



Effect of Fungicides and Plant Extracts in the Management of Foliar, Twig and Fruit Diseases of Citrus (*Citrus limon*)

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Abstract

A research work was conducted on citrus plants raised at GPC, of Fruit Tree Improvement Project (FTIP) at Horticulture Farm, Bangladesh Agricultural University, Mymensingh, to investigate the effect of fungicides and plant extracts in controlling the scab, die-back and canker. Three fungicides viz. Cupravit 50 wp (0.4%), Dithane M-45 (0.3%), Rovral 50 WP (0.2%) and extracts of 3 plants viz. Neem (*Azadirachta indica*), Ginger (*Zingiber officinale*) and Garlic (*Allium sativum*) were applied for controlling the citrus (*C. limon*) diseases (scab, die-back and canker). All the fungicides showed significant effect in the control of the above mentioned citrus diseases. The highest reduction of the scab, die-back and canker diseases was recorded applying Rovral 50 WP. Neem leaf extract was the most effective in controlling canker of leaf and fruit. Garlic extract and Neem leaf extract were the most effective in controlling die-back of twig and branches of citrus, respectively. From the above results it can be concluded that Rovral 50 WP is the most effective chemical for controlling all citrus (*C. limon*) diseases and citrus canker can successfully be controlled specially by Neem leaf and garlic extract.

Key words: Foliar, Fungicides, Plant Extract, Twig and Fruit diseases of citrus

Introduction

Citrus (*Citrus limon*) is one of the important fruit crops in Bangladesh producing only 15 metric tons citrus fruits per year (BBS, 2003). There are various factors which adversely affect the cultivation of citrus, among them diseases play an important and vital role. More than 100 diseases are known to occur on different species of citrus (Klotz, 1973). Among them scab, die-back and canker are serious. Citrus scab caused by *Elsinoe fawcettii* is the most serious disease in citrus which formerly known as sour orange scab and is cosmopolitan in humid citrus areas. Die-back is also one of the most important diseases of citrus plant which is caused by *Colletotrichum gloeosporioides*. The disease breaks out widely and has become a limiting factor of citrus cultivation.

From a survey report made by Miah and Fakir (1987) in Bangladesh showed that prevalence of die back on Elachi lemon and Kagzi lime was 89.9% and 100%, respectively. There are distinct forms of citrus canker disease caused by various pathovars and variants of the bacterium *Xanthomonas campestris* pv. *citri*. The Asiatic form of canker (canker A) caused by *X. campestris* pv. *citri* is the most widespread and severe form of this disease.

Scab, die-back and canker are the greatest limiting factors for production of citrus in our country. So, there is a great need to develop proper management practices of these diseases.

Like other diseases, the management of citrus diseases can also be done using different fungicides such as, Cupravit 50 WP, Dithane M-45 and Rovral 50 WP, Tilt 250 EC, Bavistin, and Bordeaux mixture etc. Besides, plant extracts can also be used for control citrus diseases like Neem leaf extract, Ginger extract, Garlic extract, Onion extract, Lemon grass and clove tree etc.

Present study was undertaken to find out the efficacy of fungicides and plant extracts with the objective of finding out the effects of some fungicides and plant extracts on the management of scab, die-back and canker of citrus (*C. limon*).

Materials and Methods

Experimental site

The experiment was conducted in the citrus section at Germ Plasm Center (GPC) of Fruit Tree Improvement Project (FTIP) at Horticulture Farm, Bangladesh Agricultural University, Mymensingh. The soil belongs to the old Brahmaputra Flood Plain and falls under Sonatola series. The texture of the soil of the experiment area was clay-loam (Biswas *et al.*, 1979).

Design of experiment

The experiment was laid out in Randomized Complete Block Design (RCBD) with 4 replications.

Four plants were selected for each treatment. One plant was used as one replication.

Treatments

There were 7 different treatments which were as follows:

T₀ = Control (Tap water)

T₁ = Cupravit 50 wp (0.4%)

T₂ = Dithane M-45 (0.3%)

T₃ = Rovral 50 wp (0.2%)

T₄ = Neem leaf extract (1:4 dilution)

T₅ = Ginger extract (1:4 dilution)

T₆ = Garlic extract (1:4 dilution)

Preparation of spray solution

Fungicides

The fungicidal solutions were prepared by mixing with definite amount of fungicides with tap water. Details of the fungicides used as spray materials are given in Table 1.

Table 1. Specification of the fungicides

Common name	Chemical name	Active ingredient	Dose used (%)
Cupravit 50 wp	Copper oxychloride+50% copper 3Cu (OH) ₂ -CuCl ₂	50wp	0.4%
Dithane M-45	Manganous ethylene bisdithiocarbamate + Zn	Dithiocarbamate (80%)	0.3%
Rovral 50 wp	I-Isopropyl carbamoyl-3- (3-5 dichlorophynyl hydantion	Iprodione (50%)	0.2%

Plant extract

The plant extracts were prepared with the help of Blender. Requisite amount of plant materials were dissolved in required amount of sterilized water to make

the solutions in different concentrations. The crushed materials were filtered through cheese cloth to get the fine spray solution. The specifications of the plant extract is shown in Table 2.

Table 2. Specification of the plant extracts

Common name	Botanical name	Plant parts used	Dose used (ration)
Neem	<i>Azadirachta indica</i>	Leaf	1:4
Ginger	<i>Zingiber officinale</i>	Rhizome	1:4
Garlic	<i>Allium sativum</i>	Clove	1:4

Application of spray solution

All fungicides and plant extracts were sprayed with compressed hand sprayer. Four plants were sprayed with each fungicides and plant extracts. First spray was done in 8 August, 2003. The plants were sprayed 3 times at 15 days intervals. Required amount of spray solution per plant including branches, twigs, leaves and fruits were sprayed. Control plant was sprayed with water.

Disease symptoms observed in the orchard

The plants were observed regularly from the time of spray. Time of symptom appearance was recorded. Symptoms of the scab, die-back and canker observed in the orchard were recorded and photographed.

Isolation of fungal pathogen

Infected leaves and twigs were collected for isolation of the fungi. One (1) cm in length stem piece was cut out from all the twigs, for isolation. Four pieces of inocula approximately 10 mm in length and 1.5-2.5 mm width were cut out of the infected portion of the twigs. The inocula were surface sterilized in chlorox (10%) solution for 45 seconds and washed thrice in sterile water. The inocula were then placed on acidified Potato Dextrose Agar (PDA) medium in 9 cm petridishes aseptically. After planting, the petridishes containing the inocula were incubated at room temperature (26°C±2°C) under 12 hours light alternating with 12 hours dark. The plates were incubated for 7 days.

Identification of fungal isolates

Fungi growing out of the inocula were transferred to fresh PDA plates. The fungal isolates were then sub cultured on 2% water agar and purified by hyphal tip culture method.

Pathogenicity test of isolated fungi

Pathogenicity test of isolated fungi was done in the laboratory.

Isolation and identification of bacterial pathogen (*Xanthomonas campestris P.v. citri*) by nutrient agar (NA) medium

Citrus leaves having canker spots were collected, preserved after washing in tap water. On the following day, the infected portion of the leaves were cut into small pieces and placed in petridish containing a drop of sterile water. From the final dilution, one loopful of bacterial suspension was streaked out with a wire loop on the sterilized nutrient agar (NA). Then the plate was incubated in room temperature.

Results

Isolation and identification of fungi (*Colletotrichum gloeosporioides*)

The inocula were prepared from the diseased twigs. Fungal coloni observed on PDA media. Sub culture of the fungi made on PDA for purification. When the culture was old, then the slides were prepared and the fungi were preliminary identified.

Pathogenicity test of isolated fungi (*Colletotrichum gloeosporioides*)

Isolated fungi (*Colletotrichum gloeosporioides*) obtained from citrus (*Citrus limori*) was capable of causing infection to the species of citrus. Die- back symptom was produced on the twigs by artificial inoculation. *Colletotrichum gloeosporioides* was more pathogenic to citrus (*C. limori*).

Isolation of bacteria (*Xanthomonas campestris pv. citri*) from citrus (*C. limon*) leaves

The bacteria isolated from leaves were categorized by Gi bacterial group. Gi group produced yellowish colony on nutrient agar media.

Total number of leaves branch⁻¹

There were no significant variation among the different fungicides and plant extracts over control in consideration of number of leaves branch⁻¹. The number of healthy leaves per plant varied from 217.50 to 154.50 (Table 3). The highest number of leaves (217.50) was recorded in T₀ treatment i.e. no fungicides or plant

extracts were applied which was closely followed by the T₂ treatment where Dithane M-45 was applied. On the other hand, the lowest number of leaves were found in the treatment T₄ (Neem leaf extract). The result indicated that different treatments influenced the average number of leaves but there were no statistically significant differences.

Total number of Scab infected leaves branch⁻¹

Scab infected leaves/ branch of citrus (*C. limori*) showed significant differences in respect of different fungicides and plant extracts over control in the management of foliar infection. The highest scab

infected leaves (8.09%) were observed in control condition where no fungicides or plant extracts were applied (Table 3). On the other hand, the lowest scab infected leaves (0.27%) were recorded in T₅ (Ginger extract). Among the fungicides, highest scab infected leaves (6.36%) were found in Cupravit 50 WP (T₁ treatment) and the lowest (1.35%) was recorded in T₃ treatment (Rovral 50 WP). On the other hand among the plant extracts, application of Neem leaf extract and Garlic extract performed similar (3.25%) activating in controlling scab.

Table 3. Effect of fungicides and plants extracts in the management of scab disease of leaf in citrus (*C. limoti*)

Treatments	Number of leaf per branch	Scab infected leaf per branch	
		Number	Percent (%)
T ₀ (Control)	217.50	17.50	8.09a
T ₁ (Cupravit 50 WP)	165.00	10.00	6.36b
T ₂ (Dithane M-45)	189.25	6.50	3.44c
T ₃ (Rovral 50 WP)	167.00	2.25	1.35d
T ₄ (Neem leaf extract)	154.50	5.25	3.53c
T ₅ (Ginger extract)	183.75	0.50	0.27cd
T ₆ (Garlic extract)	169.00	5.25	3.25c
Level of significance	NS	—	**
LSD (0.05)	—	—	1.559
CV (%)	15.75	—	17.94

Total number of canker infected leaves branch⁻¹

Significant variation was observed in consideration of canker infected leaves/branch of citrus (*C. limori*) in respect of different fungicides and plant extracts over control. The highest canker infected leaves (4.63%) were recorded in T₆ treatment where Garlic extract was applied (Table 4). On the other hand, the lowest canker infected leaves (1.21%) were recorded in T₃ treatment (Rovral 50 WP). Among the fungicides, lowest canker infected leaves (1.21%) were observed in Rovral 50 WP. On the other hand among the plant extracts, lowest canker infected leaves were recorded in Neem leaf extract.

Total number of branches plant⁻¹

Among the different fungicides and plant extracts over control in consideration of number of branches plant⁻¹ in the management of foliar, twig and fruit diseases of citrus there were significant variation. The highest number of branches (6.25) was recorded in T₄ treatment i.e. where Neem leaf extract was applied which was closely followed by the T₅ treatment (5.75) where Ginger extract was applied (Table 5). On the other hand, the lowest number of branches (4.25) was recorded in the treatment T₀ which was closely followed by T₁ (Cupravit 50 WP) treatment.

Total number of die-back infected branches plant⁻¹

A significant variation observed among the different fungicides and plant extracts over control in consideration of die-back infected branches plant⁻¹. The

number of die-back infected branches plant⁻¹ varied from 19.17% to 78.75% (Table 5). The highest number of die-back infected branches (78.75%) recorded in T₀ treatment i.e. no fungicides or plant extracts were applied which was closely followed by the T₄ treatment (44.05%) where Neem leaf extract was applied. On the other hand, the lowest die-back infected branches (19.17%) were recorded in the treatment T₆ (Garlic extract) which was statistically identical with T₃ treatment where Rovral 50 WP was applied. Among the plant extract, highest die-back infected branches (44.05%) recorded in T₄ treatment where Neem leaf extract was applied for controlling die-back of citrus.

Table 4. Effect of fungicides and plants extracts in the management of canker disease of leaf in citrus (*C. limori*)

Treatments	Number of leaf per branch	Canker infected leaf per branch	
		Number	Percent (%)
T ₀ (Control)	217.50	4.50	2.08bc
T ₁ (Cupravit 50 WP)	165.00	3.50	2.19bc
T ₂ (Dithane M-45)	189.25	5.75	3.04b
T ₃ (Rovral 50 WP)	167.00	2.00	1.21c
T ₄ (Neem leaf extract)	154.50	3.25	2.18bc
T ₅ (Ginger extract)	183.75	5.00	2.73b
T ₆ (Garlic extract)	169.00	7.25	4.63a
Tevel of significance	NS	—	**
LSD (0.05)	—	—	1.091
CV (%)	15.75	—	8.46

Total number of canker infected branches plant⁻¹

A significant variation observed for canker infected branches/plant of citrus (*C. limori*) in the management of foliar, twig and fruit diseases with different fungicides and plant extracts over control. The highest canker infected branch (49.17%) recorded in T₀ treatments where no fungicide or plant extracts were applied (Table 6) which was statistically similar (35.42%) with Cupravit 50 WP. On the other hand, no canker infected branches recorded in the other treatments.

Total number of twigs branch⁻¹

No significant variation among the different fungicides and plant extracts over control in consideration of number of twigs branch⁻¹. The highest number of twigs (13.00) was recorded in T₃ treatment (Rovral 50 WP) which was closely followed by the T₀ (Dithane M-45) treatment was applied (Table 7). The lowest number of twigs were found in the T₀ treatment i.e. no fungicides

and plant extracts were applied. The result indicated that different treatments influenced the average number of leaves but there were no statistically significant differences.

Total number of die-back infected twigs branch⁻¹

A significant variation was observed among the different fungicides and plant extracts over control in consideration of die-back infected twigs branch⁻¹. The number of die-back infected twigs branch⁻¹ varied from 8.23% to 48.34% (Table7). The highest number of die-back infected twigs (48.34%) was recorded in T₀ treatment i.e. no fungicides or plant extracts were applied which was closely followed by the T₄ treatment (29.94%) where Neem leaf extract was applied. On the other hand, the lowest die-back infected twigs (8.23%) was recorded in the treatment T₃ (Rovral 50 WP). Among the plant extract, lowest die-back infected twigs (12.53%) recorded in T₆ treatment where Garlic extract was applied for controlling die-back.

Table 5. Effect of fungicides and plants extracts in the management of die-back disease of branch in citrus (*C. limori*)

Treatments	Number of branch per plant	Die-back infected branch per plant	
		Number	Percent (%)
T ₀ (Control)	4.25	3.25	78.75a
T ₁ (Cupravit 50 WP)	4.50	1.75	39.58bc
T ₂ (Dithane M-45)	5.25	2.25	43.33b
T ₃ (Rovral 50 WP)	5.25	1.25	23.33cd
T ₄ (Neem leaf extract)	6.25	2.75	44.05b
T ₅ (Ginger extract)	5.75	2.25	40.48bc
T ₆ (Garlic extract)	5.25	1.00	19.17d
Level of significance	NS	—	**
LSD (0.05)	—	—	17.04
CV (%)	19.24	—	15.81

Table 6. Effect of fungicides and plants extracts in the management of canker disease of branch in citrus (*C. limori*)

Treatments	Number of branch per plant	Canker infected branch per plant	
		Number	Percent (%)
T ₀ (Control)	4.25	2.00	49.17a
T ₁ (Cupravit 50 WP)	4.50	1.50	35.42a
T ₂ (Dithane M-45)	5.25	0.50	10.00b
T ₃ (Rovral 50 WP)	5.25	0.00	0.00b
T ₄ (Neem leaf extract)	6.25	0.00	0.00b
T ₅ (Ginger extract)	5.75	0.25	5.00b
T _g (Garlic extract)	5.25	0.75	15.00b
Level of significance	NS	—	**
LSD (0.05)	—	—	15.84
CV (%)	19.24	—	19.14

Total number of fruits plant⁻¹

Statistically significant differences were observed among the different fungicides and plant extracts over control in consideration of number of fruits plant⁻¹ (Appendix V). The highest number of fruits (10.75) recorded in T₆ treatment i.e. where Garlic extract was

applied (Table 8) which was closely followed by the T₂ treatment (10.25) where Dithane M-45 applied. On the other hand, the lowest number of fruits (6.25) recorded in the treatment T₃ which was statistically identical with T₄ (Neem leaf extract) and T₅ (Ginger extract) treatment.

Table 7. Effect of fungicides and plants extracts in the management of die-back disease of twig in citrus (*C. limori*)

Treatments	Number of twigs per branch	Die-back infected twigs per branch	
		Number	Percent (%)
T ₀ (Control)	11.00	5.25	48.34a
T ₁ (Cupravit 50 WP)	11.75	1.75	15.20cd
T ₂ (Dithane M-45)	12.75	1.75	14.41cd
T ₃ (Rovral 50 WP)	13.00	1.00	8.23d
T ₄ (Neem leaf extract)	12.75	3.75	29.94b
T ₅ (Ginger extract)	12.50	2.50	20.39c
T ₆ (Garlic extract)	12.25	1.50	12.53cd
Level of significance	NS	—	**
LSD (0.05)	—	—	8.724
CV (%)	16.79	—	13.58

Total number of Scab infected fruits plant⁻¹

Scab infected fruits plant⁻¹ of citrus showed a significant variation in respect of different fungicides and plant extracts over control in the management of fruit diseases (Appendix V). The highest scab infected fruits (47.22%) recorded in control condition where no fungicides or plant extracts were applied (Table 8). On the other hand, the lowest scab infected fruits (0.00%) recorded in T₅ (Ginger extract). Among the different fungicides, the lowest scab infected fruits (17.05%) recorded in Dithane M-45. On the other hand among the plant extracts, application of Garlic extract showed the highest scab infected fruit.

Total number of Canker infected fruits plant⁻¹

In citrus, canker infected fruits plant⁻¹ showed significant differences in respect of different fungicides and plant extracts over control in the management of foliar twigs and fruit diseases. The highest number of canker infected fruits (40.97%) were recorded in control condition where no fungicides or plant extracts were applied (Table 9) which was closely followed by T₆ (Garlic extract) treatment. On the other hand, the lowest canker infected fruits (3.57%) recorded in T₄ (Neem leaf extract) which was statistically identical with the rest of the treatments in controlling canker.

Table 8. Effect of fungicides and plants extracts in the management of scab disease of fruit in citrus (*C. limori*)

Treatments	Number of fruit plant ⁻¹	Scab infected fruit per plant	
		Number	Percent (%)
T ₀ (Control)	8.50abc	4.00	47.22a
T ₁ (Cupravit 50 WP)	7.50bc	2.25	30.56b
T ₂ (Dithane M-45)	10.25ab	1.75	17.05c
T ₃ (Rovral 50 WP)	6.25c	2.25	36.31b
T ₄ (Neem leaf extract)	6.75c	1.00	14.88c
T ₅ (Ginger extract)	6.50c	0.00	0.00d
T ₆ (Garlic extract)	10.75a	2.25	20.77c
Level of significance	**	—	
LSD (0.05)	2.696	—	9.756
CV (%)	8.33	13.31	18.56

Table 9. Effect of fungicides and plants extracts in the management of canker disease of fruit in citrus (*C. limori*)

Treatments	No. of fruit plant ⁻¹	Canker infected fruit per plant	
		Number	Number
T ₀ (Control)	8.50b	3.50	40.97a
T ₁ (Cupravit 50 WP)	7.50c	0.75	9.92cd
T ₂ (Dithane M-45)	10.25a	0.50	4.77d
T ₃ (Rovral 50 WP)	6.25d	0.50	8.33cd
T ₄ (Neem leaf extract)	6.75cd	0.25	3.57d
T ₅ (Ginger extract)	6.50cd	1.50	23.21b
T ₆ (Garlic extract)	10.75a	1.75	16.35bc
Level of significance	**	—	**
LSD (0.05)	2.696	—	9.67
CV (%)	8.33	—	12.55

Discussion

Disease symptom observation, isolation and identification the leaf, twig and fruit showed that severe scab infection occurred in hot and humid weather. Huang (1999) also reported the same weather conditions: The main characteristic symptom of the die-back disease observed as the drying of the shoot tip downwards to the stem resulting in the death of twigs or branches. The tips withered leaves fall off and the twigs gradually started drying from the top to downwards. Same symptoms was reported earlier by in India. Broadbent *et al.* (1980) reported that mycoplasma like organisms are the causal agent of die- back in citrus. These are not agree with the result of Talukder (1974), Sharma and Sharma (1969) and they reported that fungal agent are the causal organism of this disease. Citrus canker was found at young leaves, branches and fruits and the symptoms are the necrotic lesions on fruits and leaves. Das (2002) reported that *Xanthomonas axonopodis* are the causal agent of this disease. Similar results also reported by Taylor *et al.*

(2002). Symptoms of the citrus canker observed was small spots on the leaf blade, then become corky and grey with stripes at the centre and fruit showed similar symptom reported by Ye *et al.* (2001) in India.

Scab, die-back and canker are the most important diseases observed in this experiment. Huang and Huang (2002) reported that approximately 50% of fruits from Nanfengmiju trees were damaged by Citrus scab (*Elsinoe fawcettii*) Unfavourable weather condition such as high humidity, rainfall and huge amount of frost and annual application of multiple fungicides are the main reasons for these damaged of citrus by scab.

Leaf and fruit of citrus are mainly affected by scab. Among the different treatments which were applied in the citrus plant that were used as experimental material, it was found that Ginger extract is the most effective control measure in considering the scab disease of citrus (*C. limori*) and among the fungicides Rovral 50 wp is the effective control measure comparing with other chemicals that were applied. It was also found that cupravit 50 WP was not much effective in controlling

of scab of citrus (*C. limon*).

There are some findings we have that did not agree with this findings. Huang (1999) reported that the control was possible by spraying Bordeaux mixture. Ran *et al.* (2001) found that the best control of citrus scab was achieved by spraying a 600-times solution of 80% M-45 when the shoots were 2 cm long. On the other hand Zhou *et al.* (2001) reported that the spraying three times a solution of 0.4-0.5% jiangnanmycin at flowering stage are the most effective chemical control for preventing attack of young leaves by scab. Whiteside (1990) reported that difenoconazole usually gave better control of scab than Dithianon. He also found that spray treatments were delayed until after some fruit had become infected, difenoconazole reduced scab severity even more than captafol because of its unique ability to inhibit the further development of existing pustules. Bushong and Timmer (2000) revealed that use of post infection sprays under field conditions appears to be promising for scab control.

Die-back is the common disease of citrus and familiar by different names. Twigs and branches are mainly infection by the disease of die-back. Among the different chemical measures which was applied in controlling dieback Rovral 50 wp are the most effective. Among the plant extracts, Garlic extract is the most effective in controlling of die-back twigs of citrus and Neem leaf extracts for the branch. Ebenezar *et al.* (1996) founded that the Bordeaux mixture is the most effective control measure for die-back of citrus. Thakore *et al.* (1994) tested and reported that the 2000 ppm Dithane M-45 is the most effective is comparing with 500, 1000 ppm in controlling of die-back.

Citrus canker occurrence has a close relationship with the daily mean temperature, when a daily temperature of 12°C occurs for 10-15 days, the spring shoots and fruit lets will be attacked. Leaf, branch and fruit are mainly affected by the canker (Zhong and Ling, 2002). Canker reduces the number of leaves, branch, fruit number as well as fruit weight and finally yield/unit. Among the different chemical treatments it is found that the Rovral 50 wp are the most effective for the controlling of canker in citrus. (*C. limon*). On the other hand among the plant extract, Neem leaf extract is the most effective in controlling of leaf and fruit canker.

Ram and Ramesh (1987) founded that the Blitox (50% orychloride) or Bordeaux mixture along with 2 prunings are the effective in reducing diseases and increasing yield. They also reported that average disease reducing was 68.3 and 65.2% and the increase in number of fruits was 94.0 and 84.8% and weight of fruits was 86.4% and 78.8% respectively, for these two treatments. On the other hand Lu and Xu (2001) reported that the 500- fold and 400-fold solution of 77% copper hydroxide and 60% chlorothalanyl solution are the most effective in controlling of citrus canker. But Ye *et al.* (2001) reported that the disease was practically controlled and minimized by calcium polysulfide @ 0.5%.

From the findings of the study, it was evident among

the chemicals, Rovral 50 wp was the most effective chemical for scab, die-back and canker control. On the other hand among the plant extracts, Neem leaf extract & Garlic extracts were equally effective. However, further investigation in the farmers field at different agro-ecological zones of Bangladesh is needed to prove the efficacy of the recommended chemicals/plant extracts against scab, die-back and canker of citrus (*C. limon*).

Conclusions

The fungicides and plant extracts showed remarkable effectiveness for the control of citrus (*C. limon*) diseases. Leaf and fruit of citrus were mainly affected by scab. It was also found that Cupravit 50 WP was not much effective in controlling of scab of citrus. Among the different chemical treatments, it was found that the Rovral 50 WP was the most effective for the controlling of scab, die-back and canker in citrus. On the other hand, among the plant extracts, Neem leaf extract was the most effective in controlling of leaf and fruit canker. Garlic extract and Neem leaf extract were the most effective in controlling die-back of twigs and branch, respectively. From this study it may be concluded that Rovral 50WP is one of the most effective chemical control measure for scab, die-back and canker. Beside among the different plant extracts, Neem leaf extract is the effective for controlling canker. Garlic extract also may be advised to the farmers for controlling canker of citrus, although it seems costly in the market.

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