ns	ns	**	**	**	3	VY ×H

*Symptoms ** and * indicate significance at 1 and 5% and ns insignificance, respectively.*

Leaf surface

The results of comparing the mean interaction of PVY virus treatment in Pars Humic on leaf area (Figure 4) showed that in general, virus decreased leaf area. The results showed that the normal composition in Pars Humic 2 in thousand had the highest and the composition of PVY virus in the control had the lowest leaf area (Figure 4).

Stem length

The results showed that PVY virus reduced the stem length of cultivar Agria (Figure 5). Also, treatment 3 per thousand Pars Humic and control treatment showed the highest and the lowest stem length, respectively. Cultivars and hybrids that have a strong number of stems, standing and open and have a uniform green surface in a few weeks after planting are selected and the faster the initial growth of plants, the higher the tuber yield (Hassanpanah *et al*., 2008).

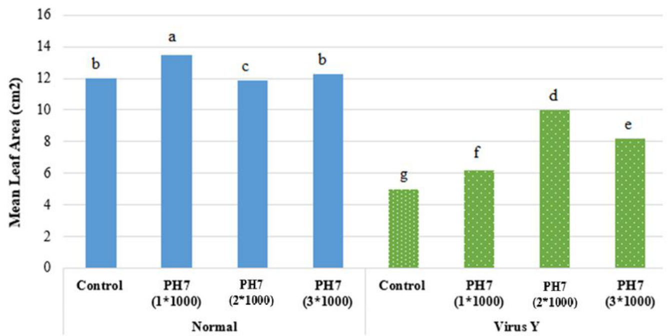

Figure 4: *Comparison of the mean bilateral effect of PVY virus treatment in Pars Humic for leaf area. The means with at least 1 common letter with no significant difference in 5% sig. level (Duncan test).*

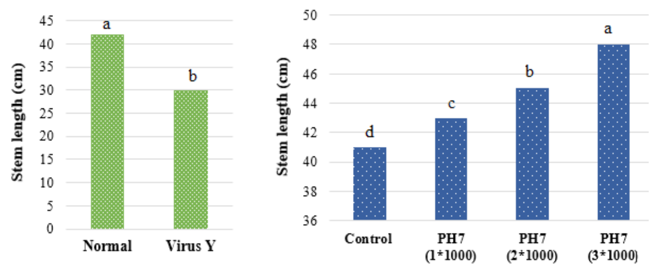

Figure 5: *Mean treatment of PVY virus and Pars Humic treatment seven for stem length. The means with at least 1 common letter with no significant difference in 5% sig. level (Duncan test).*

Conclusions and Recommendations

The results showed that the symptoms of PVY were completely distinguishable on the leaves of tobacco plants compared to PVY on the leaves of Agria. PVY-infected leaves were more curled and paler than healthy leaves of Cultivar Agria. The results of analysis of variance of the evaluated traits showed that the effect of PVY virus treatment was significant on chlorophyll a, b, leaf area and stem length at 1% and 5%, respectively. In addition, the effect of Pars Humic seven on chlorophyll a, b, leaf area and stem length was significant at 1% level. The results of the interaction effect of PVY virus treatment in Pars Humic were significant only for chlorophyll a, b and leaf area at 1% level. Pars Humic treatment with concentrations of 2 and 3 per thousand caused a significant reduction in PVY damage.

Conflict of interest

The authors have declared no conflict of interest.

References

Agrios, G.N. 2005. Plant Pathology. Elsevier Academic Press. USA, New York.

Arnon, D.I. 1956. Photosynthesis by isolated chloroplasts. I.V. General concept and comparison of three photochemical reactions. Biochemica et Biophysica Acta, 20: 449-461.

Bach, S., Yada, R. Y., Bizimungu, B., Sullivan, J.A. 2012. Crops that feed the world. Potato are the trends of increased global production sustainable? Food Sec., 4: 477–508. https://doi.org/10.1007/s12571-012-0220-1

Chen, Y., M. De Nobili and T. Aviad. 2004. Stimulatory effects of Humic substances on plant growth. Soil Organic Matter in Sustainable Agriculture. Boca Raton, Florida, CRC Pres. pp. 103-129. https://doi.org/10.1201/9780203496374.ch4

Crosslin, J., Hamm, P., Shiel, P., Hane, D., Brown, C. and Berger, P. 2005. Serological and molecular detection of tobacco veinal necrosis isolates of potato virus Y (PVYN) from potatoes grown in the western United States. Am. J. Potato Res., 82: 263-269.

Dahal, K., L. Xiu-Qing, T. Helen, A. Creelman and B. Bizimungu. 2019. Improving potato stress tolerance and tuber yield under a climate change scenario. A current overview. Front. Plant Sci., 14 May 2019. https://doi.org/10.3389/fpls.2019.00563

Danesh, D., P. Soleimanianzad, F. Philosof and S.M. Ashkan. 1994. Prevelance of four pathogenic potato viruses in Faridan experimental farm in Isfahan. J. Plant Dis., pp. 1-9. Issues:1-4, Seri 28.

FAOSTAT, 2017. Statistics division. FAO. http://faostat.fao.org/site/612/default.aspx#anc or (accessed 27 November 2018).

Hassanpanah, D., H. Hassanabadi, M. Yarnia and M.B. Khorshidi. 2008. Evaluation of quantitative and qualitative characters of advanced cultivars and clones of potato in Ardabil region. J. Agric. Sci., 2(5): 19-31.

Karasev, A.V. and Gray, S.M. 2013. Continuous and emerging challenges of potato virus Y in potato. Ann. Rev. Phytopathol., 51: 571-586.

Maghsoudi, R., Jafarpour and B. Falahatirastegar. 2004. Occurrence of N virus of potato Y virus in Khorasan province and race O of this PVYO virus in Khorasan, Gilan and Mazandaran provinces. 16th Iranian Plant Protection Congress, Tabriz. Iran. pp.123.

Mehrinfar, F., Nematzadeh, G. Ali, P. Hemmatollah and M. Hamidreza. 2014. The effect of salinity on ionic content, plant pigments and soluble sugars and starch of Aloropus halophyte. N. Agric. Find., 8(31): 251-261.

Mohaddesi A., S. Bakhshipour, A. Abbasian, M. Sattari and M. Salehi. 2013. Study on adaptability, quality and quantity characters of rice genotypes in Mazandaran. J. Plant Prod. 20(2): 19–36. (In Persian).

Nardi, S., D. Pizzeghello, F. Reniero and N. Rascio. 2000. Chemical and biochemical properties of Humic substances isolated from forest soils and plant growth. Soil Sci. Soc. Am. J., 64(2): 639-645. https://doi.org/10.2136/sssaj2000.642639x

Nikan, J., 2016. The most important viral diseases of aphids and their management in apple seed production fields. Ext. J. Iran. Plant Prot. Res. Inst., Reg. No. 50111, pp. 50.

Peyman, M., Ghannadha, M.R., Majidi, S., Zarbakhsh, A.J., Darvish, F. and Hasanabdi, H. 2004. Identification and introduction of virus resistat genotypes in potato. Iran. J. Agric. Sci., 35(4):809-815 (in Persian).

Pourrahim, R. and S. Farzadfar. 2007. Incidence and distribution of important viral pathogens in some Iranian potato fields. Plant Dis., 91: 609-615. https://doi.org/10.1094/PDIS-91-5-0609

Quenouille, J., Vassilakos, N. and Moury, B. 2013. Potato virus Y: a major crop pathogen that has provided major insights into the evolution of viral pathogenicity. Mol. Plant Pathol., 14: 439-452.

Thomas-Sharmaa, S., S.A. Abdurahmanb, S. Alic, J.L. Andrade-Piedrad, S. Baoe, A.O. Charkowskif, D. Crookg, M. Kadianc, P. Kromannh, P.C. Struikb, L. Torrance, K.A. Garrettaj and G.A. Forbes. 2016. Seed degeneration in potato: The need for an integrated seed health strategy to mitigate the problem in developing countries. Plant Pathol., 65(1): 3–16. https://doi.org/10.1111/ppa.12439

Tuzun, S. and E. Bent. 2006. Multigenic and induced systemic resistance in plants. Springer Science and Business Media, Inc., New York. https://doi.org/10.1007/b101085

Valkonen, J.P.T., 2007. Viruses, economical losses and biotechnological potential. In: J. Vreugdenhil (ed.) Potato biology and biotechnology. Elsevier, New York, pp. 619–641. https://doi.org/10.1016/B978-044451018-1/50070-1

Wang, G., Z. Hao, R.H. Anken, J. Lu and Y. Liu. 2001. Effect of UV-Bradiation on photosynthesis avtivity of Wolffia arrhiza as probed by chlorophyll flouresence transients. Adv. Space Res., 45: 839-845. https://doi.org/10.1016/j.asr.2009.12.004

Zadeh, N. and A. Ehsanpour. 2012. Effect of drought stress on some physiological parameters of two potato cultivars (Kenebec and Concord) under *in vitro* culture condition. Arid Biomed., 2(1): 70-82 (In Persian).

Zinati, F. and S. Nasrallah. 2013. Evaluate resistance to normal strain of potato Y virus in four potato cultivars under greenhouse conditions. Plant Dis. Res. Quart., 2(1): 1-4.

Zinati, F. and S. Nasrollah. 2011. First report of occurrence of potato virus Y(PVY) in potato fields of Golestan province. National Conference on Management in Agriculture. Islamic Azad University, Jahrom Branch. Jahrom, Iran. pp. 319.