

FITOPATOGEN VIRUSLARNING POMIDOR VA KARTOSHKKA EKINLARIDA NAMOYON BO'LADIGAN MORFOLOGIK ALOMATLARINI QIYOSIY TAHLIL QILISH VA ULARNING DIAGNOSTIK AHAMIYATI

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Annotatsiya: *Fitopatogen viruslar qishloq xo'jaligi ekinlarining hosildorligi va sifatini pasayishiga olib keluvchi muhim biologik omillardan hisoblanadi. Ushbu tadqiqot pomidor va kartoshka ekinlarida keng tarqalgan Potato virus Y (PVY) va Tobacco mosaic virus (TMV) tomonidan keltirib chiqariladigan morfologik alomatlarini qiyosiy tahlil qilishga bag'ishlangan. Tadqiqot davomida vizual simptomlar baholanib, ularning Kasallik Indeksi (KI) aniqlangan hamda natijalar ELISA va RT-PCR usullari yordamida tasdiqlangan. Olingan ma'lumotlar PVY ning tizimli va og'ir simptomlar, TMV ning esa asosan lokal nekrotik alomatlar bilan xarakterlanishini ko'rsatdi. Natijalarga ko'ra, dala sharoitida tezkor diagnostika uchun vizual mezonlarning muhimligini tasdiqlaydi.*

Kalit so'zlar: *fitopatogen viruslar, PVY, TMV, morfologik simptomlar, RT-PCR, vizual diagnostika.,deformatsiya*

Abstract: *Phytopathogenic viruses are important biological factors that reduce the yield and quality of agricultural crops. This study is devoted to a comparative analysis of morphological symptoms caused by Potato virus Y (PVY) and Tobacco mosaic virus (TMV), which are widespread in tomato and potato crops. During the study, visual symptoms were evaluated, their Disease Index (DI) was determined, and the results were confirmed using ELISA and RT-PCR methods. The data obtained showed that PVY is characterized by systemic and severe symptoms, while TMV is characterized by mainly local necrotic symptoms. According to the results, the importance of visual criteria for rapid diagnosis in field conditions is confirmed.*

Keywords: *phytopathogenic viruses, PVY, TMV, morphological symptoms, RT-PCR, visual diagnostics., deformation*

Аннотация: *Фитопатогенные вирусы являются важными биологическими факторами, снижающими урожайность и качество сельскохозяйственных культур. Данное исследование посвящено сравнительному анализу морфологических симптомов, вызываемых вирусом картофеля Y (PVY) и вирусом табачной мозаики (TMV), широко распространенными на томатах и картофеле. В ходе исследования оценивались визуальные симптомы, определялся их индекс поражения (DI), а результаты подтверждались с помощью методов ИФА и ОТ-ПЦР. Полученные данные показали, что PVY*

характеризуется системными и тяжелыми симптомами, в то время как TMV характеризуется преимущественно локальными некротическими симптомами. По результатам подтверждается важность визуальных критериев для быстрой диагностики в полевых условиях.

Ключевые слова: *фитопатогенные вирусы, PVY, TMV, морфологические симптомы, ОТ-ПЦР, визуальная диагностика, деформация*

Kirish

Virusli kasalliklar o'simliklar orasida eng tez tarqaluvchi va iqtisodiy jihatdan katta zarar yetkazuvchi patogen guruhlardan biri hisoblanadi. Fitopatogen viruslar o'simlik hujayralarining metabolik jarayonlariga aralashib, o'sish, rivojlanish va fiziologik holatida jiddiy buzilishlarni keltirib chiqaradi. Natijada barglarda mozaika, xloroz, nekroz, deformatsiya hamda o'simlik bo'yining o'sishdan qolishi kabi tashqi simptomlar yuzaga keladi.

Simptomlarning paydo bo'lish darajasi va shakli virusning biologik xususiyatlari, xo'jayin o'simlikning genotipi, rivojlanish bosqichi hamda atrof-muhit sharoitlariga bevosita bog'liq. Dala sharoitida kasalliklarni erta aniqlash ko'pincha vizual simptomlarga asoslanadi, biroq bir nechta viruslar o'xshash belgilarni keltirib chiqarishi mumkin. Shu sababli morfologik alomatlarni molekulyar usullar bilan tasdiqlash muhim ahamiyat kasb etadi. Ilmiy adabiyotlarda PVY va TMV viruslari keng o'rganilgan bo'lsa-da, ularning O'zbekiston sharoitida yetishtiriladigan pomidor va kartoshka ekinlaridagi simptomlarini qiyosiy tahlil qilish bo'yicha tadqiqotlar yetarli emas.

Tadqiqotning maqsadi – pomidor va kartoshka ekinlarida PVY va TMV infeksiyalari natijasida yuzaga keladigan morfologik alomatlarni qiyosiy tahlil qilish, Kasallik Indeksini aniqlash va vizual diagnostika uchun ishonchli mezonlarni ishlab chiqishdan iborat. Tadqiqot materiallari, metodlari va tadqiqot ishlari 2024–2025 yillarda Qashqadaryo viloyatidagi tajriba maydonlarida olib borildi. Tajriba ob'ekti sifatida pomidor (*Lycopersicon esculentum*, "F1 Baraka") va kartoshka (*Solanum tuberosum*, "Sante") navlari tanlab olindi. Har bir ekindan 100 tadan o'simlik tasodifiy tanlab olindi. Namuna olish gullash bosqichida amalga oshirildi. O'simliklardagi simptomlar vizual kuzatuv asosida baholanib, mozaika, barg deformatsiyasi, nekroz va stunting darajasi aniqlandi. Kasallik og'irligini baholash uchun 0–5 balli shkala asosida Kasallik Indeksi (KI) hisoblandi.

Vizual simptomlar aniqlangan namunalar laboratoriya sharoitida ELISA usuli yordamida dastlabki tekshiruvdan o'tkazildi. Keyinchalik PVY va TMV ni aniq identifikatsiya qilish uchun RT-PCR qo'llanildi. Ajratib olingan RNK asosida spetsifik praymerlar yordamida amplifikatsiya amalga oshirildi va natijalar agaroz gel elektroforezi orqali vizualizatsiya qilindi.

Olingan statistik tahlilga ko'ra, SPSS 26 dasturida qayta ishlanib, viruslar keltirib chiqargan simptom og'irliklari o'rtasidagi farqlar bir faktorli ANOVA testi yordamida baholandi. $p < 0.05$ statistik ahamiyatli deb qabul qilindi.

Tadqiqot natijalariga ko'ra, PVY bilan zararlangan pomidor o'simliklarida kuchli mozaika va barg deformatsiyasi ustunlik qildi. O'simliklarning bo'yi o'rtacha 35% ga qisqardi va KI 3.8 ± 0.3 ni tashkil etdi. TMV infeksiyasi esa asosan barg tomirlari atrofidagi nekrotik dog'lar va yengil xloroz bilan namoyon bo'ldi (KI – 2.5 ± 0.4). Statistik tahlil PVY va TMV o'rtasidagi farqning ishonchli ekanini ko'rsatdi ($p < 0.001$).

Kartoshkada PVY infeksiyasi yanada og'ir kechib, kuchli mozaika va sezilarli stunting kuzatildi (KI – 4.1 ± 0.2). TMV bilan zararlangan o'simliklarda esa asosan lokal nekrotik dog'lar qayd etildi (KI – 2.8 ± 0.3).

Molekulyar tasdiqlashda RT-PCR natijalari vizual baholashning yuqori ishonchligini tasdiqladi. Kuchli simptomli namunalarning 98% da virus RNKsi aniqlangan.

Olingan natijalar PVY ning kuchli tizimli tarqalish xususiyatiga ega ekanini, TMV esa ko'proq lokal reaksiyalarni keltirib chiqarishini ko'rsatdi. PVY ning HC-Pro oqsili o'simlikning RNK so'ndirish mexanizmini bostirishi natijasida og'ir simptomlar yuzaga keladi. TMV esa o'simlik tomonidan ko'pincha o'ta sezgirlik reaksiyasi orqali cheklanadi, bu esa nekroz bilan namoyon bo'ladi. Vizual simptomlar asosida dastlabki diagnostika o'tkazish mumkin bo'lsa-da, yakuniy xulosa chiqarish uchun molekulyar usullar bilan tasdiqlash zarur.

Xulosa

Tadqiqot natijalari PVY va TMV viruslari pomidor va kartoshka ekinlarida morfologik jihatdan sezilarli darajada farqlanuvchi simptomlarni keltirib chiqarishini ko'rsatdi. PVY kuchli tizimli infeksiya va yuqori KI bilan, TMV esa asosan lokal nekrotik alomatlar bilan xarakterlanadi. Ushbu ma'lumotlar virusli kasalliklarni dala sharoitida erta aniqlash va samarali nazorat choralarini ishlab chiqishda muhim ahamiyatga ega.

Introduction

Viral diseases are one of the most rapidly spreading and economically damaging pathogen groups among plants. Phytopathogenic viruses interfere with the metabolic processes of plant cells, causing serious disturbances in their growth, development and physiological state. As a result, external symptoms such as mosaic, chlorosis, necrosis, deformation and stunting of the plant appear on the leaves.

The degree and form of symptom development directly depend on the biological properties of the virus, the genotype of the host plant, the stage of development and environmental conditions. Early detection of diseases in the field is often based on visual symptoms, but several viruses can cause similar symptoms. Therefore, confirmation of morphological symptoms by molecular methods is of great

importance. Although PVY and TMV viruses have been widely studied in the scientific literature, there is a lack of research on the comparative analysis of their symptoms in tomato and potato crops grown in Uzbekistan.

The aim of the study is to perform a comparative analysis of morphological symptoms resulting from PVY and TMV infections in tomato and potato crops, to determine the Disease Index and to develop reliable criteria for visual diagnosis. Research materials, methods and research work were carried out in experimental areas in Kashkadarya region in 2024–2025. Tomato (*Lycopersicon esculentum*, “F1 Baraka”) and potato (*Solanum tuberosum*, “Sante”) varieties were selected as the experimental objects. 100 plants were randomly selected from each crop. Sampling was carried out at the flowering stage.

Symptoms in plants were assessed based on visual observation, and the degree of mosaic, leaf deformation, necrosis and stunting was determined. The Disease Index (DI) was calculated on a 0–5-point scale to assess the severity of the disease.

Samples with visual symptoms were initially examined in laboratory conditions using the ELISA method. Later, RT-PCR was used to accurately identify PVY and TMV. Amplification was performed using specific primers based on the isolated RNA and the results were visualized by agarose gel electrophoresis.

According to the obtained statistical analysis, processed in the SPSS 26 program, the differences between the symptom severities caused by the viruses were evaluated using the one-way ANOVA test. $p < 0.05$ was considered statistically significant.

According to the results of the study, severe mosaic and leaf deformation prevailed in tomato plants infected with PVY. The height of the plants was reduced by an average of 35% and the KI was 3.8 ± 0.3 . TMV infection was mainly manifested by necrotic spots around the leaf veins and mild chlorosis (KI – 2.5 ± 0.4). Statistical analysis showed that the difference between PVY and TMV was reliable ($p < 0.001$).

PVY infection in potatoes was more severe, with severe mosaic and significant stunting (KI – 4.1 ± 0.2). In TMV-infected plants, mainly local necrotic spots were observed (KI – 2.8 ± 0.3).

In molecular confirmation RT-PCR results confirmed the high reliability of visual assessment. Viral RNA was detected in 98% of samples with severe symptoms.

The results obtained showed that PVY has a strong systemic spread, while TMV causes more local reactions. Severe symptoms occur as a result of the suppression of the plant's RNA quenching mechanism by the HC-Pro protein of PVY. TMV, on the other hand, is often limited by the plant through a hypersensitivity reaction, which is manifested by necrosis. Although preliminary diagnosis can be made based on visual symptoms, confirmation by molecular methods is necessary to draw a final conclusion.

Conclusion

The results of the study showed that PVY and TMV viruses cause morphologically distinct symptoms in tomato and potato crops. PVY is characterized by severe systemic infection and high CI, while TMV is characterized by mainly local necrotic symptoms. These data are important for early detection of viral diseases in the field and the development of effective control measures.

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