Suppressive effect of some essential oils on controlling basal rot disease and Biochemistry of garlic cloves

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Abstract

Garlic plant were attacked by basal rot disease caused by Fusarium oxysporum (Schlecht) . Five isolates were used for pathogenicity test all tested isolates caused high percentage disease severity and disease incidence compared with the control. The highest infected isolates, isolate No 3 followed by isolate No 2 caused by Fusarium oxysporum caused basal rot of under greenhouse conditions. Evaluated chemical analysis of healthy dry cloves and dry disease cloves revealed that low carbohydrate, sugar, phenols, flavonoids and sculphure in healthy dry cloves than in disease dry cloves. Three essential oils namely jojoba (Simmondsia chinensis) mint (Mentha viridis) and clove (Dianthus caryophllus) at different three concentrations (5%, 10% and 15%) in vitro and in vivo this results indicted in vitro all essential oils reduced linear growth of the tested Fungi compared with the control essential oil jojoba (Simmondsia chinensis) gave 23.33 the highest effect, followed by mint (Mentha viridis) 31.00 and clove (Dianthus caryophllus) 58.33 concentration of 15% the highest inhibited of the linear growth of fungi in vitro. Under greenhouse conditions and field conditions all essential oils Jojoba (Simmondsia chinensis) , mint (Mentha viridis) and clove (Dianthus caryophllus) concentration 15% reduce percentage disease incidence and percentage disease severity compared with the control while the concentration 15% of jojoba (Simmondsia chinensis) the highest reduce percentage disease severity and percentage disease incidence followed by mint (Mentha viridis) followed by clove (Dianthus caryophllus) under greenhouse conditions and filed conditions during growing seasons 2016 and 2017. This study suggests that to use these essential oils such as Jojoba (Simmondsia chinensis), mint (Mentha viridis) and clove (Dianthus caryophllus) as alternatives to chemical resistance and fungicides because they are cheap, safe to use and do not leave any toxic effects on plants, animals, humans, and the environment, in addition to the easy of obtaining it is available in abundance in nature.

1. Introduction

Garlic (*Allium sativumL.*) is one of the most important vegetable crops in Egypt and all the world. Garlic has many benfinit its used for medical properties and food (Galvez and Palmero, 2021). Fungi which causes many diseases attack garlic cloves in the field during growth season and storage. Fungi

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associated with garlic cloves have been reported by several investigators Fusariun solani (Kararah and EL-Tobshy, 1979) and *F. oxysporum* (Radwan, 1980). Five fungi were isolated from garlic. These fungi included *Asprgillus niger, Botrytis allii, Fusarium oxysporum, Penicillium citrimum* and *Penicillium funiculosum* (El-Shabrawy et al., 1981). Clove rot caused by a variety of fungus species, including *Fusarium culmorum, Fusarium proliferating*, *F. oxysporum, Aspergillus niger, A. orchaceus, Botrytis alli* (Moharam *et al*.,,2013, Elshawy, *et al* .,2017). Essential oils , gums, etc . have been shown to exert biological activity against plant fungal pathogens in vitro and in vivo and can be used as bio-fungicidal products (Lozano etal.,2000, Jalili et al.,2010, Bhardwaj,2012 ,Romanazzi *et al*,.2012 and Dewidar *et al* .,2019). It is recommend to use these plant oils as alternative to chemical resistance and fungicides ,because they are cheap and safe to use, and do not leave any toxic effects on plants, animals ,humans, or structures, environmental, addition to the ease of obtaining them due to their abundance in nature. Oil extract of jojoba seeds at different concentrations from 1 to 10 % gave good control against powdery mildew incidence on different plants mentioned that using garlic and jojoba extracts under field conditions as seed treatment at the concentration 15% significantly reduced disease incidence (Hicks,2001), (Reyad and Attia2016), and (Soliman *et al*.,2013). The aim this work to isolation the causal pathogen of basal rot of garlic and control the disease by using some essential oils and study the relation between garlic in fiction and biochemical changes.

2. Methods and tools Material and methods

2.1. Isolation of the causal pathogen:

Five isolates were isolated on samples of diseased garlic cloves were collected from different localities of Assiut Governorate isolation procedures was carried out using infected garlic cloves. Soaking the infected cloves in 1% sodium hypochlorite solution for 10 minutes followed by complete washing in sterile distilled water was used for surface disinfestation of infected sample before plating on potato dextrose agar (PDA) medium at 27 °C for 5-7 days. Pure culture of the developing fungi was obtained by single spore isolate (Moharam, *et al*., 2013).

2.2 .Pathogenicity test:

Preparation of the fungal inoculum of 5 isolates of *F. oxysporum* were prepared by inoculating sterilized milk bottels 0.5 L containing barley medium by disca of F.oxysporum incubated at 27°C for 2 weeks described by (Abd-El-Moniem, 1996). Pots 25 cm diameter inoculated by containing sterilization sandy loam soil artificially infested with tested fungi. Soil inoculation was performed by mixing of 3 % of the inoculate with soil in each pot (150g/5Kg soil) and then directly pot was seeded with 5 cloves. Three replicates were used for each tested. Three replicates were used as control without inoculation disease severity and disease incidence were recorded after 60 days.

2.3.Biochemistry of Garlic cloves:-

- Determination of total phenolic contents in the garlic dry cloves.

The concentration of phenolic in plant extracts was determined using spectrophotometric method (singleton *et al*., 1999)

- Determination of flavonoid concentration in the garlic dry cloves.
- The content of flavonoids in the examined plant extracts was determined using spectrophotometric method (quartier *et al*., 2000.
- Total soluble sugars found according to the method used by (Yemme Willis 1954). Sulphur according to (Anon, 1985).

Study (Petropoulos *et al*., 2018) reported that the main carbohydrate.

2.4. Effect of three essential oils on the linear growth of F. oxysporum in vitro:

The concentrations 1.5 ml / later was used of essential oils jojoba (*Simmondsia chinensis*) mint (*Mentha viridis*) and clove (*Dianthus caryophllus*) were prepared by adding suitable amount 0.015 of each tested concentrated to 5 ml, 10 ml and 15 ml (PDA) medium in petri dishes. Inoculation was done with fungal discs, (5mm) in diameter obtained from *F. oxysporum* 7 days old culture Three replicates were used for each tested concentrate. Another group of (PDA) plates free from essential oils inoculated with the fungus as control. All plates were incubated at 27°C for 7 days. Linear growth was recorded. The percentages of reduction in the mycelia growth were calculated. The obtained data were statistically analyzed, according to (Snedecor and Lazzaretti *et al*., 1995). Statistical analysis:
The collected data were statistically analyzed using two factor and 0.01 level probability L.S.D. (Constantinescy. *et al*., 2002)

2.5 Greenhouse experiment:

This experiment was carried out in Arab EL- Awamer growing 2016 and 2017.
Tow isolates No2 and No3 were used garlic of cloves (baladyc.v.) were sown in pots 25Cm in diameter, were sterilized by dipped in 5% formalin solution for 15 minutes, left to dry for two days to get rid of formalin residues, then filled with soil previously autoclaved for two hours at 121°C. Fungas inoculation of *F. oxysporum* were added to the sterilized potted soil at rate 3% of the inoculum. Seven days after the inoculation with the pathogen, pots were sown with garlic cloves (balady c.v.) after soaked into oils jojoba (*Simmondsia chinensis*) mint (*Mentha viridis*) and clove (*Diamnthus caryophllus*) for 15 minutes before planting. Disease severity was determined after 60 days from planting. Data were statistically analyzed as Randomized Complete according data (Galal *et al*., 2002) using the formula as following : percentage of rot severity = (w1 - w2) / w1 × 100 w1 where is : the total weight of the clove, and w2 is the clove's weight after decayed tissue has been removed.

2.6.Field experiment:

Field experiment was carried out in the experimental farm of Arab EL- Awamer research station, Assiut Government, Egypt during growing season (2016 - 2017) and (2017 - 2018). The soil as method before determination of disease severity and disease incidence percentage as described before statically analysis. Randomized complete block design with three replicate plots of 10.5 m^2 Evaluation of preside recoded along with the yield per plot at harvest time 90 days of planting recorded as percentage of infection and disease severity at harvest. Data presented in Table (2) indicated that the all isolates of *Fusarium oxysporm* causal highest percentage disease incidence and disease percentage every significantly compared with control. Data also indicated that isolate No (3) causes highly percentage disease incidence and disease severity while the isolate No (5) caused lowest percentage disease severity or percentage disease incidence.

Table (1): Scientific English and Arabic names of Essential oils and their natural component:

Essential oils	English name	natural component	Arabic names
Simmondsia chinensis	Jojoba	Gadolic acid	زيت الجوجوبا
Mentha viridis	Mint	Menthend	النعناع
Dianthus caryophyllus	Clove	Eugenol	القرنفل

This is parallel line with results reported by (Ibrahim and Zein El-Abdee 2000) and (Osman 2004). Among natural plant oils tested, was the most efficient. These results were confirmed by (Ata, 2005

and Ata, *et al.,* 2006) on suger beet rust disease. Garlic extract showed high suppressive effect on linear growth of *R. solani* and *F. solani* (Kuruchve and Padmavathi, 1997) and (Abd El-Moniem, 2001). Jojoba seeds oil extract at different concentration 1% and 10% gave good control for powdery mildew disease - incidence on different plants (Hicks, 2001). Data presented in Table (2) indicated that all isolates of *F. oxysporum* causes root rot disease of garlic. Data also show that isolate (No.3) was the highly pathogenic followed by isolate (No.2) These results were in agreement with the finding of (Hicks, 2001) and (Reyad and Attia, 2016), (Soliman *et al*., (2013).

Table (2): Pathogenicity test five isolates of *F. oxysporum* causal pathogen of root rot of garlic under greenhouse coditions:

Fusarium oxysporm	**Disease incidence %**	**Disease severity%**
(1)	20.00	13.30
(2)	23.33	14.43
(3)	26.67	19.63
(4)	16.67	11.47
(5)	13.33	9.20
Control	0	0
L . S . D 5%	6.22	2.20
L . S . D 1%	8.83	3.13

Data presented in Table (3) indicated that SO4 9.27% more and phenols indisease dry clove compared with healthy dry cloves.While total carbohydrates 47% and total sugar 0.98% more in healthy dry cloves compared with disease dry cloves. Data presented in Table (3) indicated that total phenols more in infected dry clove compared with healthy dry cloves this result agree with (Manal El- Shazly and Abd El Wahab 2017) which said the increased quantity of phenolics in infected plant may be contributing to the resistance against the infection. Data presented in Table (3) also indicated that flavionids 113.74% more in infeedted dry clove compored with healthy dry cloves this results agree with (Sicilant *et al.,* 2015) . The biosynthesis of sakuranetin (a flavanone) in rice was shown to increase the plant resistance to infection against bakanaa caused by fusarium (Hasegawa fujikuroirce *et al.,* 2014) cenblast cause by *Magnaporthe oryzae.*

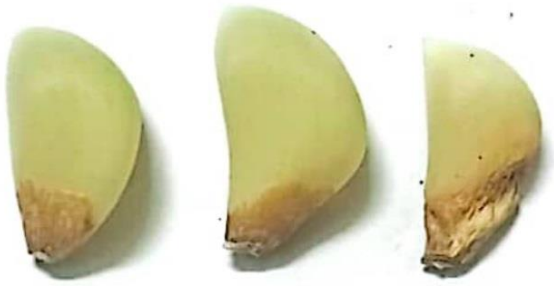
Flavonoid , such as kaempferol inhibits auxin transport , which enhances auxin concentration in the corticap cells and accelerates cell division and growth. Together these physiological a chemical processes lead to the for mation grycosyration and acyration of flavonoids have been identified, which collectively contribute to the diversity of the flavonoids synthedsized by plants (Alseekh, *et al.,* 2020).

Data presented in Table (4) indicated that all three essential oils inhibited linear growth of *F. oxysporum in vitro* compared with the control untreated with essential oils the most effective in habiting the linear growth of *F.oxysporum* Jojoba oil (*simmondsia chinensis*) followed by mint oil (*Mentha viridis*) and clove oil *(Dianthus caryophllus)* in all concentration while the concentration of 15% the heights inhibition linear growth of the pathogen compared with all the concentration.

Data also indicted that concentration 15% in all essential oils more effective in reducing linear growth of *F.oxysporum in vitro.*Also indicated that isolate No (3) more effective than isolate No (2). Data also indicated that Jojoba more effective inreducing linear growth of *Fusarium oxysporum in vitro* this results agree with *(*Elshaer *et al.,* 2019) who said that Jojoba (*simmondsia chinensis*) were tested for their ability to inhibit mycelial growth of the pathogenic fungi *Fusarium solani*, *Macrophomina phaselonia* and *Rhizoctonia solania* under the lab condition.

THE CHEMISTRY OF GARLIC

Normale clove



showing rot lesions penetrating the cloves include polygonal light brown centrally depressed spots that are not easily detected.

showing brown discoloion of the stem plat tissue later, the stem plate.

figur (1) showing Normal clove and dry rot.

Table (3): Biochemistry composition constituents of healthy garlic dry cloves and diseased garlic dry cloves:

Biochemistry composition		
1-Carbohydrates	**Healthy garlic dry cloves**	**diseased garlic dry cloves**
	7.40	6.04
2- sulfer SO4 %	9.27	15.82
3- Phenols %	1473.22	8872.06
4- Flavonoids %	113.74	444.31
5- Sugars %	0.98	0.65

Table (4) : Effect of three essential oils on the linear growth of *F. oxysporum in vitro*:

Essential oils	**Concentration**	**Linear growth (mm)**	
		Isolate 2	**Isolate 3**
Jojoba	5%	30.00	31.00
Mint		43.00	43.00
Clove		62.67	66.67
Mean		45.22	46.89
Jojoba	10%	30.67	29.00
Mint		41.33	38.33
Clove		60.67	64.00
Mean		44.22	43.78
Jojoba	15%	23.33	26.67
Mint		31.00	33.33
Clove		58.33	60.67
Mean		37.56	40.22
Control		89	89
LSD 5%	**Conc.**	14.251	15.422
	E. oils	4.3892	3.7577
	Conc. x E. oils	4.2018	4.7036
LSD 1%	**Conc.**	19.313	20.899
	E. oils	5.9481	5.0923
	Conc. x E. oils	5.7569	6.4443

Conc. : Concentration - **E. oils:** Essential oils

Data presented in Table (5) indicated that Jojoba oil more effective in reducing % disease severity and % disease incidence this results agree with (Manal El-Shazly and Abd El-Wahab 2017) who said that all treatment with Jojoba seeds extract caused virus inhibition when plant were sprayed before the virus transmission in onion plant Egypt. (Soliman *et al.*, 2013) mentioned that using garlic and jojoba extracts under field conditions seed treatment at the concentration 3% significantly reduced disease incidence and also increased the percentage of yield components, e., the number and weight of pods/plat and dry weight of 100 seeds followed by jojoba extracts.

Data presented in Table (5) indicated that concentration 15% of Jojoba more effective in reducing disease incidence percentage and disease severity percentage followed by mint and clove under green house conditions during growing seasons (2016 and 2017).

Data presented in Table (5) also indicated that isolate No (3) more effective in reducing disease severity percentage and disease incidence percentage than isolate No (2) during growing seasons (2016 and 2017) under green house conditions. Role in the ability of Jojoba, in controlling *Fusarium oxysporum* may be attributed to the presented of Jojoba oil wax esters which are derived from esterification of monoethylenic acids and monoethyfenic alcohols, these compounds block the

movement of the pathogenic fungi (Hicks , 2001). Data presented in Table (5) indicated that the tested natural essential oils tested significantly reduced the development of Basal rot disease of garlic during two tested seasons when compared with control this result agree with (Hicks, 2001) , (Reyad and Attia, 2016) and Soliman *et al*., (2013). Data presented in Table (6) indicated that concentration 15% of Jojoba more effective in reducing disease incidence percentage and disease severity percentage followed by mint and clove under filed conditions during growing seasons (2016 and 2017).

Table (5): Effect of Essential oils on the disease incidence and disease severity at concentration 15% of Basal of Basal rot disease in green house during 2016 and 2017 growing season:-

Isolate No	Essential oils	2016 season		2017 season	
		Disease incidence %	Disease severity %	Disease incidence %	Disease severity %
2	Jojoba	33.50	12.75	34.50	11.75
3		35.00	14.18	36.00	13.50
Mean		34.25	13.46	35.25	12.62
2	Mint	40.75	14.87	41.75	15.00
3		41.50	15.18	42.00	16.18
Mean		41.12	22.46	41.87	15.59
	Clove	46.50	16.90	46.00	14.90
		44.50	15.90	43.50	20.90
Mean		45.5	16.40	44.75	17.90
	control	21.50	20.50	20.50	25.40
L . S . D	5%	4.75	1.33		
	1%	2.54	1.36		

Table (6): Effect of Essential oils on the disease incidence and disease severity at concentration 15% of Basal of Basal rot disease in under filed conditions during 2016 and 2017 growing season:-

Isolate	Essential oils	2016 season		2017 season	
		Disease incidence %	Disease severity %	Disease incidence %	Disease severity %
2	Jojoba	30.00	14.50	33.00	18.75
3		34.00	20.00	35.00	17.50
Mean		32	17.25	34.00	18.12
2	Mint	36.00	13.75	44.25	19.00
3		40.00	15.00	46.20	18.00
Mean		38	14.37	45.22	18.50
2	Clove	45.00	15.70	45.70	20.70
3		44.00	17.90	47.50	22.90
Mean		44.50	16.80	46.60	21.80
	control	21.50	20.50	20.50	25.40
L . S . D		4.75	7.33		
		6.57	10.16		

References

[1] Abd- El- Moneem KMH, (1996).Effect of Micronutrients on incidence of sesame charcoal root rot and wilt disease complex Assiut Journal of Agricultural Sciences 27 : 181 - 195.

[2] Anon, (1985) witer oilseed rape growing systems technical Note 66 cH, The North of Scotland collage of Agriculture ,Aberdeen

[3] Al seekhs., perezde Souza L, Benina M, Fernie AR (2020). The style and substance of plant flavonoid

decoration, towards defining both structure and function. Phytochemistry. 174 : 112 – 347.

[4] Ata, A.A. (2005).Studies on suger beet rust disease in Egypt. M.S. Thesis, plant path Dept., Fac. of Agric., Ain Shams univ. Cairo, pp124.

[5] Ata, A.A, El - Samman, G.M., Moursy, Maysa, A., Masour, M.I. and Mostafa, H.M. (2006) control of beet rust by natural plant oils and systemic fungicides. Agric , Ain Shams univ., Cairo, Egypt,.Annuals Agric. Sci., sp. Issue, I, 193 - 205.

[6] Bhardwaj,S.K.(2012).Evaluation of plant extracts as antifungal agents against Fusarium solani (Mart,) Sacc,World Journal of Agricultural Sciences.8(4):385 : 388

[7] Constantinescys, F., Sesan, T.E., Eland, Y., KohI, J. and Shtienbery, D. (2002). soil -born funge and host plant influence on the efficacy of Bacillus subtitlis boi- control against proc. 7th work. group meat., Influence of Abiotic and Biotic factors on Bio- control Against. Pin Bay Kusadasi, Tukey 22 - 25 May 2002.

[8] Dawood,K,M,Y.M.Shabana,El- Sayed A.Fayzalla and El –Sherbiny (2003). Search for antifungal compounds of plant origins for biological control of plant diseases. J.Agric. Sci.Mansoura Univ.,28(7)5317- 5333.

[9] Dewidar,A.A.I.,Kenawy,A,G.M.I and Ghabrial, E.W.R.(2019). Influence of different garlic treatments on controlling basal stem rot, root rot and infection by broomrape in geranium plants .Egypt .J.phytopathol.,47(1):347- 366.

[10] El-Shaer,A.H.,Imara,D.A.,Soliman,M.S.,kHafagi,E.Y.and EL- Nahas,S.E.M.(2019) Potential Antifungal Activity of Two Plant Extracts and jojoba oil aginst fumgi causing straw berry crown and root – rots .Egypt.J.Phytopathol.,Vol.(47) No20,121 - 140

[11] EL-shabrawy , A.M.,Amein , A.M. and Selam, A. (1981) . Resistance of garlic cultivars to certain storage diseases in relation to their chemical composition. Assiut .J.Agric.Sci.,12: 137.

[12] El-Shahawy, I.E., Said, N.M., Morsy, A.A. (2017). Fusarium proliferatum, the main cause of clove rot during storage, reduces clove germination and causes wilt of established garlic plants; Journal of plant pathology, pp. 85 - 93.

[13] Galal, A., Abdel Gawad, T., El Bana, (2002). Post - harvest decay of garlic cloves caused by Bacillus polymyxa and Fusarium moniliforme, Egyption Journal of Microbiology, 37 (1): 71 - 88.

[14] Galvez, L., Palmero, D. (2021). Incidence and Etiology of post harvest fungal Diseases Associated with Bulb Rot in Garlic (Allium Sativum) in Spain. Foods, 10 (5): pp. 1063.

[15] Hasegawa M, Mit Suhara I, seos, okadak, Yamane H, Iwai I, (2014). Analysis on blast fungus – responsive characters of a flavonoid phytoalexin sakuranetir, accu malation in infected rice leaves antifungal activity and dexoxification by fungus Molecules No. 19 (8) : 18 – 11404.

[16] Hicks, S.C. (2001). Method of controlling powdery mildew infections of plants using Jojoba wax Espacenet patent search. Bibliographic Data: us 6174920 (BI): 1-12.

[17] Ibrahim, Thanaa F. and Zein El-Abdeen A. (2000). Biological control of Acremonium wilt of grain sorghum caused by Acremonium strictum, Annals Agric. Soc. Moshtohor, 38 (1): 199 - 208.

[18] Jalili–Marandi,R.,Hassani,A.,Ghosta,Y.,Abdollahi, A.,Pirzad,A.and Sefidkon, F.(2010).Thymus Kotschyamus and Carum Copticum essential oils as botanical preservatires for table grap. Journal of medicinal plants Research, 4(22): 2424-2430.

[19] Kararah M.A,and EL-Tobshy, Zeinab.(1979). Preliminary observations on the effect of certain phytopathogenic organisns on garlic deplation phenomenon. 3ed Egypt . phytopathological congress, 419 -443.

[20] Kuruchve, V. and Padmavathi, R. (1997). fungi toxicity of selected plant products against pythium aphanid ermatum. Indian phytopathol., 50 (4): 529 - 535.

[21] Lazzaretti, E., Menten, J.O.M. and Bettiol, W. (1995). Treatment of wheat seed with Bacillus subtitlis for the control of pyricularia oxyzae, Bipolaris sorokiniana and Alternavia tenuis. Phytologyic, 21 (21): 163 - 167.

[22] Lozano,T.C,Cordoba, S.N., Avila-de-Moreno, C.; Velosa, R.M. and de Morno, C. 2000. Evoluation of the effect of hydrolates of garlic (Allium sativum) and weshonion (Allium fistulosum) on the development of the phtopa thogenic fungi Botryis allii and sclerotium cepivorum fitopathologia-colombiana, 24 : 29-32.

[23] Moharam, M.H., Farrag, E.S., Mohamed, M.D. (2013). Pathogenic fungi in garlic seed cloves and first report of Fusarium proliferatum causing cloves rot of stored bulbs in upper Egypt; Archives of phytopathology and plant protection, 46 (17): 2096 - 2103.

[24] Manal . A. El- Shazly and A.S. Abd El-Wahab (2017). Effect of Jojoba seed extract and Riboflavin inpreventing the transmission of tris yellow spot virus (IYSV) to onion plant in Egypt . Iinternational Jornal of virology 13 : 14 – 28.

[25] Nadia A. and EL- Safwani.O.B.Nasf,(2002) Anti fungal activity of some plant Extracts aganinst Damping off Diseease of Lupin and Chichkpea seed lings. J.Agric.Sci.Mansoura Univ.,27(5): 2945-2953).

[26] Osman, Ettimad A.H. (2004). Studies on the interaction between soil microflora and the pathogenic organisms causing sorghum diseaces. MSC. Thesis Agric, Microbiol. Dept., Fac. of Agric Cairo univ. Egypt pp 166.

[27] Quettier, D.C., Gressier, B., vassEur, J. Dine, T, BruNet, C., Luyckx, M.C., Cayin, J.C., Bail Leu L, F., trotin, F (2000). Phenolic compounds and antioxid ant activities of buckwheat (Fagopyrum esculentum Moench) hulls anfbur. J. Ethnopharmacol. (72) : 35 – 42.

[28] Radwan, I .A.M.(1980).studies on storage diseases of garlic in A.R.E.Ph.D. Thesis , Fac.Agric.,Zagagzig University,

[29] Reyad, N. and Attia, M.F. (2016). Management of Zinnia powdery mildew using safe alternatives to fungicides. Egypt. J. Phytopathol., 44 (1): 134 - 155.

[30] Romanazzi, G.,Lichter, A., Gabler, F.M. and Smilanick, J.L.(2012) Recent advances on the use of natural and safe alternatives to conventional methods to control postharvest gray mold of table grapes . postharvest Biology and Technology,(63):141-147.

[31] Selim, E.M., Ammar, M. Amer, G, Awad, H. (2020). Effect of some plant extracts, plant oil and Trichoderma spp on tomato fusarium wilt disease. Menoufia, J. plant prot. (5): 155 – 167.

[32] Siciliant I, Amaral careiro G, spadaro D, Garibaldi A, Gullino MI. (2015). Jasmonic acid, abscisic acid, and salicylic acid are involved in the photoalexin responses of rice to Fusarium fujikuroi, a high gibberellin producer pathogen. J. Agric. Foodchem. 63 (37) : 42 – 8134.

[33] Singleton, V.L., Orthofer, R., Lamuela – Raventos, R.M. (1999). Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin-ciocal teureagent. Methods Enzymol (299) : 152 – 178.

[34] Soliman, N.K., Saber, M.M. and Ahmed M.F.A. (2013).Evaluation of some plant extracts on controlling damping - off and root - rot diseases of been (phaseolus vulgaris L.,). Egypt. J. Phytopathol., 41 (1): 185 - 198.

[35] Yemme, E.W.j willis, A.J. (1954). The estimation of carbohydrates in plant extrats by anthrone.Biochemical Journal, lon.V.57n 3p.508 – 514.