Minufiya J. Agric. Res. Vol.37 No. 1: 139 - 152 (2012) "http://www.mujar.net"

EFFICIENCY OF SOME RESISTANCE INDUCERS AND GA_3 TO GARLIC YIELD, QUALITY AND ITS EFFECTS ON PURPLE BLOTCH DISEASE (*Alternaria porii*)

N. S. Youssef[1] and A. A. Galal[2]

1- Vegetable Res. Dept. Hort. Res. Inst., Agric. Res. Center (ARC) Giza, Egypt.
2- Plant Pathology Dept, Fac. Agric., Minia University.

(Received: Oct. 23, 2011)

ABSTRACT: *Horticultural and Pathological experiments were carried out at the Experimental Farms of Mallawy Agriculture Research Station, Hort. Res. Institute, Giza, Egypt and the Lab of Plant Pathology Dept. Fac. Agric. El-Minia University during the 2006/2007, 2007/2008 and 2008/2009 growth seasons of garlic cv. "Sids 40". This research was studied the efficiency of elicitors e.g., (Benzothiadiazole (BTH), p-coumaric acid (CA), Salicylic acid (SA), Propylgallate (PG) as resistance elicitors (RE), Gibberellic acid (GA_3) as growth promoter compound, Pentachloronitrobenzene (PCNB) and Mancoper, 69.5% WP (MC) as an effective fungicide were used as positive control. These treatments were used at 100 ppm conc. except MC which used at 2000 ppm conc. Garlic cloves were soaking for 48h in Vitro to determine the germination %, radical length and the root number. Also, in Vivo the previous treatments were used by soaking garlic cloves for 24h. Also, the plants were foliar sprayed three times (after 100,110 and120 days from planting) with the same conc.*

The horticultural studies have revealed that, SA and CA treatments caused restrain for the growth of the shoot, radical length and number compared to the control treatment. The highest root number was recorded with GA_3 followed by BTH. The radical length and plant height were all higher with BTH than those of the control.

In Vivo, the results showed that GA_3 was more effective for increasing plant height (cm). However, the lowest values were recorded with SA and CA treatments; it's reflected a favorable effects and significant increase in the shoot fresh weight of whole plant (g). Also, the fresh and cured yield was significantly affected by the defense elicitors treatments used. Both SA, CA in the first season and CA in the second season promoted fresh and cured yield (ton/fed.) and quality characters needed for bulb diameter (cm), bulbing ratio and weight loss %. Also, PCNB recorded a significant increase in the cured yield (ton/fed.) in the second season with insignificant differences with SA treatment.

The pathological studies in Vitro revealed that GA_3 and PG were promoted treatments for enhancing the mycelial linear growth (cm) but BTH and MC were promoted treatments for increasing spore formation (sporulation) of A. porii. Salicylic acid treatment was strongly inhibited the mycelial linear growth and sporulation (spore formation) and can be used for the induction of systemic acquired resistance (SAR). The highly protectant % based on mycelial linear growth (cm) was recorded with SA (100%) followed by MC (53.93 %), CA (45.25 %). In Vivo, The all Inducers elicitors and GA_3 treatment recorded the lowest significant disease incidence compared to the control treatment (tap water). The best performance for controlling purple blotch disease was recorded by CA and SA besides the fungicide (MC) treatments.

Key words: *Garlic, cv. "Sids 40",resistance elicitors, growth promoter, purple blotch, Alternaria porii,*

INTRODUCTION

Garlic (*Allium sativum* L.) is an annual bulb crop, an aromatic bulb and herbaceous annual spice crop (Kurian, 1995). In terms of production, garlic is ranked second after onion (Valadez, 1992) and has higher nutrition and medical value than onion (Bachamann, 2001) and one of the main vegetable crops in Egypt. The increase in yield and improving bulb quality of garlic with little risks on the human and environment can be achieved and it is usually dependent on many factors. Inducing systemic resistance in the host plant become a good target for increasing

yield, minimizing disease incidence/severity with least cost and without environmental pollution (Elad, 1992, Galal and Abdou, 1996 Galal *et al.*, 2000).

Among the foliar diseases, purple blotch is one of the most destructive diseases, commonly prevailing in almost all onion growing areas of the world, which causes heavy loss in onions under field conditions (Kumar and Palakshappa., 2008). Due to health risk and pollution hazards by use of chemical fungicides in plant disease control, it is considered appropriate to minimize their use.

Previous studies showed that improving agricultural treatments through the application of some defense elicitors to induce systemic acquired resistance (SAR) of plants against fungi has been successfully used. Radman *et al.*, (2003) showed that the plants which show physiological and morphological responses to a range of physical and chemical factors known as "elicitors". These responses have been considered as defense reactions:" elicited". Many compounds provides good protection against fungal and bacterial pathogens of many crops in greenhouse as well as field conditions but few literature on the efficiency of these compounds on garlic yield and on the garlic purple blotch disease caused by the fungi *Alternaria porii* were reported.

Applications of chemicals which activate plant defense mechanisms before pathogen attack with no environmental side effects have drawn a considerable attention of the researchers.

The synthetic chemical a benzothiadiazole (BTH) (2,6 dichloroisonicotinic acid), has been release in Europe as BION (Syngenta Ltd., Basel, Switzerland) and in the United States as Actigard (Syngenta Crop Protection Inc., Greensboro, North Carolina). It is a functional analog of the plant endogenous hormone-Like compound salicylic acid (SA), which is required for the induction of plant defense genes leading to SAR (Hien Dao, *et al.*, 2009). It has been used for the induction of SAR in wheat, bean, soybean, barley against fungal and bacterial pathogen (Dann and Deverall, 1995) and on pepper when applied as foliar spray against *Sclerotinia sclerotiorum* (Yusuf and Sally, 2004). Colson-Hanks, *et al.*, 2000 showed that reduced susceptibility of the cotton plants to Alternaria leaf spot was attributed to systemic acquired resistance caused by the application of BTH.

Salicylic acid (2-hydroxy benzoic acid) has been implicated in several other processes in plants like thermogenesis, flowering, germination, fruit yield, bioproductivity, etc., (Ansari and Misra, 2007). SA is a natural phenolic compound (Klessig and Malamy, 1994). It has been considered a natural growth regulator with numerous functions in plants (Raskin, 1992 and Zhou *et al.*, 1999), many reports regarding pre-treatment of plants by SA showed to be effective against *Alternaria* sp. Fungi in tomato and other plants (Spletzer and Enyedi, 1999 and Coquoz *et al.*, 1995) SA, which derives from shikimate-phenylpropanoid pathway, is first converted to trans-cinnamic acid and it is then either hydroxylated to O-coumaric acid. It has been suggested that coumaric acid are organic compounds and has antioxidant properties (Kiyomi *et al.*, 1983). Also, Stejskal *et al.*, 2001 showed that propylgallate, (PG) (Three hydroxyl groups) has strong antioxidant effect in foods, blocks activity of lipoxygenase and play role for increasing pigment contents and yield of potato (Youssef and Abd Allah, 2007). Ismaeil *et al.*, 2006 found that ascorbic acid, BTH, citric acid, SA and PG were able to induce resistance in sunflower plants against *Sclerotium rolfsii*. Plant hormones play an integral role in controlling the growth, metabolism and morphogenesis of higher plants (Taiz and Zeiger, 1991). Gibberllins are the most powerful of the growth promoters (Khan and Chaudhry, 2006).

We examined if the exogenous application of SA and other chemicals including: PG, CA, GA_3, BTH, MC and PCNB as garlic cloves seed soaking + foliar application could activate SAR against garlic purple blotch disease caused by *Altrnaria porii* and effects on garlic bulb yield and quality.

MATERIALS AND METHODS

In Vitro experiments: These experiments were conducted on the first week of October, 2007 and 2008 seasons at the Lab of Mallawy Agric. Res. Station. Horticulture Res. Inst. Garlic heads were chosen according to larger size homogenate, free from all defects Then the different treatments were used as recorded in Table 1: these 8 treatments were applied by soaking the seeds of garlic cloves for 48h every mention solution each at the mentioned concentration in Table 1, then rinsed and seeded in Petri Plates (12.0 cm), four Petri Plates/ treatment were used, ten garlic seed cloves/Petri Plate were incubated in growth chamber (25 ^{o}C ± 2 and 16h photo period) and droplets from water were added in the Petri plates when needed during the incubation period. After 10 days from seeded, the average shoot and root length (cm) and number of roots/ clove were recorded.

Field experiments:

On October, 10, of 2007 and October 5, of 2008 seasons, garlic cloves (cv. "Sids 40") were planted at the Experimental Farm of Mallawy Agric. Res. Station. Horticulture Res. Inst. Garlic heads were chosen, largest size, free from all defects. Then the different resistance elicitors, growth promoter and fungicide treatments were used as in Table 1:

These treatments were applied by soaking the seeds of garlic cloves before planting and the plant were foliar sprayed again. The chosen garlic cloves were soaked for 24h in every one of the above solutions, then rinsed and planted at spacing of 10 cm in both sides of ridges of rows which were 60 cm in apart and 3m in long. Each experimental plot consisted of 4 rows. The treatments were arranged in a randomized complete block design with three replicates. The agricultural practices for garlic production were followed as recommended by Ministry of Agriculture and garlic requirements for fertilization in accordance to the available nutrients in the soil which listed in Table 2.

Table (1): Concentrations and forms of the resistance elicitors, growth promoter and fungicides treatments

Treatments		Conc. (ppm)	Forms	Molecular weight (g/mol)	
Benzothiadiazole	(BTH)	100	C6H4N2S	136.174	Resistance elicitor
Salicylic acid	(SA)	100	C7H6O3	138.12	Resistance elicitor
Propylgallae	(PG)	100	C10H12O5	212.199	Resistance elicitor
p-Coumaric acid	(CA)	100	C9H8O3	164.15	Resistance elicitor
Gibberellic acid	(GA3)	100	C19H22O6	346.37	Growth promoter
Pentachloronitrobenzene	(PCNB)	100	C6Cl5NO2	295.33	fungicide
Mancoper (69. 5% WP)	(MC)	2000			fungicide
Control (tap water)		0.00	H2O	18.00	

Table (2): Some physical and chemical properties of the soil at depth of 0-30 cm (average in the two seasons)

Texture grade	Sand	Silt	Clay	pH	E.C	CEC	CaCo3 %	O. M	Available nutrient (ppm)		
									N	P	K
Silt/Clay	16	41	43	8.36	1.12	37	1.8	1.07	50	11.5	83

CEC = Cation exchange capacity (meg/100g soil) E.C = Electric conductivity (ds/m, 1:5 soil water extract)

After 100 days from planting, plants were foliar sprayed with the previous solutions 3 times (100, 110, 120 days after sowing). In the control plot only water was sprayed in the same manner of the defense elicitors. Three weeks before harvest, ten plants were randomly taken from each experimental plot to determine: plant height (cm), whole plant fresh weight (g), bulb diameter, bulbing ratio: (neck diameter/bulb diameter) according to Mann (1952).

Garlic was harvested on 20th and 13th of April 2008 and 2009, respectively. Fresh yield (kg/plot) at harvesting date was recorded. All data were calculated as ton/fed. The harvested garlic plants were left to be cured for 21 days as curing process in the open field. Random samples about 5 kg of cured plants were taken from each plot of each treatment in both seasons and packed in small nylon net bags. These samples were stored under the room condition. The stored garlic samples were taken out from the store room after 6 months and weight loss % were recorded using the following formula: Weight loss % = (initial weight of cured sample – actual weight at the specific time of storage/initial weight of cured sample X 100) (Gomea, 2006)

Pathological experiments:

1- Isolation the causal agent of garlic purble blotch (*Alternaria porii*):

The causal agent of purple blotch disease of *Alliums* species *Alternaria porii* was isolated from the garlic "c.v. Sids.40" previous plant crops (2006/2007) growing seasons. Diseased samples were collected, washed by tap water, surface sterilized by 1 % sodium hypochlorite for 3 min, rinsed 3 times by sterilized distilled water then small portions from the area between healthy and diseased leaf tissues were cut and transferred onto Petri plates containing nutrient agar medium, 15 ml medium in each plate. Plates were incubated at 20°C and the fungal was examined. Developed hyphal forming fungus typical of *A. porii* was purified using hyphal tip technique. Disks were taken from each culture and kept on nutrient medium plate and slants until further use.

2- Direct effects of resistance elicitors (BTH, CA, SA, PG) and growth promoter (GA_3) compared to fungicides PCNB and (MC) on

a- Growth of *Alternaria porii* in *Vitro*.

Erlenmyer flasks 250 ml containing nutrient agar medium (beef extract, 3g; yeast extract, 5g; D-glucose, 5g; agar,18g;/1000 distilled water) was either amended or not (control) with 100 mg/l of the resistance elicitors treatments and 2g/l for MC (Table 1), 1 flasks/ treatment. Flasks were autoclaved, after flasks had been cooled, each flask/treatment was dispensed into Petri plates, 5.0 mm diameter plugs of 20-day-old cultures of *A. porii* grown on nutrient agar medium were inoculated, incubated for 20 days at 25 °C and then the mycelial growth and sporulation (spore formation) were registered.

b- Disease incidence of *Alternaria pori* in *Vivo*

After the application of resistance elicitors treatments, (120 days from planting) garlic purple blotch disease was recorded from all plots and compared it with the control treatment (tap water) and the fungicide treatments (PCNB) and (MC) as positive control.

Statistical analysis: All recorded data were subjected to the analysis of variance procedures and treatment means were compared using the Duncan as described by Duncan (1955).

RESULTS AND DISCUSSION

In vitro experiments

Shoot and root initiations:

Data in Table 3 reveale that, SA and GA_3 and CA treatments caused restrain for the growth of the shoot length (cm) in the two seasons. The highest shoot and root length was recorded with BTH in the two seasons compared to the control treatment. The highest root number was recorded with GA_3 followed by BTH in the two seasons. Mancoper (MC) and PG treatments were intermediate. While the lowest root number was recorded with SA treatment. These results are in agreement with those reported by Feng *et al.*, 2007.

Table (3): Efficiency of some resistance elicitors, growth promoter and fungicides treatments on the shoot and root initiation of garlic cloves cv. Sids 40 seed soaking (48h) after 10 days from seeded in Petri Plates (25°C ±2) in the two successive seasons of 2007/2008 and 2008/2009

Treatments, ppm	First season			Second season		
	Shoot length (cm)	Radical length (cm)	Number of roots	Shoot length (cm)	Radical length (cm)	Number of roots
Benzothiadiazole (BTH), 100ppm	15.50±0.78	7.85±0.28	21.0±2.64	8.0±0.86	6.66±0.28	15.33±1.15
Coumaric acid (CA), 100ppm	10.75±0.8	3.26±0.28	14.33±2.08	6.5±0.5	6.33±0.28	14.66±1.15
Gibberellic acid (GA3), 100ppm	11.21±0.96	5.68±0.60	23.0±1.73	2.4±0.52	6.83±0.28	17.73±1.41
Propylgallate (PG),100ppm	14.08±0.8	4.71±0.36	18.0±1.73	6.83±0.28	6.50±0.50	15.0±1.0
Salicylic acid (SA),100ppm	12.49±86	3.68±0.28	16.0±1.00	3.98±0.028	5.66±0.57	11.83±0.76
Pentachloronitrobenzene (PCNB), 100ppm	14.20±0.96	6.10±0.36	20.66±0.57	6.36±0.70	7.50±0.86	13.0±0.5
Mancoper (69..5% WP) (MC), 2000ppm	12.96±0.06	4.47±0.42	20.0±0.3	5.26±0.2	5.40±0.1	13.75±1.08
Control (tape water)	12.83±0.28	4.20±0.30	22.0±1.73	4.16±0.28	5.16±0.28	13.0±1.0

Data are mean ±SD of 3 replicates each replicate (20 garlic seed cloves) taken randomly.

Field experiments:

Plant height (cm) and shoot fresh weight (g)/plant:

It is clear from data in Table 4 that there were significant effects on both plant height (cm) and shoot fresh weight (g)/plant due to soaking garlic cloves seed and spraying garlic plants with BTH; GA_3; SA; PG; CA; MC; and PCNB. GA_3 was more effective and gave significantly increase in plant height (cm) in the two seasons (61.83 and 68.03 cm respectively). These results are in agreement with those reported by Sharma *et al.*, (1998) on potato; Khan and Chaudhry (2006) on some cucurbits, Rahman *et al.*, (2006) on garlic and Emongor (2007) on cowpea. While, SA and CA treatments recorded the lowest values in plant height in the two seasons. These results are in the same line with those reported by Feng *et al.*, (2007) on garlic. Plant hormones play an integral role in controlling the growth, metabolism and morphogenesis of higher plants (Taiz and Zeiger, 1991). Gibberllins are the most powerful of the growth promoters (Khan and Chaudhry, 2006). Moreover, SA and CA treatment in the first season and CA in the second season reflected significant favorable effect on shoot fresh weigh (g) /plant. Theses results are in agreement with those reported by Gutiérrez-Coronado *et al.*, (1998) on soybean plants. The lowest values were recorded with BTH and MC. While, PG and PCNB gave an intermediate values compared to the control treatment (tap water).

Fresh and storage yield (ton/fed.):

Data presented in Table 5 show that fresh and storage yield (ton/fed.) was significantly affected by the application of the defense elicitors treatments. The highest scores were recorded by the application of SA followed by CA; MC and PCNB in the first season and CA and PCNB in the second one. The lowest values for fresh and cured yield were recorded by BTH and GA_3 treatments in the first season and PG and GA_3 in the second one. These results are in harmony with that of Sharma *et al.*, (1998) on potato plants, they showed that treated potato plants with gibberellic acid delayed tuber initiation and decreased tuber yield. The recorded results of Feng *et al.*, (2007) showed that garlic foliage application by

salicylic acid increased bulb formation and bulb yield. Also, the efficiency of SA was observed on pea plants, and the maximum yield and yield components were more pronounced in the plants that received the SA twice (seed treatment and foliar spray) at two different stages of development (Murtaza *et al.*, 2007).

Bulb diameter (cm):

Data presented in Table 6 show that there were significant differences among treatments and significant increase in bulb diameter compared to control treatments, in the two seasons. The highest significant increase in this respect was recorded with CA in the two seasons, followed by SA and MC in the first season and PCNB in the second season.

Neck diameter (cm):

Data illustrated in Table 6 show that neck diameter of garlic plants was significantly affected by treatments. The highly significant reduction in neck diameter was achieved by SA in the two seasons .

Table (4): Plant height (cm) and shoot fresh weight (g/plant.) of garlic cv. Sids 40 as affected by some resistance elicitors (BTH, SA, PG, CA,), growth promoter (GA_3) and fungicides (MC and PCNB) in the two seasons of 2007/2008 and 2008/2009.

Treatments, ppm	First season				Second season			
	Plant height (cm)		Shoot fresh weight (g/plant)		Plant height (cm)		Shoot fresh weight (g/plant)	
Benzothiadiazole (BTH), 100ppm	56.23	E	22.67	E	65.00	C	18.96	C
Gibberellic acid (GA3), 100ppm	61.83	A	23.68	D	68.03	A	17.03	D
Salicylic acid (SA), 100ppm	56.75	DE	28.57	A	56.27	F	18.83	C
Propylgallate (PG), 100ppm	60.8	B	25.04	C	63.66	D	20.40	B
p-Coumaric acid (CA), 100ppm	57.27	D	26.25	B	63.50	DE	21.83	A
Mancoper (69..5% WP) (MC), 2000ppm	58.9	C	23.41	D	66.79	B	18.76	C
Pentachloronitrobenzene (PCNB),100ppm	58.56	C	25.08	C	62.60	E	20.39	B
Control (tap water)	58.23	C	22.5	E	63.20	DE	15.97	E
L.S.D at 0.05	0.673		0.664		1.048		0.643	

Table (5): Fresh yield (ton/fed.) at the harvest time and storage yield (ton/fed.) after six months from storage as affected by some resistance elicitors (BTH, SA, PG, CA), growth promoter (GA_3) and fungicides (MC and PCNB) in the two seasons of 2007/2008 and 2008/2009.

Treatments, ppm	First season				Second season			
	Fresh yield (ton/fed.)		Storage yield (ton/fed.)		Fresh yield (ton/fed.)		Storage yield (ton/fed.)	
Benzothiadiazole (BTH), 100ppm	9.26	D	5.61	E	8.48	D	4.28	D
Gibberellic acid (GA3), 100ppm	9.26	D	5.45	EF	8.73	C	4.13	E
Salicylic acid (SA), 100ppm	10.93	A	6.36	A	8.82	C	4.64	B
Propylgallate (PG), 100ppm	10.03	C	5.87	D	8.03	E	4.12	E
p-Coumaric acid (CA), 100ppm	10.67	AB	6.20	AB	9.99	A	5.03	A
Mancoper (69..5% WP) (MC), 2000ppm	10.53	B	6.11	BC	8.09	E	4.36	C
Pentachloronitrobenzene (PCNB),100ppm	10.37	BC	6.02	CD	9.82	B	5.02	A
Control (tap water)	9.233	D	5.35	F	8.01	E	3.92	F
L.S.D at 0.05	0.358		0.175		0.1238		0.055	

Table (6): Bulb and neck diameter (cm.) of garlic bulbs cv. Sids 40 as affected by some resistance elicitors (BTH; SA; PG; CA), growth promoter (GA_3) and fungicides (MC and PCNB) in the two seasons of 2007/2008 and 2008/2009.

Treatments, ppm	First season				Second season			
	Bulb diameter (cm)		Neck diameter (cm)		Bulb diameter (cm)		Neck diameter (cm)	
Benzothiadiazole (BTH), 100ppm	5.613	C	1.00	BC	5.26	D	1.01	C
Gibberellic acid (GA3), 100ppm	5.543	D	1.05	AB	5.12	E	1.12	B
Salicylic acid (SA), 100ppm	5.703	B	0.87	D	5.69	C	0.86	G
Propylgallate (PG), 100ppm	5.543	D	0.99	BC	5.14	E	0.91	F
p-Coumaric acid (CA), 100ppm	5.793	A	0.93	CD	6.02	A	0.98	D
Mancoper (69..5% WP) (MC), 2000ppm	5.67	BC	1.10	A	5.29	D	0.94	E
Pentachloronitrobenzene (PCNB),100ppm	5.63	C	1.03	AB	5.90	B	1.16	A
Control (tap water)	5.38	E	1.07	AB	4.58	F	0.95	E
L.S.D at 0.05	0.055		0.078		0.055		0.020	

Bulbing ratio %:

Results in Table 7 indicate that the mean values of bulbing ratio were high for all studied treatments and differed significantly. Control treatment, MC and GA_3 in the first season and GA_3 in the second season gave relatively higher significant values in the bulbing ratio, (0.198, 0.196, 0.189 and 0.222, respectively). The SA treatment in the two seasons (0.152, 0.150) has the lowest values for this character which indicate its effect in the earliness of maturity. This quality characters are needed if quality is too maintained during the post harvest period. These results clearly, suggested that bulbing ratio can be significantly influenced by elicitors and promoter treatments.

Weight loss %:

Presented data in Table 7 show that the efficiency of the elicitors treatments on weight loss % of whole plant after 6 months from curing was significant in the second season. The lowest values for weight loss % in the second season were recorded with MC followed by SA, CA, PCNB and PG with insignificant differences among them. The lowest values for weight loss % in the two seasons was recorded with SA. Physiological weight loss was the most important factor contributing towards weight loss during storage (Ammar, 2007). The findings by Xiu-dong, (2007) showed that SA is an endogenous signal substance that exists universally in plants, which has been confirmed as a new hormone, and plays an important physiological role plays a crucial function in ripening fruits and horticultural products preservation.

Pathological experiments:

Mycelial growth and spore formation

Table 8 show the growth parameters e.g . mycelial linear growth (cm) / Petri Plate (9 cm) and sporulation (spore formation) of fungi *A. porii*. *A. porii* was greatly affected by the resistance elicitors compound. Salicylic acid (SA) provided a complete inhibition to myclial growth and spore formation. Propylgallate (PG) and gibberellic acid (GA_3) exhibited growth stimulation for *A.porri*. While, CA, BTH, MC and PCNB significantly suppressed mycelial linear growth (cm) (Fig, 1). This result are in harmony with that reported by Galal and El-Bana, (2002) who reported that p-coumaric acid significantly affected the inhibition of carpogenic germination of *Sclerotium sclerotiourum*.

Snyman and Cronje, (2008) reported that SA in plants is a signaling molecule regulating disease resistance responses such as SAR and the hyper sensitive response (HR). Benzothiadiazole (BTH) and MC caused a higher increase in spore formation (221.66±10.4 $x10^3$ and 95.4±4.14$x10^3$ spores) respectively, compared to the control treatment (72.66± 6.8 $x10^3$ spores). The highest reduction in spore formation was pronounced with PCNB (5.66 ±0.57 $x10^3$ spores). Obtained data are consistent with those reported by Edwards, (2006) who showed that (PCNB) as fungicide can be used to control diseases on vegetables.

The highly protection against *A. porii* based on mycelial linear growth (cm) was recorded with SA (100%) followed by CA (45.25 %) compared to the fungicides treatment (PCNB, 63.38%) and (MC, 53.49 %). These results are in agreement with those reported by *Fayza et al.*, (2005) and Spletzer and Enyedi (1999) on tomato plants, who showed that SA is involved in regulation of resistance and activate SAR against *A solani*. While, GA_3 and PG recorded a negative control. The growth promoter, GA_3 had promoted the mycelial linear growth (cm) and reduced sporulation compared to the control treatment and can be simulate the injury when used as foliar treatments at the time of infection.

Table (7): Bulbing ratio of garlic bulb cv. Sids 40 and weight loss % after six months of storage as affected by some resistance elicitors (BTH, SA, PG, CA), growth promoter (GA_3) and fungicides (MC and PCNB) in the two seasons of 2007/2008 and 2008/2009.

Treatments, ppm	First season				Second season			
	Bulbing ratio		Weight loss %		Bulbing ratio		Weight loss %	
Benzothiadiazole (BTH), 100ppm	0.178	C	39.38	B	0.193	C	49.52	C
Gibberellic acid (GA3), 100ppm	0.189	ABC	41.12	AB	0.222	A	52.67	B
Salicylic acid (SA), 100ppm	0.152	D	41.7	AB	0.150	F	47.38	DE
Propylgallate (PG), 100ppm	0.178	C	41.61	AB	0.176	D	48.64	CD
p-Coumaric acid (CA), 100ppm	0.161	D	41.89	A	0.163	E	47.95	D
Mancoper (69..5% WP) (MC),2000ppm	0.196	AB	42	A	0.178	D	46.10	E
Pentachloronitrobenzene (PCNB),100ppm	0.182	BC	41.94	A	0.196	C	48.47	CD
Control (tap water)	0.198	A	41.99	A	0.208	B	54.72	A
L.S.D at 0.05	0.014		n.s 2.19		0.005		1.39	

Table (8): Mycelial growth (cm), sporulation (spore formation) and protection percentage of *Alternaria porii* as affected by some resistance elicitors (BTH, SA, PG, CA,), growth promoter (GA_3) and fungicides (MC and PCNB)

Treatments	Mycelial linear growth (MLG) (cm)	Spore formation (Sporulation)	% Protection based on MLG
Benzothiadiazole (BTH), 100ppm	6.06±0.11	221.66 ± 10.40	9.95
Coumaric acid (CA), 100ppm	3.68±0.16	60.0 ± 3.0	45.31
Gibberellic acid (GA3), 100ppm	8.61±0.125	38.0 ± 4.35	+ 28.10
Propylgallate (PG), 100ppm	8.51±0.22	90.66 ±5.13	+ 26.44
Salicylic acid (SA), 100ppm	0.00	0.00	100
Pentachloronitrobenzene (PCNB),100ppm	2.46±0.416	5.66 ±0.57	63.44
Mancoper (69..5% WP) (MC), 2000ppm	3.13±0.14	95.4±4.14	53.49
Control (Medium without treatments)	6.73±0.25	72.66± 6.8	0.00

Data are means of 3 replicates (each replicate 4 Petri Plate) ± SD Spore formation $x10^3$ per (cm) Culture medium Mycelial growth (cm) /Petri Plate (9.0 cm)

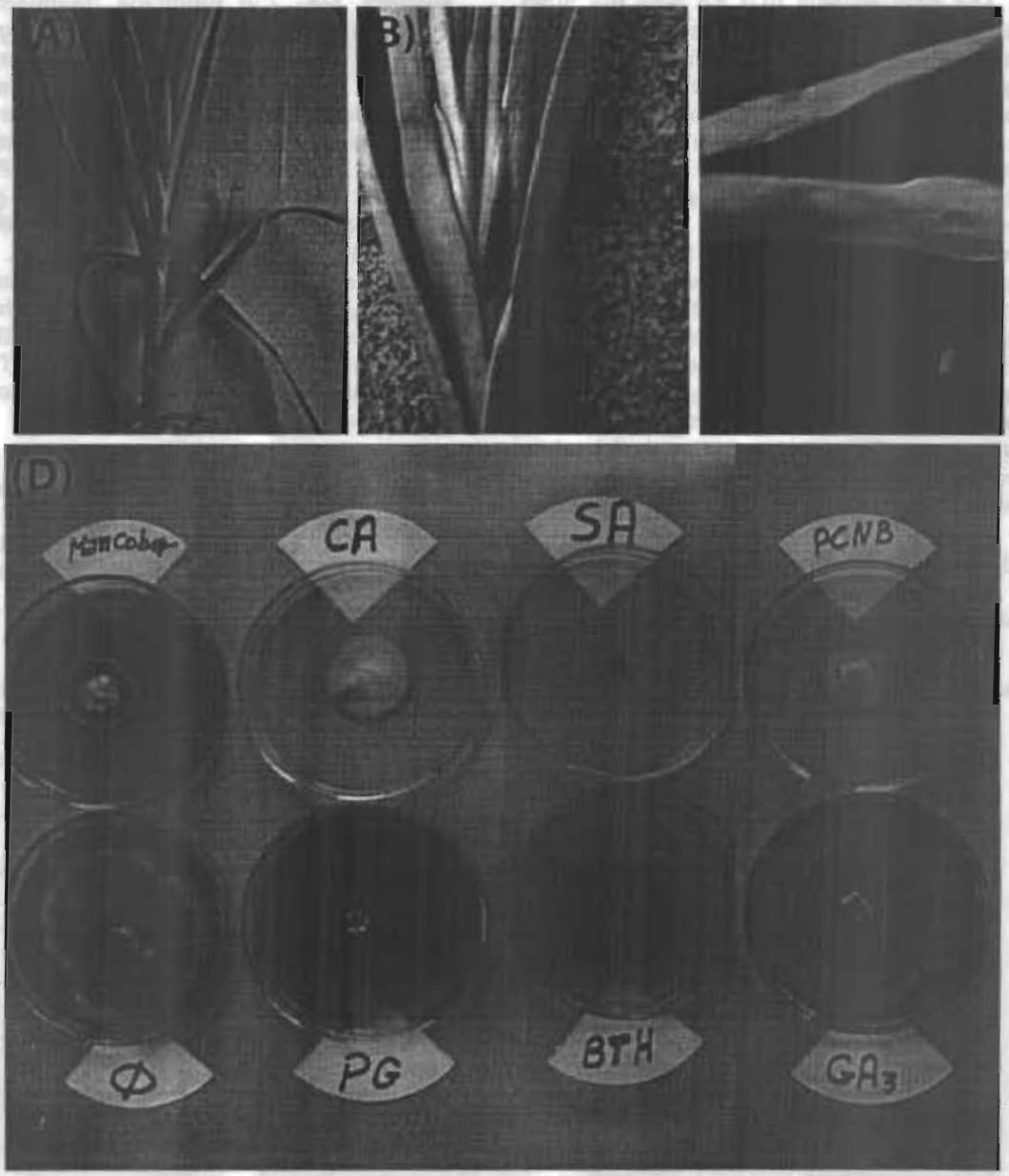

Fig. 1: Symptoms of purple blotch (*Alternaria porii*) on garlic plants (A) non-infected plants (B) infected leaves and (C) infected pseudostems,; collected from the experimental field at Mallawy Agriculture Research Station. (D) Efficiency of resistance inducers (benzothiadiazole, (BTH), propylgallate (PG), salicylic acid (SA), coumaric acid (CA)), Gibberellic acid (GA_3) and pentachoronitrobenzene (PCNB) and mancoper, (MC) as fungicides compared to the control treatment (Ø) on the mycelial growth (cm) on Petri plates (9cm).

The data reveale that SA was the most stable compound and the most protective compound against *A porii* infection followed by PCNB and CA. The obtained results by Esmailzadeh *et al.*, (2008) reported that there is highly correlation between increasing the endogenous levels of free SA in treated plants and reduction of the blighted leaf areas. Also, Gozzo (2003) reported that Exogenous application of SA and some other chemicals including: polyacrylic acid, acetyl salicylic acid, 2, 6-dichloroisonicotinic acid, methyl salicylate, jasmonic acid and jasmonic methyl ester, benzothiadiazole derivatives, DL-B-aminobutyric acid and oxalic acid, can induce accumulation of pathogenensis-related proteins and lead to reduced incidence of several diseases on many crops.

Disease assessment (%):

The disease rating was identically followed by the application of the resistance elicitors, GA_3 and fungicide treatments in both years (Table 9). Control (no fungicide and no resistance elicitors) treatments showed significantly highest disease incidence (27 and 25.8 %) on garlic plants in both seasons, respectively. The resistance elicitor's treatment and the fungicides PCNB and MC had significant effects on garlic purple blotch disease and gave significant decrease in the disease incidence. The highest significant decrease was recorded with GA_3 followed by CA and PCNB in the first season followed by SA, CA and BCNB treatments in the second season. These results are in agreement with that recorded by Xiu-dong, (2007).

The possible explanation for a role of p-coumaric acid is that it is an intermediate in the pathway for synthesis of cinnamoyl type of phenols, some of which go for lignin biosynthesis whereas others are channeled for synthesis of phytoalexins .

Table (9): Disease assessment (%) of garlic purple blotch (*Alternaria porii*) on plants at 140 days, as affected by some resistance elicitors (BTH, SA, PG, CA,), growth promoter (GA_3) and fungicides (MC and PCNB).

Treatments, ppm	Disease assessment (%)			
	First season		Second season	
Benzothiadiazole (BTH), 100ppm	24.2	B	14.0	D
Gibberellic acid (GA3), 100ppm	13.7	E	15.9	C
Salicylic acid (SA), 100ppm	20.7	C	11.2	E
Propylgallate (PG), 100ppm	21.7	C	19.5	B
p-Coumaric acid (CA), 100ppm	18.3	D	10.2	EF
Mancoper (69..5% WP) (MC), 2000ppm	23.2	B	20.5	B
Pentachloronitrobenzene(PCNB),100ppm	18.3	D	10.1	F
Control (tap water)	27.0	A	25.8	A
L.S.D at 0.05	1.459		1.003	

REFERENCES

Ammar, A. Y. M. (2007). Some studies on improving garlic productivity. M.Sc. Thesis, Fac. Of Agric., El-Minia Univ., A.R.E

Ansari, M. S. and N. Misra (2007). Miraculous role of salicylic acid in plant and animal system. URL: http:// scialert.net/abstract/? Doi=ajpp. 51-58

Bachmann, J. (2001). Organic garlic production. http:// attar. Ncat.org/attar-pub/pdf/garlic.pdf.

Colson-Hanks, E.S., *S. J. Allen* and *B. J. Deveral* (2000). Effect of 2,6-dichloroisonicotinic acid or benzo-thiadiazole on Alternaria leaf spot, bacterial blight and Verticillium wilt in cotton under field conditions. Australasian Plant Pathology 29 170 – 177

Coquoz, J. L., A. J. Buchala, P. Meuwly and J .P. Metraux (1995). Arachidonic acid induces local but not systemic synthesis of salicylic acid and confers systemic resistance in potato plants to *Phytophthora infestans* and *Alternaria solani*. Phytopathology, 85: 1219-1224.

Dann, E. K. and B. J. Deverall (1995). Effectiveness of systemic resistance in bean against foliar and soilborne pathogens as induced by biological and chemical means. Plant Pathol., 44: 458-466.

Duncan D. B. (1955). Multiple range and multiple F tests. Biometrics 11:142.

Durner, J., J. Saha and D. F. Klessig (1997). Salicylic acidand disease resisance in plants. Trends Plant Science 2 : 266-274

Edwards, D. (2006). Registration Eligibiliy Decision for Pentachloronitrobenzene. Ph. D. Director, Special Review and Registration Division. July 11, 2006

Elad, Y. (1992). The use of antioxidants (free radical scavengers) to control grey mould (*Botrytis cinerea*) and white mould (*Sclerotinia sclerotiorum*) in various crops.Plant Pathology. 41: 417-426.

Emongor, V. (2007). Gibberrellic acid (GA3) influence on vegeaive growth, nodulation and yiel of cowpea (*Vigna unguiculata* (L.) Walp. Journal of Agronomy 6: 509-517.

Esmailzadeh, M., M. J. Soleimani and H. Rouhani, (2008). Exogenous applications of salicylic acid for inducing systemic acquired resistance against tomato stem canker disease. J. Boil. Sci., 8: 1039-1044.

Fayza, A. Faheed., Gamala, A. Abd-Elaah and M. Ahmed (2005). Alleviation of disease effect on tomato plants by heat shock and salicylic acid infected with Alternaria solani. International Journal of Agriculture & Biology. V. 7 No.5 : 783-789

Feng, X., C. Zhi-hui, G. Zhi-hua and D. Hui-fang (2007). Effects of SA treatments on bulb formation and activity of protective enzymes in garlic. Journal of Northwest A & F University (Natural Science Edition). 2-19

Galal, A. A and E. Abdu (1996). Antioxidant for control of fusarial diseases in cowpea. Egypt. J. Phytopathol., 24: 1-12

Galal, A. A. and A. A. EL-Bana (2002). Inhibition of carpogenic germination of sclerotia of *Sclerotium sclerotiourum* (L.b.) by coumaric acid derivatives. Egypt. J. Phytopathol, Vol, 30 : 67-97.

Galal, A. A., M. N. Shaat and A. A. El-Bana (2000). Sensitivity of *Alternaria radicina* and *Alternaria tenuissima* to some antioxidant compounds. J. Agric. Sci., Mansoura Univ., 25: 1553-1562.

Gomea, M. G. M. (2006). Genetic studies on some economic characters in onion. Ph. D. thesis, Fac. Of Agric., El-Minia Univ., A.R.E.

Gozzo, F., (2003). Systemic acquired resistance in crop protection: from nature to a chemical approach. J. Agric. Food Chem., 51: 4487-4503.

Gutiérrez-Coronado, M. A., C. Trejo-López, and A. Larqué-Saavedra (1998) Effects of salicylic acid on the growth of roots and shoots in soybean. Plant Physiology and Biochemistry.36: 563-565

HienDao, T. T., R. C. Puig, H. K. Kim, C. Erkelens, W. M. Alfons, Lefeber. Huub. J. M. Linthorst, YoungHae Choi and Robert Verpoore. (2009). Effects of benzohiadiazole on the meabolom of Arabidopsis thaliana. Plant Physiology and Biochemistry. 47: 146-152

Ismail, M. E., H. M. Abdalla and A. A. Galal (2006). Factors affecting induced resistance in sunflower plants against basal stem rot caused by Sclerotium rolfsii (Corticum rolfsii). Assiut J. of Agriculture.

Khan, A. S. and N. Y. Chaudhry (2006). GA_3 improves flower yield in some cucurbits treated with lead and mercury. African Journal of Biotechnology. 5 (2): 149-153

Kiyomi, K., H. Tomoko, H. Makiko and K. Tsutao (1983). "Reaction of p-hydroxycinnamic acid derivatives with nitrite and its relevance to nitrosamine formation. *Journal of Agricultural and Food Chemistry* 31 (4), 780-5.

Klessige, D. F. and J. Malamy (1994). The salicylic acid signal in plants. Plant Mol Biol. 26: 1439.

Kumar, T. P. and M. G. Palakshappa (2008). Management of purble blotch of onion through bioagents. Karnataka, J. Agric. Sci., 21 (2):306-308

Kurian, J. C., (1995). Plant that heal. Oriental Watch Man Publishing House, Pune, India, P: 31.

Mann, L. K. (1952). Anatomy of the garlic bulb an factors affecting bulb development, Hilgardia, 21: 195-228.

Murtaza, G., R. Asghari, S. Ahmad and S. Abdulmagid (2007). The yield and yield component of pea (*Pism sativum* L.) as influenced by salicylic acid. *Pak. J. Bot.*, 39(2): 551-559.

Radman, R., Saez, C. Bucke and T. Keshavarz (2003). Elicitation of plants and microbial cell systems. Biotechnol. Appl. Biochem. 37: 91-102

Rahman, M. H., M. S. Haquel, M. A. Karim and M. Ahmed (2006). Effects of Gibberellic Acid (GA3) on Breaking Dormancy in Garlic (*Allium sativum* L.). INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY. *Vol. 8, No. 1*,63-65

Raskin, I. (1992). Role of salicylic acid in plants. Annual Review of Plant Physiology Plant Molecular Biology 43, 439–463.

Sharma, N., N. Kaur and A. K. Gupta (1998). Effects of Gibberellic Acid and Chlorocholine Chloride on Tuberisation and Growth of potato Solanum *tuberosum* (L) J. Sci. Food Agric. 78, 466-470

Snyman, M. and M. J. Cronje (2008). Modulationof heatshockfactorsac-companies-salicylic acid-mediaed-poentiation of Hsp70 in tomato seedlings. Journal of Experimental Botany. 1-8

Spletzer, M. E. and A. J. Enyedi (1999). Salicylic Acid Induces Resistance to *Alternaria solani* in Hydroponically Grown Tomato. Biochemistry and Cell Biology. 89 : 722-727

Stejskal. D., J. Proskova, A. Petrzelova, J. Bartek, I. Oral, B. Lacnak, D Horalik and S. Sekaninova (2001). Application of cationic propylgallate as inducer of thrombocyte aggregation for evaluation of effectiveness of antiaggregation therapy. Biomed. Papers.145 , 69-74.

Taiz, L. and E. Zeiger (1991). Auxin growth and tropism. In: Plant Physiology. The Benjamin/cummings Publishing Co. Inc. California, pp. 398-42.

Valadez, L. A. (1992). Onion (*Allium cepa* L.) and garlic. (*Allium sativum* L.) production in Mexico. Onion Newsletter for the Tropics. N0. 7

Xiu-dong, Q.I. (2007). Progress of the Physiological Action of Salicylic Acid in Plants. Journal of Habei Normal University of Science and Technology. CNKI:ISSN:1672-7983.0.2007-01-018

Youssef. N. S. and E. M. M. Abd Allah (2007). Role of antioxidant treatments in improving potato yield and quality. Bull. Fac. Agric., Cairo Univ., 56: 144-158.

Yusuf, Y. and M. Sally (2004). Effect of treating pepper with benzothiadiazole derivative and No-Pathogenic Xanthomonas campestris pathovars on the level of disease caused by Sclerotinia Sclerotiorum. Plant Pathology Journal 3 : 52-55.

Zhou, X. M., A. F. Mackenize, C. A. Madramootoo and D. L. Smith (1999). Effects of Stem-injected plant growth regulators, with or without sucrose, on grain production, biomass and photosynthetic activity of field-grown corn plants. J. Agronomy and Crop Science. 183: 103.

فعالية بعض محفزات المقاومة ومحفز النمو(حمض الجبريليك) على محصول الثوم وجودته وتأثيرهما على الإصابة بفطر اللطعة الارجوانية

ناصر سيد يوسف[١] ، انور عبدالعزيز جلال[٢]

١ – قسم التكاثر الخضرى والبطاطس – معهد بحوث البساتين –الجيزة –مصر

٢ – قسم امراض النبات – كلية الزراعة – جامعة المنيا

الملخص العربي

تجارب بستانية ومرضية معملية وحقلية اجريت بمزارع ومعامل محطة البحوث الزراعية– ملوى–معهد بحوث البساتين وقسم امراض النبات بكلية الزراعة – جامعة المنيا على محصول الثوم صنف سدس ٤٠ خلال المواسم الزراعية ٢٠٠٦/٢٠٠٧و٢٠٠٧/٢٠٠٨.و ٢٠٠٨/٢٠٠٩

هذا البحث قام بدراسة فعالية بعض المحفزات الدفاعية مثل (بنزوثيوديازول – حمض الكيوماريك– حمض السالسيلك– بروبيل جالات) ومحفز النمو (حمض الجبريليك) على انها مواد تعطى حماية للنبات وتلعب دورا فى استحثاث المقاومة الجهازية والاخرى فى سرعة النمو فى النبات بالاضافة الى المبيدات الفطرية (بنتاكلورونيتروبنزين وماتكوبر ٦٩,٥ % وزن/حجم (٥٢,٠% ماتكوزيب– ١٧,٥ % اوكسى كلور النحاس) للمقارنة زيادة انتاجية وجودة محصول الثوم وتقليل الاثر الضار الناجم عن الاصابة باللطعة الارجوانية مع تقليل مخاطر التلوث للانسان والبيئة باستخدام مواد اكثر امانا.

تجارب بستانية:

هذه المعاملات تم استخدامها تحت ظروف المعمل بتركيز ١٠٠ جزء فى المليون فيما عدا مانكوبر فقد تم استخدامه بتركيز ٢جم /لترعن طريق نقع الفصوص بها لمدة ٤٨ ساعة كل مادة على حدة لتقدير نسب الانبات وكذلك عدد وطول الجذورالمتكونة/فص.

ايضا تحت ظروف الحقل تم استخدام هذه المعاملات بنفس التركيزات السابقة عن طريق نقع الفصوص بها لمدة ٢٤ ساعة وزراعتها وكذلك رش النباتات بها بنفس التركزات لمدة ثلاث مرات عند اعمار ١٠٠–١١٠–١٢٠ يوم من الزراعة.

اظهرت النتائج المعملية : ان حمض السالسليك والكيوماريك قد اعاق الزيادة فى طول النمو الخضرى وكذلك طول النمو الجذرى وعدد الجذور المتكونة واعلى عدد للجذور المتكونة قد تحقق مع المعاملة بحمض الجبريليك يليها معاملة ال بنزوثيوديازول فى كلا الموسمين .اطول الجذور المتكونة واقصى ارتفاع للنمو الخضرى قد تحقق مع المعاملة ب البنزوثيودبازول ويليها المبيد الفطرى بنتاكلورونيتروبنزين وكلا من المانكوبر والبروبيل جالات كانت نتائجهم متوسطة بالمقارنة بمعاملة الكنترول (نقع الفصوص فى الماء فقط).

أظهرت النتائج الحقلية :

أن حمض الجبريلك كان الأكثر فاعلية في زيادة طول النبات (سم) ومع أن اقل القيم قد لوحظت مع المعاملة بحمض السالسيلك وحمض الكيوماريك فى زيادة ارتفاع النبات الا انهم قد اعطوا افضل زيادة معنوية فى الوزن

الطازج للنبات بالكامل.ايضا ان المحصول الطازج والمعالج (طن/فدان) قد تاثر معنـــوا باســـتخدام هـــذه المعـــاملات (المحفزات الدفاعية) واظهر كلا من السالسيلك وحمض الكيوماريك فى الموسم الاول وحمض الكيوماريك فى الموسم الثانى اعلى زيادة معنوية فى الوزن الطازج والمعالج (طن/فدان) وكذلك زيادة صفات الجودة المرغوبة (قطر البصلة – معدل التبصيل – الفقد فى الوزن)

ايضا ادت المعاملة بالمبيد الفطرى بنتاكلورونيتروبنزين اعلى زيادة معنوية فى المحصول المعالج (طن/فدان) فى الموسم الثانى وبدون اختلافات معنوية مع حمض السالسليك.

تحت ظروف المعمل: اظهرت الدراسة ان حمض الجبريليك و بروبيل جالات كانت معاملاتهم تشجيعية فى زيـــادة النمو الخطى الميسليومى لفطر الالترناريا بوراى المسبب للطعة الارجوانية فى الثوم بالمقارنة بالمعـــاملات الاخـــرى وكذلك المبيد الفطرى بنتاكلورونيتروبنزين بينما كانت المعاملة بحمض السالسيليك و بنتاكلورونيتروبنزين و حمـــض الكيوماريك الاكثر تاثيرا فى تثبيط النمو الميسليومى الخطى للفطر اما بالنسبة لعدد الجراثيم المتكونة فقد اعطى كلا من البنزوثيوديازول و المبيد الفطرى مانكوبر اعلى زيادة فى عدد الجراثيم المتكونة بالرغم من تاثيرهم على حجـــم النمو الميسليومى.

اعلى حماية محسوبة على اساس النمو الميسليومى الخطى ضد العدوى بالفطر تحت ظروف المعمل قد لوحظـــت مع المعاملة ب حمض السالسيليك (١٠٠% حماية) و يليه المبيد الفطرى بنتاكلورونيتروبنزين (٦٣,٣٨ %) و المبيد الفطرى مانكوبر (٥٣,٤٩ %) وحمض الكيوماريك (٤٥,٢٥%) بينما اقل نسبة حماية كانت مـــع البنزوثيوديـــازول (٩,٩٥ %) اما بالنسبة لحمض الجبريليك والبروبيل جلات فلم يعطوا اية حماية بل جاءت نتائجهم ايجابية فى زيـــادة حجم النمو الميسليومى للفطر اعلى من معاملة الكنترول

تحت الظروف الحقلية تلاحظ ان قياس نسب الاصابة للمعاملات المستخدمة عن طريق نقع الفـــصوص والـــرش للنباتات لاستحثاث المقاومة قد ادت الى انخاض معنوى فى نسب الاصابة بالمقارنة بمعاملة الكنتـــرول واحـــسن اداء لاستحثاث المقاومة للاصابة باللطعة الارجوانية قد تلاحظ مع المعاملة ب حمض الكيوماريك يليه حمض السالسليك ثم المبيد الفطرى بنتاكلورونيتروبنزين.