Original Research Article

Integrated Control of Some Fungal Diseases Affecting Guava and Pomegranate from Farm to Fork in Egypt

Abstract

These studies aim to identify a group of pathogens and design an integrated control program reducing the infection in Guava *Psidium guajava* and Pomegranate *Punica granatum* by cross inoculation method. Almost eight fungi were collected from governorate Ismaelia and Behera in 2019. *Alternaria alternate* ,*Fusarium* spp, *Phomopsis psidii*, *Macrophomina* spp.,*Cercospora* spp. *Botrytis cineria* and *Pestalotia* spp. were the most frequencies isolated fungi on all fruits. In the second season 2020 we treated trees with biocides, fungicides and fertilizer they gave significant differences between the treated treatments and control .The bluegreen algae bio treatment, showed the best results compared with both of RizoN and Plantagaurd treatments, the percentage of disease severity on the leaves was 13.4%, compared to the control45%, the best chemical treatment was Fungalpro ,Topsin and Collise, where the disease severity was 0% in case of guava ,the same results obtained in pomegranate .At the end of the season, the best results were in the treatment with fungalpro which gave the least disease severity percentage on each of the leaves, branches and fruits in both guava and pomegranate .In the third season 2022 we applied integrated control program there were a significant decrease in pathogenic fungi in leaves, branches, flowers and ripe fruits, as the population at the end of the season for some fungi reached zero, such as *Phomopsis sp*. and *Pestalotia sp.*As *Alternaria* fungus, the results showed significant differences compared with the control, with regard to Guava, the percentage of disease severity in fruits was 8.75% and 9.75% in both Ismailia and South of Tahrir, respectively, compared to the control, which reached 85.5% and 88.5% in Ismailia and South of Tahrir, respectively. The results for pomegranate followed the same pattern.

Keywords: Pomegranate, Guava, Plant Diseases, Biological Control, Isolation and Identification.

Introduction

Egypt Guava (*Psidium guajava* L.) is a tropical plant that can be eaten fresh without cooking. It is rich in fiber and vitamins, especially vitamin C (Joseph and Priya, 2011) .Guavas are commonly cultivated in tropic and subtopic regions, making them a tropical fruit. Egypt guava production as of 2019 was 2.7 million tons making it rank sixth the global chart .**Batista Silva *et al*., 2018).** The cultivation of guavas is concentrated in lower parts of the country, mainly El-Beheira and Damietta. Bassateen El Sabahia has, a lot of effort went into improving the quality and yield of this variety. It is medium-sized and pear-shaped. It also is pink blushed, has thick white flesh, and has good produce over a long season. The process of clipping happens when the fruit is fully grown but under-ripe **Arafat, 2018**. Early harvesting of the crop protects it from bird attacks and reduces its marketing value, and then fruits are ripening further in an area of room temperature where each is individually wrapped. Storage is in a cool, moist area of temperatures between 7°c-10°c. The guavas are then packed in weight-specific cartons, exported under temperatures of 45°F to 55°F, and shipped worldwide.

Pomegranate *Punica granatum* is one of the popular and distinguished fruits with consumers in various countries of the world due to its health benefits, it is an autumn fruit and it riches anti-cancer and antioxidant components, and it is also a good source of vitamin A, vitamin B, vitamin E, and folic acid. Many countries are famous for producing and exporting pomegranates. Egypt is one of 5 largest pomegranate-producing countries in the world, pomegranates is exported to countries such as Mauritius, Seychelles, Madagascar, the Maldives, and other countries. The value of export is estimated abroad by about 700 tons per year **Al Damarawy2018**.and since ,guava,(that is harvested at summer season),and pomegranate may be grown in similar season, so both of Gauva and Pomegranate may be attack with similar aerobic pathogen diseases, such as *Alternaria , phompsis, fusarium , Botritis , Pestalotia* or *Cercospore*

Guava crop is seriously damaged; pathogens attack all parts of plants except roots. The growing tip of affected plants turns dark brown and the black, necrotic areas extend backward, causing dieback of plants. There is an appearance of small spots of the size of pin-head on fruit especially during monsoon (Ismail *et al*., 2010 and Dwivedi and Neetu, 2012). Later several spots coalesce to form bigger lesions. On the tips and margins of the leaves spots are grey in color. The cool season (January to March) and hot, dry weather (from April to June) prevent the spread of infection. Fungicides like; thiophanate methyl and tebuconazole were found to be effective against shoot blight and fruit rot Performance of five fungicides viz., mancozeb (0.25%), companion (0.25%), carbendazim(0.05%), copper oxychloride (0.3%) and captan (0.3%) against fruit spot and rot diseases of pomegranate was compared through field trials. Significant reduction in diseases was observed by the use of captan, companion and copper oxychloride, but copper oxychloride leaves scars on the fruit after spray which in turn reduces the market acceptability (Zakaria,2021). The diseases are serious during rainy season. The optimum temperature for growth and sporulation was 25 to 30°C.Spray 1 per cent Bordeaux mixture or Zineb (0.2 %). Cercospora leaf spot (*Cercospora sawadae*) ,the affected leaves show brown water soaked patches, on their under surface. Biological control by several microorganisms, plants and animals have been discovered and well known for their antagonistic effect against other living organisms. Such organisms paved the way of another stream of plant disease management i.e. biological control. It is highly recommended and considered as most sustainable approach of disease management as it has no harmful effects on environment. *Bacillus subtilis* and *Cryptococcus albidus* were found to be effective in controlling fungal decay of pomegranate fruit (Janisiewicz and Korsten, 2002).

Materials and Methods

Samples Collection

A survey of crop fungi were conducted on two economically important fruits *i.e.* Pomegranate (*Punica granatum*) and Guava (*Psidium guajava*) 2019, 2022 seasons. Naturally infected fruits of Guava and Pomegranate were collected from orchards at Ismaelia governorate and South of Tahreer in Behera governorate Egypt. Samples were brought to the laboratory in separate sterilized polythene bags, examined critically with respect to symptomatology and sorted out for the isolation of the causal agents.

Isolation and identification of the associated fungi

The isolation and identification of the causal agents were performed in season 2019 before any treatments for every single leaf, stem, flower and fruit. While fruits exhibit fruit spots were isolated from the peel surface. Infected fruit tissues were surface sterilized in 1% sodium hypochlorite solution for 1 min and rinsed twice in sterilized water. Using a sterile scalpel, tissue pieces composed of spots, halo, and surrounding healthy tissue were placed onto potato dextrose

agar (PDA) amended with tetracycline at 12µg/ml, and incubated at 25°C.In some cases, rotting fruit samples were incubated in a moist chamber and mycelium of individual fungal species transferred onto PDA plates and incubated for 3-7 days at a temperature of 25°C.Fungal colonies emerging from symptomatic tissue was picked up and transferred to new plates and left to grow for 5 to 7 days prior. Pure cultures were then obtained by single spore isolation and maintained on PDA slants for further study. The fungi were observed under a microscope and identification of the pathogens was made with the help of available literature (Biligrami *et al*., 1991). For further identification (Grizzle, 2006 and Singh, 2009). Different frequencies of fungi on same crop were noted in season 2022 after application the control management program
Pure culture stocks of the isolated fungi were kept on PDA slants at 5^{o}C for further study. Frequency (%) of the isolated fungi was calculated using the following equation:

$$\text{Frequency (\%)} = \frac{\text{No. of each fungal colonies}}{\text{Total number of all fungi}} \times 100$$

Field experiments

Field experiments were conducted on Guava and Pomegranate trees cultivar at Ismailia and South of Tahrir at Behera governorates during 2020,2021 and 2022 growing seasons to evaluate the effect of biocides and fungicides against the natural infection of total airborne pathogenic fungal types were identified. The most important of them are*Phomopsis psidi, Pestalotia sp. ,Alternaria sp.,Cercospora sp., Macrophomenia sp*. and *Colletotrichum sp.,*

In 2020 we evaluated the effect of treatments separately i.e. four fungicides (Copper sulfate, Fungi pro (Prochlorazol) ,Collise (Poscalide + ChrizaoxamMethyle), Alpha Captan and Topsin M (Thiophenate Methyl) sprayed three times each alone alternative 10 days as well as the biocides (Bluegreen, Plantaguard and RizoN) are commercial products where are produced in Agricultural Research Center , and fertilizer calcium phosphate they sprayed four times each alone as well as the alternation among them, Table 1.showd the all treatments. The trees were left to the natural infection by plant pathogens and it were received the same cultural practices that are recommended. Distributed according to a complete randomized design, with three replicates, using four trees/ replicates as experimental unit. Four foliar sprays were applied at 10-day intervals during spring seasons in first April. In the second season 2021we starting spray to estimate all treatments on trees, in the third season 2021/2022 we applied the integrated control program we sprayed in April fungicides twice to reduce the number of sprays alternative with biocides . Infected leaves and flowers were examined at the end of the experiment to estimate disease severity, leaves were selected randomly from each total main replicate were been recode their assessed for the presence or absence of disease. Disease severity % was recorded using disease scale from samples; the number of brown spots is counted to estimate the percentage of affected area. The percentage of affected area is calculated using equation (1). Percentage = (Affected area/Total area)x100 (1) Where, Affected area= Number of brown spots count Total area = Total size of leaf, stem or fruit The affected area is calculated by counting number of brown spots over total area on leaf, stem and ripe fruits. The grading is performed based on percentage of affected area, whether image sample is normal, partially affected, moderately affected or unhealthy as shown below.Less than 1% affected area = Normal
Less than or equal to 25% affected area = Partially affected Less than or equal to 50% affected area = Moderately affected More than 50% affected area = Unhealthy (Zakaria,2021)

Statistical analysis

Disease severity was statistically analyzed as a complete randomized block design according to Snedecor and Cocharn (1980)using Web Agri. Stat Package Computer Program (WASP).

Table 1.Tested treatments:

TREATMENTS	rate/100liter water	active ingredient
Fungal pro 45% EW	75 cm^3	Prochlorazol (fungicide)
Collise 30%SC	250 cm^3	chrisoximemethyl+poscalide fungicide
Topsin M70%WP	65g	Chlorpthalonil Methyl fungicide
Copper sulfate	100gm	COPPER+ sulfur fungicide
Plantguard	250g	biocides*Trichoderma* sp. $3x10^6$ spore/ml
RhizoN	250g	biocides*Bacillussubtillis*. $3x10^6$ c.f.u/ml
Bluegreen	10L/ acre	biocides Algae
Calcium Phosphate	1:2 kg/ tree	fertilizer

Results

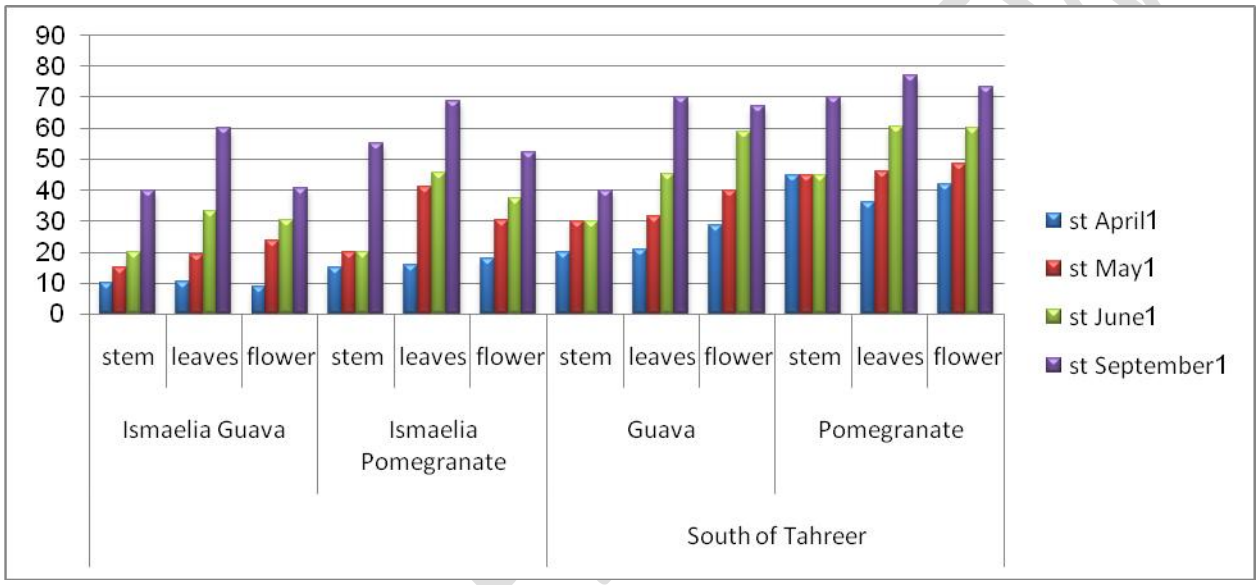
Isolations	Time	Ismaelia						South of Tahreer					
		Guava			Pomegranate			Guava			Pomegranate		
		stem	leaves	flower fruits	stem	leaves	flower/ fruits	stem	leaves	flower/ fruits	stem	leaves	flower/ fruits
Phomopsis	**1 April**	**13**	**12**	**17**	**2**	**1**	**1**	**17**	**17**	**15**		**3**	**5**
Alternaria			**35**	**28**		**17**	**20**		**43**	**33**		**29**	**27**
Pestalotia		**7**	**15**	**13**	**2**	**1**	**2**	**12**	**13**	**23**	**1**	**1**	**3**
Fusarium					**5**								
Botrytis					**10**	**15**					**12**	**10**	**18**
Macrophomina											**17**	**15**	**13**
Cercospora						**3**						**1**	**2**
Nufaccins						**3**					**2**	**5**	
Others		**18**	**30**	**11**	**13**	**15**		**25**	**20**	**22**	**26**		
Phomopsis	**1 may**	**22**	**17**	**23**	**2**	**5**		**10**	**18**	**24**		**5**	**2**
Alternaria			**38**	**37**		**23**	**23**		**38**	**35**		**30**	**33**
Pestalotia		**18**	**13**	**25**	**4**	**5**		**20**	**17**	**15**		**7**	**3**
Fusarium													
Botrytis						**17**	**18**					**8**	**6**
Macrophomina						**14**	**15**					**11**	**12**
Cercospora						**6**						**11**	
Nufaccins													
Others		**35**	**23**	**12**			**13**	**18**	**21**	**25**		**12**	
Phomopsis	**1 June**		**21**	**5**	**1**	**2**	**2**	**14**	**18**	**15**		**2**	**2**
Alternaria			**30**	**39**		**36**	**28**		**38**	**39**		**22**	**28**
Pestalotia		**20**	**5**	**16**	**0**	**0**	**3**	**2**	**2**	**1**			**1**
Fusarium													
Botrytis						**8**	**5**						**4**
Macrophomina					**14**	**19**	**6**						**8**
Cercospora													
Nufaccins													
Others		**1**	**10-15**	**11**		**16**	**8**					**15**	**5**
Phomopsis	**1 september**			**13**									**2**
Alternaria				**39**			**25**		**26**				**38**
Pestalotia				**42**					**2**				
Fusarium													
Botrytis													
Macrophomina							**17**						**9**
Cercospora													**22**

Nufaccins													
Others							**12**			**30**			**18**

Table (2) Relative frequency (%) and symptoms of fungal species associated with Guava and Pomegranate during pre/postharvest in season (1) 2019 at Ismaelia and South Tahreer.

Survey study was conducted on two fruits i.e. Pomegranate and guava which collected from mature trees in the field of Egypt and from different governorates of Ismaelia governorate and South of Tahreer in Behera governorate. The samples of leaves, stems, flowers and fruits revealed that, 8 fungal species belonging to 8 genera were associated with symptoms. In general, the two genera *Alternaria alternate* and *Fusarium* spp, *Phomopsis psidii*., *Macrophomina* spp., *Cercospora* spp. *Botrytis cineria* and *Pestalotia* spp. were found to be the most dominant fungi on all fruits (Table 2).

Figure 1: Average of %disease severity of Guava and Pomegranate in season (1) 2019 at Ismaelia and South of Tahreer.



It also appears in Figure 1, an average percentage of disease severity during the first season 2019, where the infection started from the beginning of April and continues to increase during the season untilhad harvestedduring September, for both guava and pomegranate in Ismailia and South Tahrir, Where the infection appeared starting from the leaves, stems, flowers and fruits with small nodes until the fruits are fully ripe,as a causal pathogens of heart rot of pomegranate fruits. Table 3 showed the effect of the different treatments separately starting from mid-February and spraying alternately every 15 days. The table showed the effect of these treatments on the percentage of the average disease severity on each of the branches, leaves, flowers and ripe fruits of guava and pomegranate until the end of the season in September in the south of Tahrir and Ismaelia in season 2020,The results showed that there were clear significant differences between the treatments, where the bluegreen algae, showed the best results compared to the rest of the biological compounds, which are RhizoN and Plantagaurd, where the percentage of disease severity on the leaves was 13.4 , compared to the control. 45%, as for the rest of the chemical treatments, the best was Fungipro, Topsin and collise, where the disease severity was 0% in case of guava ,the same results obtained in pomegranate .At the end of the season, the best results were in the treatment with fungi pro, as it gave the least disease severity percentage on each of the leaves, branches and fruits in both guava and pomegranate.

Table(3): Effect of spraying different fungicides ,biocides and fertilizers on average of %disease severity of Guava and Pomegranate in season (2) 2020 at Ismaelia and South of Tahreer.

Treatments	Time of sprays	Ismaelia						South of Tahreer					
		Guava			Pomegranate			Guava			Pomegranate		
		stem	leaves	flower	stem	leaves	flower	stem	leaves	flower	stem	leaves	flower
Bluegreen	15/2,1/3,15/3,1/4	13.4	28.6	29.5	6.8	27.25	23.25	15	33.75	30.5	20	32	39.75
Bluegreen	15/4,30/4	13.4	25.7	27	6.8	22.25	32.5	10	28	27.5	20	29.5	34
Bluegreen	15/5,1/6	13.4	24.9	25	6.8	18.75	22	10	26.75	24.5	15	25.25	22
Plantagaurd	15/2,1/3,15/3,1/4	56.5	29.4	32.7	6.8	28.25	30	25	36.5	38	20	38.25	37.5
Plantagaurd	15/4,30/4	56.5	28.4	29	20	24.25	25.75	30	32	32.75	20	33	28.75
Plantagaurd	15/5,1/6	56.5	27.8	27	20	22.75	18.25	35	26.5	28.5	20	44	28.75
Rizo N	15/2,1/3,15/3,1/4	29.7	32	32	13.4	31.5	31.75	25	37.5	34.25	15	37.5	41
Rizo N	15/4,30/4	29.7	31.4	31	20	29	28.5	25	33.75	30.75	20	31.75	34.25
Rizo N	15/5,1/6	29.7	27.2	27.5	25	27.25	24.75	25	27.75	25.5	25	23.75	25.75
Calcium phosphate	15/2,1/3,15/3,1/4	13.4	30.7	28.8	5	19.25	31.25	15	30	31.25	10	31.75	36
Calcium phosphate	15/4,30/4	13.4	28.4	27.4	5	24.5	25	10	26.25	29.5	10	28.5	29.5
Calcium phosphate	15/5,1/6	13.4	25.8	25.8	5	22	23.75	10	25.25	23	20	24.5	24.25
Copper sulfide	15/2,1/3,15/3,1/4	13.4	32	32.2	15	29.75	27.25	20	35.5	36.5	20	40.5	32.75
Copper sulfide	15/4,30/4	13.4	29.6	29.3	15	29.75	30.5	20	30	28	25	30.25	32.75
copper sulfide	15/5,1/6	26.5	27.7	18.4	20	28.5	46.25	20	25.75	24.5	35	23.25	27
Alpha captan	15/2,1/3,15/3,1/4	6.8	29.2	28.2	10	30.5	34.5	15	31	33.5	5	38	40.25
Alpha captan	15/4,30/4	6.8	28	27.7	10	29.75	30.5	15	28	28	15	31.25	33.5
Alpha captan	15/5,1/6	6.8	24.8	25.5	10	25.5	26.25	15	22.5	23.5	20	24.75	27.25
Fungi Pro	15/2,1/3,15/3,1/4	0	24.2	24	0	22.25	21.75	5	30.75	29.25	5	30.75	33.5
Fungi Pro	15/4,30/4	0	24.5	25.2	0	19.25	17.25	0	30	26.75	5	24.5	28
Fungi Pro	15/5,1/6	0	22.6	22.7	0	16	11.75	0	22.5	23.25	5	19.5	24.25
Topsin M	15/2,1/3,15/3,1/4	0	30	28	10	35	31	10	33.25	33	20	38.5	35.75
Topsin M	15/4,30/4	0	27.4	25.7	5	25.5	27.25	5	27.75	28.75	20	34.5	30
Topsin M	15/5,1/6	0	24.2	23.8	5	24.25	21	5	23.5	27.5	15	24.25	23.5
Collise	15/2,1/3,15/3,1/4	0	30	30.4	0	28	24	0	29.5	27	10	31.5	33.5
Collise	15/4,30/4	0	27.7	25	0	23.25	22.5	0	21.75	22.75	10	28	28
Collise	15/5,1/6	0	22.1	20.8	0	17.75	16.5	0	18.5	18	10	20.75	21.25
control	15/4	32.8	32	34.2	30	38.25	34.75	30	49	43.75	40	60.5	59
control	15/5	39.2	36.6	49.5	35	44.5	46	40	55.75	58.5	50	71	70.25
control	15/6	45	41	45.4	70	44.5	70	65	71.5	50.75	70	82.5	78.5
L.S.D 5%	//////////////////////	11.744	3.071	3.007	13.01	3.005	3.286	13.598	2.807	2.728	12.497	3.007	2.328

Table(4): Effect of applying management control program contains fungicides ,biocides and fertilizers on average of %disease severity of Guava and Pomegranate in season (3) 2021/2022 at Ismaelia and South of Tahreer.

Ismaelia								South of Tahreer					
Treatments	Time	Guava			Pomegranate			Guava			Pomegranate		
		stem	leaves	flower	stem	leaves	flower	stem	leaves	flower	stem	leaves	flower
Copper sulfide	1-2,10-2	0	0	///////	0	0	//////	0	0	//////	0	2	//////
control	1/3	0	0	///////	0	0	//////	0	0	///////	0	10	///////
Alpha captan	1-3,10-3	5	7.5	//////	10	16.75	/////	5	7	//////	20	28.25	///////
control	20-3	15	10.5	//////	20	24.25	///////	10.5	14.5	///////	25	31.25	/////////
Calcium phosphate	20-3,30-3,10-4	15	18.5	17.25	10	22.5	24.5	5	18.25	22.5	25	25.25	23.5
control	15-4	25	27.25	21.75	25	30.25	28.25	20	23.75	27	45	39	28
Fungi Pro	15-4,25-4	15	20.25	18	20	17.25	22	10	26.25	29.5	25	22.75	20.75
control	5-5	35	40.25	29.25	30	35	38.25	30	38	35.25	50	50.25	36.75
Collise	5-5,15-5	10	17	15	20	24.5	18.25	10	27.5	22.5	25	19.25	12
control	25-5	35	47	31.25	50	42.75	52	30	49.5	50.75	60	49.5	71.75
Topsin M	25-5,5-6	15	15	11	15	21.75	18	10	19.5	17.25	20	12	9
control	15-6	35	53.25	44.5	55	48.25	68.25	40	62.75	74.5	65	62.5	71.5
Bluegreen	15-6,22-6	15	13.25	9.75	20	8.25	6.75	10	15.25	13.5	20	8.25	9.5
control	29-6	45	65.25	55	70	78	75	50	76.5	84.5	70	78	75
Plantagaurd	29-6,5-7	15	12	11	15	19.75	16.75	10	10.5	12.25	15	6.5	6.25
control	15-7	45	77	74.5	60	72.5	60	60	90.5	81.5	80	100	82
Rizo N	12-7,19-7	15	8.5	8.75	25	18.5	18.5	20	9	9.75	15	5	5.5
control	26-7	50	80	85.5	70	86.25	88.75	85	100	88.5	80	100	100
L.S.D 5%	//////////////////	12.5	3.256	3.08	10.7	3.8	4.07	13.62	7.9	5.6	8.6	5.2	3.3

Table 4 showed the results of applying the integrated control program for plant diseases that affect guava and pomegranate in each of Ismailia and South of Tahrir. Where we found that all the plants were sprayed only twice every ten days, except for the treatment of fertilization with calcium phosphate, which was three times every ten . Hence, the efficiency of the program was in reducing the number of fungicides sprays, as well as the introduction of biofungicides in the program to reduce toxicity and increase safety on fruits, especially in the case of export.
The program was designed on the basis of the beginning of spraying in February, when the buds swell, to eliminate any fungal or insect infection from the previous season, and then spraying with fungicides such as Alpha Captan, Fungipro ,Collise and TopsenM ,and at the beginning of flowering, settling and ripening of fruits, biocides are sprayed i.e. Bluegreen ,Plantagaurd and RizoN in order to preserve the flowers from falling, protect the fruits and reduce fungicide residues in them.The results showed significant differences at the end of the season compared to the control, where we found that with regard to Guava, the percentage of disease severity in fruits was 8.75% and 9.75% in both Ismailia and South of Tahrir, respectively, compared to the control, which reached 85.5% and 88.5% in Ismailia and South of Tahrir, respectively. The results for pomegranate followed the same pattern.

Table 5: showed the results of survey and isolation of pathogenic fungi on Guava trees in both Ismailia and South of Tahrir, after applying the integrated control program in the third season 2022,The results showed a significant decrease in pathogenic fungi that infect leaves, branches, flowers and ripe fruits, as the population at the end of the season for some fungi reached zero, such as *Phomopsis sp*. and *Pestalotia sp.* and *Alternaria* fungus, it was one of the most common infections in leaves, flowers and fruits, but the frequency of infection in the program was lower than in the control. Data in table 6: showed the survey of fungi in pomegranate trees at Ismaelia and South of Tahreer, The number of all fungi decreased significantly, but the most widespread of them was *Alternaria* fungus compared to the rest of the fungi. Despite this, the application of the control program reduced the number of fungi compared to the control.

Table (5) Relative frequency (%) and symptoms of fungal species associated with Guava during pre/postharvest in season (3) 2022 at Ismaelia and South Tahreer.

Treatments	Time	Guava in Ismailia season3											
		Phomopsis			*Pestalotia*			*Aternaria*			Others		
		Stem	Leaves	Flower /fruits	Stem	Leaves	Flower/ fruits	Stem	Leaves	Flower /fruits	Stem	Leaves	Flower/fruits
Copper Sulfide	1-3	7	9	///////	4	2	///////	0	13	///////	0	0	//////
	control	15	13		7	7		0	25		0	5	
Alpha Captan	20-3	8	7	/////	1	3	//////	0	20	/////	2	0	//////
	control	13	12		2	7			29		5	20	
Calcium Phosphate	15-4	7	2	9	6	5	11		6	20	12		
	control	8	15	18	13	11	12		19	27	20		
Fungi Pro	5-5	7	5	11	10	8	9		17	14	20		
	control	10	12	14	12	11	11		25	30	25		
Collise	25-5	4	4	5	3	1	3		15	16		10	15
	control	5	4	8	7	3	7		35	34		27	20
Topsin M	15-6	1	3	0	1	3	0		10	11		7	12
	control	3	10	6	2	7	5		37	20		20	25
BlueGreen	29-6	0	0	2	0	0	1		10	19	3	7	4
	control	3	2	3	1	1	4		25	22	9	13	10
Plantagaurd	12-7	0	0	0	0	0	0		11	14	13	4	5
	control	5	3	3	1	2	1		23	27	20	12	12
Rizo N	26-7	0	0	0	0	0	0		17	14	4	5	3
	control	1	3	5	1	2	2		21	18	9	27	7
Treatments	Time	Guava in South of Tahreer season3											
		Phomopsis			*Pestalotia*			*Aternaria*			Others		
		Stem	Leaves	Flower /fruits	Stem	Leaves	Flower/ fruits	Stem	Leaves	Flower /fruits	Stem	Leaves	Flower/fruits
Copper Sulfide	1-3	12	6	//////	5	5	/////////		23	////////	23		//////
	control	16	12		8	9			25		27		
Alpha Captan	20-3	11	12	////////	6	9	/////////		19	////////	13	17	///////
	control	19	20		11	15			23		25	20	
Calcium Phosphate	15-4	17	7	10	17	6	8		25	14	7	9	8
	control	20	13	13	20	9	12		35	19	10	10	10
Fungi Pro	5-5	14	13	12	5	8	10		21	18	5	7	15
	control	17	19	18	13	14	21		28	33	32	23	20
Collise	25-5	1	3	3	3	1	1		10	21	12	0	6
	control	5	7	8	9	2	3		23	25	27	4	14
Topsin M	15-6	0	0	2	0	0	0		16	17	3		
	control	5	3	9	1	1	5		22	28	7		
BlueGreen	29-6	0	0	0	0	0	0		12	10	0	0	
	control	5	3	5	1	2	4		18	21	3	6	
Plantagaurd	12-7	0	0	0	0	0	0		4	9	0		
	control	5	2	2	1	1	1		8	13	3		
Rizo N	26-7	0	0	0					9	7	0		
	control	3	3	2					10	16	7		

Table (6) Relative frequency (%) and symptoms of fungal species associated with Pomegranate during pre/postharvest in season (3) 2022 at Ismaelia and South Tahreer.

Treatments	Time	Pomegranate in Ismailia season3																			
		Phomopsis			*Pestalotia*			*Aternaria*			*Macrophomina*			*Cercospora*			*Botrytis*			Others		
		Stem	Leaves	Flower	Stem	Leaves	Flower	Stem	Leaves	Flower	Stem	Leaves	Flower	Stem	Leaves	Flower	Stem	Leaves	Flower	Stem	Leaves	Flower
Copper Sulfide	**1-3**	**2**	**4**		**1**	**1**			**19**		**9**	**7**			**0**			**3**				
	control	**3**	**5**		**1**	**2**			**23**		**11**	**9**			**2**			**3**				
Alpha Captan	**20-3**	**1**	**1**			**1**		**0**	**15**		**11**	**9**			**2**		**8**	**15**				
	control	**3**	**2**			**5**		**2**	**29**		**17**	**13**			**6**		**10**	**17**				
Calcium Phosphate	**15-4**		**1**	**0**	**0**	**1**	**0**		**27**	**17**	**17**	**11**	**0**		**1**	**0**	**19**	**13**	**11**	**11**	**9**	**8**
	control		**4**	**2**	**2**	**2**	**1**		**35**	**33**	**19**	**15**	**14**		**7**	**6**	**23**	**20**	**22**	**18**	**17**	**12**
Fungi Pro	**5-5**	**0**	**0**	**0**	**0**	**0**	**0**		**19**	**14**	**10**	**3**	**7**		**3**	**1**	**4**	**1**	**4**	**4**	**6**	**7**
	control	**8**	**2**	**3**	**2**	**2**	**1**		**30**	**25**	**15**	**10**	**10**		**7**	**3**	**9**	**4**	**8**	**9**	**11**	**11**
Collise	**25-5**	**0**			**0**				**12**	**16**	**3**	**2**	**2**		**0**		**1**	**0**	**2**		**3**	**4**
	control	**2**			**3**				**28**	**21**	**8**	**7**	**8**		**1**		**3**	**5**	**13**		**10**	**22**
Topsin M	**15-6**			**0**					**12**	**8**	**0**	**0**	**0**				**0**		**0**	**0**	**7**	**6**
	control			**3**					**17**	**16**	**3**	**3**	**2**				**1**		**4**	**18**	**13**	**20**
BlueGreen	**29-6**	**0**	**0**	**0**		**0**			**9**	**13**	**0**	**0**	**1**					**7**	**0**	**5**	**4**	**2**
	control	**2**	**3**	**2**		**2**			**13**	**19**	**2**	**2**	**7**					**11**	**2**	**12**	**15**	**25**
Plantagaurd	**12-7**	**2**	**0**	**2**					**5**	**8**	**2**	**1**	**1**						**0**		**1**	**8**
	control	**6**	**3**	**3**					**11**	**15**	**6**	**3**	**2**						**1**		**6**	**17**
Rizo N	**26-7**	**0**			**0**				**2**	**4**	**0**		**0**					**0**	**0**	**2**	**23**	
	control	**1**			**2**				**7**	**14**	**1**		**1**					**1**	**10**	**7**	**25**	
Treatments	**Time**	**Pomegranate in South of Tahreer season3**																			
		Phomopsis			*Pestalotia*			*Aternaria*			*Macrophomina*			*Cercospora*			*Botrytis*			Others		
		Stem	Leaves	Flower	Stem	Leaves	Flower	Stem	Leaves	Flower	Stem	Leaves	Flower	Stem	Leaves	Flower	Stem	Leaves	Flower	Stem	Leaves	Flower
Copper Sulfide	**1-3**	**0**			**1**	**0**			**7**		**13**	**3**			**0**		**6**	**2**		**6**		
	control	**1**			**1**	**2**			**9**		**17**	**6**			**3**		**9**	**4**		**15**		
Alpha Captan	**20-3**	**1**	**3**			**1**	**1**		**19**		**11**				**4**		**5**	**4**			**0**	
	control	**2**	**6**			**3**	**2**		**25**		**18**				**8**		**8**	**7**			**4**	
Calcium Phosphate	**15-4**	**0**	**1**	**1**	**0**	**1**	**0**		**23**	**22**	**2**	**10**	**8**			**4**		**9**	**9**	**8**		**13**
	control	**6**	**4**	**4**	**4**	**2**	**2**		**30**	**30**	**10**	**14**	**14**			**5**		**13**	**15**	**12**		**15**
Fungi Pro	**5-5**	**0**	**0**	**0**			**0**		**19**	**11**	**5**	**7**	**13**				**3**	**1**	**3**	**3**		
	control	**2**	**2**	**4**			**1**		**23**	**27**	**15**	**11**	**19**				**8**	**4**	**9**	**7**		
Collise	**25-5**	**0**	**0**	**0**	**0**				**15**	**12**	**2**	**3**	**5**		**0**		**5**	**0**	**3**		**3**	**8**
	control	**5**	**1**	**1**	**2**				**20**	**19**	**6**	**8**	**7**		**2**		**13**	**4**	**10**		**5**	**11**
Topsin M	**15-6**	**0**		**0**					**7**	**1**	**9**	**2**	**1**		**0**		**0**	**0**	**3**	**2**	**2**	**2**
	control	**1**		**1**					**19**	**23**	**15**	**3**	**1**		**1**		**14**	**9**	**9**	**7**	**9**	**5**
BlueGreen	**29-6**	**1**	**0**	**0**					**11**	**8**	**3**	**1**	**0**				**5**	**0**	**1**	**0**	**6**	**3**
	control	**2**	**2**	**2**					**12**	**17**	**5**	**5**	**2**				**8**	**4**	**6**	**2**	**9**	**7**
Plantagaurd	**12-7**	**0**		**0**					**5**	**5**	**3**	**0**	**0**				**1**	**1**	**0**	**0**	**0**	**5**
	control	**2**		**1**					**8**	**13**	**4**	**3**	**1**				**2**	**1**	**1**	**3**	**5**	**7**
Rizo N	**26-7**	**1**	**0**		**0**				**2**									**1**		**0**		
	control	**6**	**3**		**1**				**6**									**1**		**10**		

DISCUSSION:

The main objective of this research is to design an integrated control program for most of the fungal diseases that affect guava and pomegranate. The program should preserve the fruits from farm to fork. The survey and identification of some pathogens i.e. *Alternaria alternate* and *Fusarium* spp, *Phomopsis psidii*., *Macrophomina* spp.,*Cercospora* spp., *Botrytis cineria* and *Pestalotia* spp.(Tziros*et al*., 2007and Ezra *et al*. 2010). These pathogens usually attack the fruit during bloom/fruit set and as the fruit develops, the fungus spreads to the interior of the fruit causing "black heart" or "heart rot" (Ezra *et al*., 2010 andYehia2013). According to available literatures, this is the first report of *A. alternta* as causal pathogen of black spot of pomegranate fruits in Egypt. Other *Alternaria* species from pomegranate fruits were non-pathogenic. *A. alternata* can be found as an epiphytic saprophyte on all parts of the plant without causing any damage ,hence the integrated control program should include the biological control at the beginning of flowering and fruit settings to avoid fungicide residues and maintain the vitality of flowers, as well as reduce the number of fungicide sprays .Recently, the trend towards environmentally friendly biological compounds has appeared, and among these compounds is bluegreen algae, which showed effective results close to fungicides in controlling most pathogenic fungi of guava and pomegranate and reducing the number of isolated fungi as well. This is consistent with what was found by the Hamed *et. al*.2017 and Aziz *et al*.2020].,where was found that the mechanism of its work is Production of materials that inhibit the growth of fungal hyphae, such as methanolic, ethanolic, diethyl ether, acetone, ethyl acetate, benzene, and chloroform, have proven to be effective in protecting plants against pathogenic fungal species [Jiménez *et.al*.2011;Esserti *et.al* 2017.Also among the biological compounds used are isolates of *Trichoderma* fungus in compound Plantaguard and *Bacillus* bacterium in Rizo N compound, several researchers recorded that biological control agents are sustainable and effective bioagents that could be used for plant diseases(Gandhi *et al*., 2017),*Trichoderma harzianum* and *Bacillus subtilis* gave maximum disease control against *Fusarium oxysporum* f. sp. *Lycopersici* of tomato wilt and *F. graminearum* of wheat (Moussa *et al*.,2013; Estefania and Ligia, 2018; Fitrianingsih *et al*., 2019). Furthermore ,*Trichoderma* spp are considered within the greatest recorded fungi for biological approach for controlling plant pathogens. These antagonists produce various enzymes such as chitinlytic enzyme which implicated as an agent sharing in their ability as biocontrol action (Cherif and Benhamou, 1990;Lorito *et al*., 1993; Lima *et al*., 1997). Atef (2017) reported that application of either *T. harzianum* or *B. subtilis* individually or in combination was effective in control root rot of wheat caused by *R. solani* under *in vitro* and greenhouse trails. Fungicidal effect was very clear that decreasing the diseases pre and post harvest so we spraying the fungicides before flowering and fruiting as protecting guava and pomegranate before disease appeared this results are harmony with **Mahesh, *et.al* 2020.**The post-harvest fungal diseases are responsible for biodeterioration of tropical fruits pulp (Gadgile*et al.*, 2010). Guava and pomegranate fruits shared fungal association in Egypt so, our study received more attention to these fruits. Similarly some species were thought to attack fruits long before harvest and exhibited host specificity i.e. leaves, stems and flowers of guava associated with *B.ciniria* and *Phomopsis psidii* and black spots of pomegranate caused by *A. alternata* while others were observed to be responsible for the postharvest, decay and deterioration as general pathogens. Hence the importance of the integrated control program in this study before harvest, whose symptoms appear after harvest. The program was designed on the basis of the beginning of spraying in February, (after first time of irrigation),when the buds swell, to eliminate any fungal or insect infection from the previous season, and then spraying with fungicides such as Alpha Captan a,Fungal pro ,Collise and TopsenM , at the beginning of flowering, settling and ripening of fruits, biocides are sprayed i.e. Bluegreen ,Plantagaurd and RizoN in order to preserve the flowers from falling, protect the fruits and reduce fungicide residues in them. In this study we found that Fungicides like; thiophanate methyl and Prochlorazol (fungicide) chrisoximemethyl and copper+ sulfur were found to be effective against shoot blight and fruit rot Performance of five fungicides against fruit spot and rot diseases of pomegranate these results are harmony with (Zakaria2021).

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