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Optimizing the Application Date of Certain Antiviral Compounds to Control Watermelon Mosaic Virus in Squash

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Abstract

Squash plants are infected by the Watermelon mosaic virus WMV, which can cause severe losses in squash production. Traditional chemical control strategies do not lead to satisfactory outcomes. Thus, this study aimed to evaluate the efficiency of certain antiviral compounds (Quercetin, Acyclovir, and Chalcone) under greenhouse conditions to control WMV and to determine the best application date to maximize the efficiency of these chemicals to control WMV. In general, the early application of antiviral compounds resulted in grader reduction of WMV disease severity compared with the late application, as the disease severity was 30.2% and 42.67% for early and late applications, respectively, in the case of quercetin and 30.2% and 42.7% in the case of acyclovir and 30.2% and 39.5% for chalcone. Early applications also led to a significant increase in the total chlorophyll and carbohydrate contents and increased the plant height and fresh and dry weight of squash plants compared with untreated plants. These results prove that the application of certain antiviral compounds is an efficient method to control WMV, and as early as these antiviral compounds were applied, the efficiency of these antivirals was increased.

Keywords: *Acyclovir, Antiviral, Chalcone, Quercetin, Watermelon mosaic virus*

Introduction

Squash is a member of the family Cucurbits, which is considered one of the most important plant families of vegetable crops after solanaceae worldwide. In general, there are certain cucurbit vegetables that are important for consumers, including cucumber (*Cucumis sativus* L.), pumpkin (*Cucurbita maxima* Duchesne), squash (*Cucurbita pepo* L.), and gourd (*Lagenaria siceraria*). The estimated production of cucurbit (117.53) million metric tons in 2023, accounting for 13.8% of all the vegetables produced globally (FAO 2022).

Globally, cucurbits are infected by more than 90 different viruses (Radouane *et al.*, 2021 and Mulholland *et al.*, 2023), most of which are transmitted by aphids and whiteflies. Aphids can transmit viruses in a non-persistent manner from several families, including Potyviridae. Potyviridae is one of the largest families of +ssRNA plant viruses, capable of infecting various plants, including Watermelon mosaic virus

(WMV). WMV is one of the most common viruses affecting squash, significantly reducing its production worldwide. (Yeşil, 2021; Mulholland *et al.*, 2023; Rabadán *et al.*, 2023; López-Martín *et al.*, 2024) *Aphis craccivora*, *Aphis gossypii*, and *Myzus persicae* are the most common and efficient vectors capable of transmitting the virus in a non-persistent manner. (Lecoq and Desbiez, 2008). WMV causes various symptoms in squash, including yellowing, mosaic, and mottling on leaves, followed by deformation and size reduction. Consequently, WMV can lead to severe yield losses, affecting both the quantity and quality of squash production, either as a single infection or in combination with other viruses, compared with uninfected plants. (Koklu and Yilmaz, 2006).

The main challenge in managing viral diseases is that the only possibility is to prevent infection, as viruses have no cure. (Almasi and Almasi, 2018; Xiang *et al.*, 2020). Using pesticides to control these viruses is ineffective because they are transmitted in a non-persistent manner within minutes. Additionally, the use of pesticides has numerous negative environmental consequences; therefore, an alternative strategy is needed for virus control. Utilizing specific antiviral substances to combat plant viruses is a safe and effective approach to managing these pathogens and could serve as a viable substitute for conventional methods. (Mulholland *et al.*, 2023; Moya-Ruiz *et al.*, 2023; Lecoq and Desbiez, 2012; Lopez-Martin *et al.*, 2024; Sharma, 2023; Radouane *et al.*, 2021; Mahdi *et al.*, 2024 and Gadhave *et al.*, 2020)

Thus, this study aims to evaluate the application date of certain antiviral compounds for the reduction and control of Watermelon mosaic virus (WMV) under greenhouse conditions during the summer of 2023. This manuscript presents a new avenue for innovative antiviral therapeutics in crops, which may serve as a promising method for field application.

Materials and Methods

1. Source of the virus

Cucurbitaceae plant samples, including pumpkin (*Cucurbita maxima* Duchesne) and squash (*Cucurbita pepo* L.), were collected from the Experimental Farm of the Faculty of Agriculture, Assiut University, Assiut, Egypt, during the 2022 growing season. These samples showed viral-like symptoms resembling those of the watermelon mosaic virus (WMV), such as mosaic, yellowing, mottling, leaf deformation, and stunting.

2. Mechanical Inoculation.

At the seedling stage, one week after planting the *Cucurbita pepo* (HYTECH HYBRID SEED SQUASH) cultivar, mechanical inoculation was performed as previously described by Hashem *et al.* (2024).

3. Virus Identification.

WMV, which was used in this study, has been previously molecular identified by Farouk *et al.* (2024 a).

4. The tested chemicals to control WMV

To control Watermelon mosaic virus (WMV) in squash plants, we investigated the effectiveness of the application date for three potential antiviral compounds. These included Quercetin, a naturally derived compound, as well as two synthetic compounds: Acyclovir (2-amino-9-(2-hydroxyethoxy) methyl-1H-purin-6(9H)-one, $C_8H_{11}N_5O_3$) and Chalcone, synthesized from *p*-chlorophenol and benzaldehyde. (Farouk *et al.* 2024 b)

5. Assessment of the effect of the application date of Quercetin, Acyclovir, and Chalcone on squash plants infected with WMV under greenhouse conditions.

Quercetin, Acyclovir, and Chalcone achieved an inhibition rate against WMV in squash plants (Farouk *et al.* 2024 b). The application dates were tested at 2 and 9 days post-inoculation as early and late applications, respectively. The concentrations of all compounds were 100, 200, and 500 ppm, respectively. Squash plants at the cotyledon stage were mechanically inoculated as described by Hashem *et al.* (2024), and the compounds were sprayed separately on the plants at 2 and 9 days post-inoculation.

6. Measurements

- Disease severity (%)

Data were recorded three and six weeks after mechanical inoculation based on the symptom severity index, following the rating scale for WMV as described by Abdalla *et al.* (2017).

- Determination of physiological changes in squash plants, as disease assessment.

- Total chlorophyll

The total chlorophyll content was assessed six weeks after inoculation using the SPAD-502 Plus chlorophyll meter, manufactured in Japan. The SPAD chlorophyll meter provides a quick method for estimating the total chlorophyll content, as demonstrated in previous studies by Khadka *et al.*, (2020).

- Total carbohydrate

The anthrone-sulfuric acid method was employed to quantify the total carbohydrate content six weeks after inoculation, demonstrating remarkable efficiency in carbohydrate estimation, as validated by prior studies (Hansen and Moller, 1975).

- Assessment of the height of squash plants.

Plant height was recorded in centimetres for each individual plant six weeks after mechanical inoculation with WMV. (Farouk *et al.* 2024 b)

- Assessment of the fresh and dry weight of squash plants.

Fresh weight was recorded six weeks after mechanical inoculation, while dry weight was measured after the plants were dried under solar rays, expressed in grams per plant. (Farouk *et al.* 2024 b)

7. Experimental site and soil type

The experiment was conducted in a greenhouse at the Faculty of Agriculture, Assiut University, during the summer of 2023. The soil used was a clay-loamy to sandy mixture in a 3:1 ratio, placed in pots measuring 30 cm in diameter.

8. Statistical analysis

The experiment was designed using a randomized complete block design (RCBD). Statistical analysis was conducted with the COSTAT software (CoHort Software, 2006; Birmingham, UK), based on a two-way ANOVA test. All data were analyzed using the two-way randomized block methodology, followed by mean comparison to generate the least significant difference (LSD) at $P \leq 0.05$.

Results

Assessment of the effect of the application date of Quercetin, Acyclovir, and Chalcone on squash plants infected with WMV under greenhouse conditions.

Results in Table 1 show that the application date significantly influenced the effectiveness of certain antiviral compounds (Quercetin, Acyclovir, and Chalcone) in reducing the severity of Watermelon mosaic virus (WMV) infection in squash plants under greenhouse conditions, 3 weeks after inoculation.

In general, the early application of antiviral compounds resulted in a greater reduction in the severity of WMV compared with the late application across all tested antiviral compounds (Quercetin, Acyclovir, and Chalcone).

The disease severity was 30.2% and 41.67% for the early and late application of Quercetin, respectively. Similarly, it was 30.2% and 42.7% for acyclovir and 30.2% and 39.5% for Chalcone.

Table 1. Effect of application date on the efficiency of certain antiviral compounds to reduce Disease severity (Three Weeks After Inoculation) of WMV.

Disease Severity: Three Weeks after Inoculation									
Sub. Conc.	Quercetin			Acyclovir			Chalcone		
	Date of the application			Date of the application			Date of the application		
	Early	Late	Mean	Early	Late	Mean	Early	Late	Mean
100	20.83	37.5	29.16	28.83	33.33	31.08	20.83	33.33	27.08
200	20.83	41.67	31.25	28.83	45.83	37.33	20.83	41.67	31.25
500	20.83	41.67	31.25	33.33	45.83	39.58	33.33	37.5	35.41
0 (control)	45.83	45.83	45.83	45.83	45.83	45.83	45.83	45.83	45.83
Mean	30.2	41.67		30.2	42.7		30.2	39.5	
L.S.D									
Substance (S)		6.48			6.03			6.08	
Concentration (C)		9.17			8.52			8.61	
S × C		12.97			12.08			12.17	

L.S.D least significant difference at $P \leq 0.05$ by ANOVA.

The concentration also significantly influenced the effectiveness of these antiviral compounds in controlling WMV. In general, the optimal concentration for reducing disease severity was 100 ppm, followed by 200 ppm and 500 ppm. The disease severity

was approximately 29.16%, 30.25%, and 37.5% for Quercetin; 17.08%, 33.33%, and 39.58% for Acyclovir; and 27.08%, 31.25%, and 35.41% for Chalcone.

Results in Table 2 show that the application date did not significantly impact the effectiveness of certain antiviral compounds (Quercetin, Acyclovir, and Chalcone) in reducing the severity of Watermelon mosaic virus (WMV) infection in squash plants under greenhouse conditions six weeks after inoculation.

The disease severity was 61.45% and 62.62% for the early and late application of Quercetin, respectively. Similarly, it was 68.75% and 69.79% for Acyclovir, and 69.79% and 75% for Chalcone.

The most effective concentration for reducing disease severity was 100 ppm, followed by 200 ppm, and then 500 ppm. The disease severity was 54.16%, 58.33%, and 66.67% for Quercetin; 62.5%, 66.67%, and 72.91% for Acyclovir; and 68.75%, 70.83%, and 75% for Chalcone.

Table 2. Effect of application date on the efficiency of certain antiviral compounds to reduce Disease severity (Six Weeks After Inoculation) of WMV.

Disease Severity: Six Weeks After Inoculation									
Sub. Conc.	Quercetin			Acyclovir			Chalcone		
	Date of the application			Date of the application			Date of the application		
	Early	Late	Mean	Early	Late	Mean	Early	Late	Mean
100	50	58.33	54.16	62.5	62.5	62.5	66.67	70.83	68.75
200	54.16	62.5	58.33	66.67	66.67	66.67	66.67	75	70.83
500	66.67	66.67	66.67	70.83	75	72.91	70.83	79.15	75
0 (control)	75	75	75	75	75	75	75	75	75
Mean	61.45	62.62		68.75	69.79		69.79	75	
L.S.D									
Substance (S)		10.78			7.69			7.01	
Concentration (C)		15.24			10.87			9.91	
S × C		21.56			15.38			14.02	

L.S.D least significant difference at $P \leq 0.05$ by ANOVA.

Results in Table 3 show that the application date did not significantly impact the effectiveness of certain antiviral compounds (Quercetin, Acyclovir, and Chalcone) in increasing the chlorophyll content in zucchini plants infected with Watermelon mosaic virus (WMV) under greenhouse conditions.

The chlorophyll content was approximately 31.49 and 30.91 SPAD readings per plant for the early and late applications of Quercetin, respectively. For Acyclovir, the values were 26.19 and 25.53 SPAD readings per plant, while for Chalcone, they were 28.54 and 27.62 SPAD readings per plant.

The most effective concentration for increasing the chlorophyll content was 100 ppm, followed by 200 ppm and 500 ppm. The chlorophyll content was 37.93, 33.77, and 30.12 SPAD readings per plant for Quercetin; 29.33, 26.98, and 24.98 SPAD readings per plant for Acyclovir; and 31.86, 31.1, and 27.05 SPAD readings per plant for Chalcone.

Table 3. Effect of application date on the efficiency of certain antiviral compounds to increase chlorophyll content after infection with WMV.

Chlorophyll contents									
Sub.	Quercetin			Acyclovir			Chalcone		
	Date of the application			Date of the application			Date of the application		
Conc.	Early	Late	Mean	Early	Late	Mean	Early	Late	Mean
100	37.31	38.55	37.93	32.54	26.13	29.33	36.43	27.28	31.86
200	33.81	33.73	33.77	27.34	26.63	26.98	29.69	32.51	31.1
500	31.87	28.37	30.12	23.23	26.4	24.81	26.38	27.72	27.05
0 (control)	22.97	22.97	22.97	21.64	22.97	22.31	21.64	22.97	22.31
Mean	31.49	30.91		26.19	25.53		28.54	27.62	
L.S.D									
Substance (S)		2.14			3.94			4	
Concentration (C)		3.03			5.58			6	
S × C		4.29			7.89			6.99	

L.S.D least significant difference at $P \leq 0.05$ by ANOVA.

Results in Table 4 show that the application date significantly influenced the effectiveness of Quercetin and Chalcone in increasing the carbohydrate content in zucchini plants infected with Watermelon Mosaic Virus (WMV) under greenhouse conditions.

The carbohydrate content was 4.72%/plant and 4.18%/plant for the early and late applications of Quercetin, respectively, while for Chalcone, the values were 3.71 %/plant and 3.02 %/plant.

The most effective concentration for increasing the carbohydrate content was 100 ppm, followed by 200 ppm and 500 ppm for Quercetin, with corresponding carbohydrate contents of 6.04 %/plant, 5.93 %/plant, and 3.61 %/plant.

For Acyclovir and Chalcone, the optimal concentration was 200 ppm, followed by 500 ppm and 100 ppm. The carbohydrate content measured 3.09 %/plant, 2.87 %/plant, and 2.7%/plant for acyclovir, while for Chalcone, it was 3.91 %/plant, 3.85 %/plant, and 3.49 %/plant, respectively.

Table 4. Effect of application date on the efficiency of certain antiviral compounds to increase carbohydrate content after infection with WMV.

Carbohydrate contents									
Sub.	Quercetin			Acyclovir			Chalcone		
	Date of the application			Date of the application			Date of the application		
Conc.	Early	Late	Mean	Early	Late	Mean	Early	Late	Mean
100	8.234	3.85	6.042	2.542	2.868	2.704	4.728	2.256	3.492
200	4.512	7.35	5.93	2.72	3.454	3.092	3.97	3.858	3.914
500	3.914	3.312	3.612	2.544	3.208	2.876	3.944	3.772	3.858
0 (control)	2.224	2.224	2.224	2.224	2.224	2.224	2.224	2.224	2.22
Mean	4.722	4.184		2.51	2.938		3.716	3.028	
L.S.D									
Substance (S)		0.41			0.44			0.49	
Concentration (C)		0.58			0.62			0.7	
S × C		0.82			0.88			0.1	

L.S.D least significant difference at $P \leq 0.05$ by ANOVA.

Results in Table 5 show that the application date significantly influenced the effectiveness of Quercetin in increasing the height of zucchini plants infected with Watermelon mosaic virus (WMV) under greenhouse conditions.

The plant height was 30.41 cm/plant and 26.91 cm/plant for the early and late applications of Quercetin, respectively.

The most effective concentrations for increasing plant height were 100 ppm and 200 ppm, followed by 500 ppm. The height measured 34.16 cm/plant, 31.33 cm/plant, and 27.5 cm/plant for Quercetin; 32.83 cm/plant, 28.33 cm/plant, and 28.16 cm/plant for Acyclovir; and 29 cm/plant, 26.33 cm/plant, and 26 cm/plant for Chalcone.

Table 5. Effect of application date on the efficiency of certain antiviral compounds to increase Height after infection with WMV.

Sub.	Height								
	Quercetin			Acyclovir			Chalcone		
	Date of the application			Date of the application			Date of the application		
Conc.	Early	Late	Mean	Early	Late	Mean	Early	Late	Mean
100	36.67	31.67	34.16	34	31.67	32.83	28.67	29.33	29
200	35.33	27.33	31.33	28	28.67	28.33	24.67	28	26.33
500	28	27	27.5	27	29.33	28.16	24	28	26
0 (control)	21.67	21.67	21.67	21.67	21.67	21.67	21.67	21.67	21.67
Mean	30.41	26.91		27.67	27.83		24.75	26.75	
L.S.D									
Substance (S)		2.33			2.04			2.18	
Concentration (C)		3.3			2.89			3.08	
S × C		4.67			4.09			4.36	

L.S.D least significant difference at $P \leq 0.05$ by ANOVA.

Results in Table 6 show that the application date significantly influenced the effectiveness of Quercetin in increasing the fresh weight of squash plants infected with Watermelon mosaic virus (WMV) under greenhouse conditions.

The fresh weight was 50.5 g/plant and 30.75 g/plant for the early and late applications of Quercetin, respectively.

The most effective concentration for increasing the fresh weight was 100 ppm, followed by 200 ppm and 500 ppm for Quercetin and Acyclovir. The fresh weight measured 43.56 g/plant, 34.16 g/plant, and 29.33 g/plant for quercetin and 40.5 g/plant, 30.16 g/plant, and 28.83 g/plant for Acyclovir.

For Chalcone, the optimal concentration was 200 ppm, followed by 100 ppm and 500 ppm, with fresh weights of 27 g/plant, 25.33 g/plant, and 19.67 g/plant, respectively.

Table 6. Effect of application date on the efficiency of certain antiviral compounds to increase Fresh weight after infection with WMV.

Sub.	fresh weight								
	Quercetin			Acyclovir			Chalcone		
	Date of the application			Date of the application			Date of the application		
Conc.	Early	Late	Mean	Early	Late	Mean	Early	Late	Mean
100	35.67	51.67	43.56	49.33	31.67	40.5	26.33	24.33	25.33
200	38	30.33	34.16	30	30.33	30.16	25.33	28.67	27
500	33	25.67	29.33	26.33	31.33	28.83	23	16.33	19.67
0 (control)	15.33	15.33	15.33	15.33	15.33	15.33	15.33	15.33	15.33
Mean	50.5	30.75		30.25	27.16		22.5	21.16	
L.S.D									
Substance (S)		4.05			4.17			3.35	
Concentration (C)		5.73			5.9			4.74	
S × C		8.11			8.34			6.71	

L.S.D least significant difference at $P \leq 0.05$ by ANOVA.

Results in Table 7 show that the application date significantly influenced the effectiveness of Acyclovir in increasing the dry weight of zucchini plants infected with Watermelon mosaic virus (WMV) under greenhouse conditions.

The dry weight was 5.33 g/plant and 4.04 g/plant for the early and late applications of Acyclovir, respectively.

The most effective concentration for increasing the dry weight was 200 ppm, followed by 100 ppm and 500 ppm for Quercetin, with corresponding dry weights of 7.33 g/plant, 7 g/plant, and 4.33 g/plant. For Acyclovir, the optimal concentration was 100 ppm, followed by 500 ppm and 200 ppm, with dry weights of 5.5 g/plant, 5.5 g/plant, and 5.16 g/plant, respectively. For Chalcone, the most effective concentration was 100 ppm, followed by 200 ppm and 500 ppm, with dry weights of 3.5 g/plant, 2.83 g/plant, and 2.33 g/plant, respectively.

Table 7. Effect of application date on the efficiency of certain antiviral compounds to increase Dry weight after infection with WMV.

Sub.	Dry weight								
	Quercetin			Acyclovir			Chalcone		
	Date of the application			Date of the application			Date of the application		
Conc.	Early	Late	Mean	Early	Late	Mean	Early	Late	Mean
100	7	6.33	7	6.33	4.67	5.5	4	3	3.5
200	6.33	7.67	7.33	5.67	4.67	5.16	2.33	3.33	2.83
500	6	4	4.33	6.67	4.33	5.5	2.33	2.33	2.33
0 (control)	2.33	2.33	2.67	2.67	2.67	2.67	2.67	2.67	2.67
Mean	5.33	5.33		5.33	4.08		2.83	2.83	
L.S.D									
Substance (S)		1.72			1.17			0.67	
Concentration (C)		2.44			1.66			0.98	
S × C		3.45			2.35			1.35	

L.S.D least significant difference at $P \leq 0.05$ by ANOVA.

Discussion

Viral infections in plants pose a serious challenge to sustainable and economically valuable crops across the globe, leading to considerable financial losses annually (Moraru *et al.*, 2018). Managing or eliminating virus infections in plants is particularly difficult because of the complex and constantly changing nature of virus outbreaks, coupled with the rapid evolution of viral strains (Elena *et al.*, 2014).

Due to their transmission by aphids in a non-persistent manner, which allows rapid spread, innovative approaches for enhancing viral resistance using biotic and abiotic inducers have been introduced to offer a straightforward and durable solution. In agriculture, two primary strategies are employed for disease management: preventive measures to curb virus transmission and immunization techniques aimed at developing virus-resistant plant varieties. (Matthews and Hull, 2002; Murphy and Dane, 2009; Ghosh and Biswas, 2018; Rolnik and Olas, 2020 and Shrestha *et al.* 2021).

A promising strategy for combating these infections is the use of antiviral compounds, which help suppress virus replication and minimize crop damage (Chen *et al.*, 2019 and Liu *et al.*, 2019 and Farouk *et al.*, 2024 b). Many substances of both natural and synthetic origin have been studied for their inhibitory effects against phytopathogenic viruses. However, none have demonstrated a satisfactory selective action that would allow their use for the specific prophylaxis and treatment of plant viral diseases (Hosseini *et al.*, 2007).

In this study, the timing of application for the potential activity of three compounds—Quercetin, Acyclovir, and Chalcone—was evaluated against WMV infection to assess their ability to protect squash plants under greenhouse conditions.

The results of the current experiment revealed a significant difference in the effectiveness of the date of application of these compounds in reducing viral infection. However, none of the tested compounds achieved complete inhibition of the virus in this experiment.

In general, the early application of Quercetin proved to be the most effective inhibitor of WMV, followed by Acyclovir and Chalcone. The best concentrations were 100 ppm and 200 ppm, with 500 ppm being less effective. These results align with previous findings, which indicate that antiviral compounds are an effective method for controlling plant viruses. (Krcatović *et al.*, 2008; Panattoni *et al.*, 2011; Yang *et al.*, 2012 and Mao *et al.*, 2024) The use of antiviral compounds has proven to be an effective method for controlling many viral diseases (Liu *et al.*, 2019).

Carbohydrate and chlorophyll contents were measured in squash plants six weeks after infection with WMV. The results of the experiment showed that the application of these compounds led to variations in the carbohydrate and chlorophyll content compared to the control. In general, the early application of Quercetin was the most effective compound, resulting in the highest increase in the total carbohydrate and chlorophyll content. These findings are partially in agreement with previous studies by Técsi *et al.* (1994), Srivastava and Tiwari (1998), and Radwan *et al.* (2007), which suggest that viral infection can significantly impact the carbohydrate and chlorophyll contents in plants.

Height, fresh weight, and dry weight were also measured in squash plants six weeks after infection with WMV. The results of the experiment showed that the application of these compounds led to variations in height, fresh weight, and dry weight compared with the control. early application of Quercetin was the most effective compound, resulting in the highest increase in height, fresh weight, and dry weight. Furthermore, the findings of this study align with previous research suggesting that viral infection can significantly impact the physiological characteristics of infected plants (Tecsi *et al.*, 1994; Srivastava and Tiwari, 1998 and Radwan *et al.*, 2007 Kaur *et al.*, 2021).

This study concluded that the early application of antiviral compounds, particularly Quercetin, may help reduce the severity of viral infections. However, the use of antiviral compounds is still under investigation as a primary method for large-scale application, like to pesticides. Nonetheless, this approach alone is insufficient to completely control these viruses, and it should be implemented alongside other management strategies. Therefore, this study recommends an integrated strategy for managing plant viruses that infect squash plants, with the early application of Quercetin as a key component of this strategy.

Conclusion

In summary, the findings of this study demonstrate that Quercetin, Acyclovir, and Chalcone possess the potential to mitigate the severity of Watermelon mosaic virus (WMV) infection and enhance physiological characteristics of the plant, thereby boosting its productivity. These results underscore the importance of incorporating these compounds into integrated pest management strategies, contingent upon further field-based research to optimize their application and promote environmentally sustainable alternatives to conventional chemical pesticides.

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تحديد ميعاد المعاملة الأمثل ببعض المركبات المثبطة للفيروسات من أجل مكافحة فيروس تبرقش البطيخ في الكوسة

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الملخص

تصاب نباتات الكوسة بفيروس تبرقش البطيخ (WMV)، الذي يؤدي إلى خسائر ضخمة في إنتاج الكوسة. لا يؤدي استخدام استراتيجيات مكافحة الكيمائية التقليدية إلى نتائج مرضية، لذلك هدفت هذه الدراسة إلى تقييم كفاءة بعض المركبات المضادة للفيروسات (كيرسيتين، أسيكوفير، وتشالكون) تحت ظروف الصوبة لمكافحة WMV، وتحديد أفضل موعد للتطبيق لزيادة كفاءة هذه المركبات لمكافحة فيروس تبرقش البطيخ. بشكل عام، التطبيق المبكر بالمركبات المثبطة للفيروسات أدى إلى انخفاض أكبر في شدة المرض مقارنة بالتطبيق المتأخر، حيث كانت شدة المرض 30.2%، 42.67% للتطبيقات المبكرة والمتأخرة على التوالي في حالة الكيرسيتين، 30.2%، 42.7% في حالة الأسيكوفير، 30.2%، 39.5% بالنسبة لتشالكون. والتطبيق المبكر أدى أيضا إلى زيادة معنوية في محتوى النبات الكلى من الكلوروفيل والكربوهيدرات، وكذلك أدت إلى زيادة في طول النباتات والوزن الطازج والجاف للنباتات مقارنة بالنباتات غير المعاملة، هذه النتائج أثبتت أن استخدام بعض المركبات المضادة للفيروسات هي طريقة فعالة لمكافحة فيروس تبرقش البطيخ WMV، وكلما كان تطبيق هذه المركبات في وقت مبكر، كلما زادت فعاليتها في مكافحة الفيروس.

الكلمات المفتاحية: المواد المثبطة للفيروس، الكيرسيتين، الاسيكوفير، تشالكون، فيروس تبرقش البطيخ