USE OF BIOTECHNOLOGICAL METHODS IN ASSESSING THE DISEASE RESISTANCE OF GRAPE VARIETIES

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Annotation:
In this study, the resistance of local (Husayni, Toifi, Kattakurgan) and foreign (Moldova, Kardinal, Rizamat) grape varieties to the main diseases - oidium (Uncinula necator), mildiu (Plasmopara viticola) and gray rot (Botrytis cinerea) in the conditions of Uzbekistan was assessed using biotechnological methods. Along with traditional field observations, molecular markers (SSR, RAPD, SNP), in vitro experiments, and phytopathological tests were used. The obtained results showed that local varieties, despite their adaptability to climatic conditions, have a high degree of sensitivity, while foreign varieties have a higher degree of resistance. Molecular analysis confirmed the presence of genes **Run1** and **Rpv1** responsible for resistance in some varieties and hybrid forms. In vitro experiments were effective in determining the resistance of individual varieties to stress factors and their ability to regenerate. Disease resistance genes were recorded in 30-40% of hybrid forms obtained on the basis of crossing local and foreign varieties, of which 25-30% showed high resistance in practice. In addition, some hybrid samples showed superior results in terms of yield and fruit quality indicators. Based on the research results, it has been proven that biotechnological methods allow for a quick and reliable assessment of grape varieties for disease resistance, accelerate the breeding process two to three times, and play an important role in creating high-yielding, resistant varieties.

Keywords: Grape breeding, biotechnological methods, molecular marker, in vitro, disease resistance, oidium, mildiu, hybrid forms, Run1, Rpv1.

ENTRANCE

Grape (Vitis vinifera L.) has been one of the fruit crops that has played an important role in human life since ancient times. In the world, the area of vineyards is more than 7.3 million hectares, and more than 75 million tons of grapes are harvested annually. Uzbekistan is known in Central Asia as a major region of winemaking and viticulture. Despite the favorable climatic conditions of our country for viticulture, the widespread occurrence of various diseases in recent years has caused serious damage to yields and product quality. In particular, such dangerous diseases as oidium (Uncinula necator), mildiu (Plasmopara viticola), gray rot (Botrytis cinerea) are the main threat to grape cultivation. This increases the need to create disease-resistant varieties in grape breeding.

Traditional breeding methods, i.e., crossing different varieties and selecting the best forms based on agrobiological observations in subsequent generations, require a lot of time. With this approach, the level of disease resistance is often assessed depending on environmental conditions, which reduces the effectiveness of selection. Therefore, modern science **developing fast, reliable, and effective assessment methods** is an important task.

As a result of achievements in the field of biology and genetics in recent decades, **biotechnological methods** are widely used in grape breeding . Among these methods, molecular markers (SSR, RAPD, AFLP, SNP), tissue culture (in vitro), genetic-molecular analyses, and phytopathological tests are of particular importance. It became possible to identify disease resistance genes using molecular markers, test resistance to stress factors in vitro, and study resistance mechanisms through immunological tests.

Looking at world experience, large-scale research is being conducted in such countries as France, Italy, the USA, China, and Russia on the assessment of grape varieties using biotechnological methods. For example, it was noted that the use of molecular markers in the creation of varieties resistant to the disease Plasmopara viticola has accelerated the selection process by 2-3 times. By applying similar approaches in the conditions of Uzbekistan, along with preserving the gene pool of local grapes, the possibilities of creating new high-yielding and disease-resistant varieties will expand.

Although the grape varieties available in Uzbekistan have many positive characteristics, most of them are susceptible to diseases. Therefore, using foreign varieties as genetic material, crossing them with local varieties, and evaluating them using biotechnological methods serve to increase the effectiveness of selection. As a result of this process, **promising varieties with disease resistance genes** are isolated, and subsequently, there is an opportunity to introduce them on an industrial scale.

MAIN PART

In studies conducted in the conditions of Uzbekistan, the degree of disease resistance of local and foreign grape varieties was assessed based on biotechnological methods, and the results were compared with international experience. First of all, phytopathological observations showed that although local varieties are highly adapted to climatic conditions, they are distinguished by their sensitivity to dangerous diseases such as oidium, mildiu, and gray rot. For example, in the husayni and toyfi varieties, the degree of infection with oidium during the growing season was 40-45%, which can lead to a significant decrease in yield. Among foreign varieties, Moldova and Kardinal showed relatively high resistance, with a damage rate of 20-25%. These differences are explained by their genetic characteristics and adaptation mechanisms. As a result of genetic analysis using molecular markers, the presence of Run1 and Rpv1 genes responsible for disease resistance in some varieties was confirmed. Especially

in the Moldovan variety, the presence of the Run1 gene, which provides resistance to oidium, was determined using SSR markers, while in some hybrid forms, a combination of several resistance genes was noted. This circumstance makes it possible to use them in the breeding process as promising parental forms. Assessment using molecular markers was carried out much faster than traditional methods, which made it possible to accelerate the selection process by two to three times.

During the research, grape varieties were also studied under in vitro conditions. Stress resistance tests were conducted using tissue culture methods. In conditions such as high humidity, infection with fungal spores, and salt concentration, the regeneration ability of some varieties was observed to be high. For example, the Moldovan and Kardinal varieties showed the ability for rapid regeneration and active cell division under in vitro conditions, while the Husayni and Kattaqo'rg'on varieties showed slow regeneration. Such results show that in vitro methods are an effective tool for determining the mechanisms of resistance of grape varieties at the cellular level. The activity of antioxidant enzymes was especially high in resistant varieties, which increased their resistance to fungal attacks.

Among the hybrid forms obtained as a result of crossing local and foreign varieties, disease-resistant, high-yielding, and superior in quality indicators samples were selected. As a result of molecular genetic analysis, resistance genes to diseases were identified in 30-40% of hybrids, and when evaluated using phytopathological tests, 25-30% of these hybrids showed high resistance in practice. This made it possible to confirm the results obtained on the basis of molecular markers with practical observations. Some hybrid forms were distinguished not only by the level of disease resistance, but also by yield and quality indicators. For example, it was noted that in some hybrid samples, the yield increased by 15-20%, the sugar content in the fruits was 18-20%, and the shelf life was longer. This allows for the creation of disease-resistant varieties in viticulture, as well as the improvement of economically significant qualities.

When comparing the obtained results with international experience, many similarities were observed. For example, in studies conducted in France, Italy, and the USA, it was noted that the Moldovan variety shows high resistance to oidium and mildiu diseases, which coincides with the results of our research. This increases the reliability of our research. The low resistance of local varieties is explained by the limited genetic diversity. Therefore, the enrichment of the local gene pool and the creation of new genetic combinations through crossing with foreign varieties is an important stage of the breeding process.

However, due to the fact that many foreign varieties cannot fully adapt to local climatic conditions, a number of problems arise in their direct cultivation. Therefore, in hybrid forms, along with disease resistance, it is important to maintain the property of adaptability. These results show that for effective selection in viticulture, it is necessary to combine

biotechnological methods with traditional ones. Determination of resistance genes using molecular markers, assessment of stress resistance through in vitro experiments, and obtaining practical confirmation based on phytopathological tests accelerate the selection process and lay the foundation for the creation of new high-yielding varieties.

In general, the research results led to the following scientific and practical conclusions: it was established that local varieties have a high sensitivity to oidium and mildiu diseases, while foreign varieties have a relatively high level of resistance; the possibility of early detection of resistance genes using molecular markers accelerated the selection process; in vitro experiments were effective in determining the resistance characteristics of grape varieties at the cellular level; some hybrid forms obtained as a result of crossing were distinguished by high yield and resistance indicators; comparison with international studies confirmed the reliability of the results.

Thus, biotechnological methods have proven themselves as an important tool for accelerating the selection process, effectively supplementing traditional methods in assessing grape varieties for disease resistance. Based on the results obtained, the possibilities of creating new high-yielding, disease-resistant, and climate-resilient varieties in the conditions of Uzbekistan have expanded, which contributes to the sustainable development of the country's viticulture industry, increasing export potential, and ensuring food security.

CONCLUSION

The results of the conducted research showed that the use of biotechnological approaches in assessing the resistance of grape varieties to diseases, along with traditional observations and field experiments, significantly accelerates the selection process and increases its effectiveness. Although local varieties are highly adaptable to climatic conditions, they are distinguished by their sensitivity to dangerous diseases such as oidium, mildiu, and gray rot. In foreign varieties, the degree of resistance is relatively high, which increases their significance as a genetic resource.

As a result of the use of molecular markers, the presence of disease-resistant genes in some varieties and hybrid forms was revealed. This approach served to assess the genetic potential of varieties at an early stage, accelerating the selection process by 2-3 times. In vitro experiments showed that some varieties have high resistance to stress factors and regeneration abilities. The results of molecular analyses were practically confirmed using phytopathological tests.

Some of the hybrid forms obtained on the basis of crossing local and foreign varieties showed not only high resistance to diseases, but also superior results in terms of yield and fruit quality indicators. This expands the possibilities of creating export-oriented and economically efficient varieties with high economic importance in viticulture.

In conclusion, biotechnological methods are an integral part of grape breeding, with the help of which it is possible to create disease-resistant, high-yielding, and climate-resilient varieties. This approach serves as an important scientific and practical basis for modernizing the viticulture industry of Uzbekistan, increasing export potential, and ensuring food security.

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