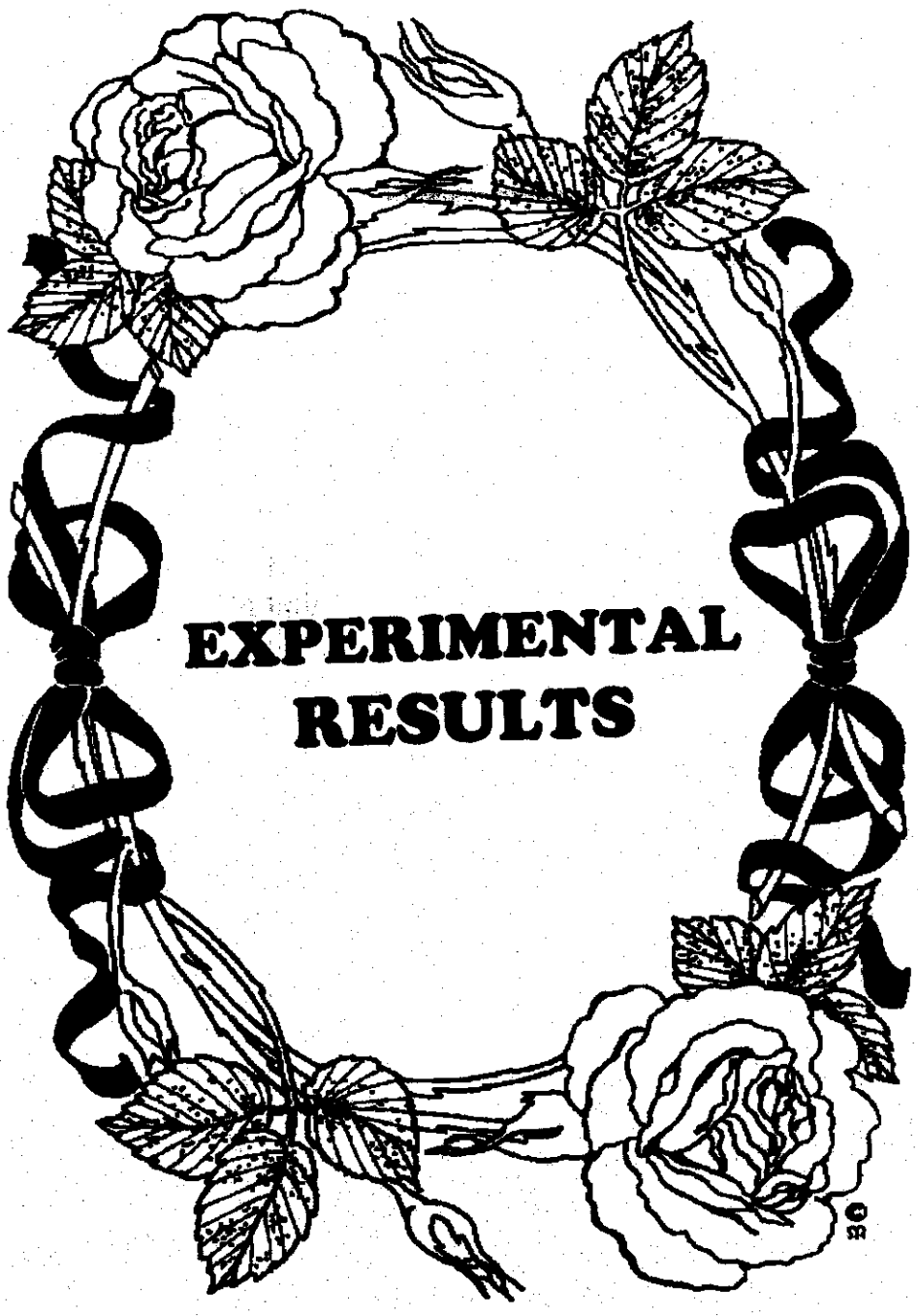

EXPERIMENTAL RESULTS

VI- EXPERIMENTAL RESULTS

Isolated fungi and their frequency:

Different fungi were isolated from snap bean and snow pea pods showing rot symptoms collected from Giza, Behaira, Ismailia, Menoufiya, Noubariya and Beni Suef during season 2004. Cultural characteristics and microscopic examination revealed that, the obtained isolates belonged to five different genera of fungi namely; *Alternaria* spp., *Botrytis cinerea, Fusarium* spp., *Penicillium* spp. and *Sclerotinia sclerotiorum* **(Table, 1)**.

Also, data in **Table (1)** indicated that, *Sclerotinia sclerotiorum* and *Botrytis cinerea* were most dominant followed by *Alternaria* spp., *Fusarium* spp. and *Penicillium* sp. Out of the total number of fungal isolated *i.e.*, 38 from different localities 14 were *Sclerotinia sclerotiorum* (36.84%), 11 *Botrytis cinerea* (28.95%), 5 each of *Alternaria* sp. (13.16%) or *Fusarium* sp. (13.16%) and 3 *Penicillium* sp. (7.89%). *Sclerotinia sclerotiorum* and *Botrytis cinerea* were isolated from all 5 locations, except *B. cinerea* on Paulista cv. at Menouf only. While, *Alternaria* spp. and *Fusarium* spp. were isolated from only three locations. Fungus *Penicillium* sp. was isolated from two locations. According to the variety of bean and the locations that showed pods rotting, data revealed that, Ismailia, El-Tahrir and Beni Suef locations were suitable for the infection of *S. sclerotiorum* on Paulista and Bronco cvs. While, Ismailia and El-Tahrir were suitable for *Botrytis cinerea* on Paulista cv., meanwhile, Giza was suitable for the same fungus on Bronco cv. Paulista cultivar was the most susceptible to *Penicillium* sp. at Ismailia and Menoufia locations. On the other hand, Ogzyra and Emy cultivars were more resistant to *Alternaria* spp., *Fusarium* spp., and *Penicillium* sp. at Noubariya and Giza, respectively.

Table (1): Frequency of fungi isolated from snap bean and snow pea pod-rots that collected from different locations.

Crop	Cultivars	Locations	Total No. of Fungi	Number and frequency of the isolated fungi									
				Alternaria sp.		*Botrytis cinerea*		*Fusarium* sp.		*Penicillium* sp.		*Sclerotinia sclerotiorum*	
				No.	%	No.	%	No.	%	No.	%	No.	%
Snap bean	Paulista	Ismailia	9	0.0	0.00	3	30.0	0.0	0.0	1	10.0	5	50.0
		El-Tahrir	8	2.0	25.0	2	25.0	1	12.5	0.0	0.00	3	37.50
		Menouf	9	2.0	22.2	0.0	0.00	4	44.4	2	22.2	1	11.11
	Bronco	Giza	5	1.0	20.0	3	60.0	0.0	0.00	0.0	0.00	1	20.0
		Beni Suef	3	0.0	0.00	1	33.3	0.0	0.00	0.0	0.00	2	66.67
	Ogzyra	Noubariya	2	0.0	0.00	1	50.0	0.0	0.00	0.0	0.00	1	50.0
	Emy	Giza	2	0.0	0.00	1	50.0	0.0	0.00	0.0	0.00	1	50.0
	Total		**38**	**5**	**13.16**	**11**	**28.95**	**5**	**13.16**	**3**	**7.89**	**14**	**36.84**
Snow pea	Snow wind	El-Tahrir	2	0.0	0.00	1	50.0	0.0	0.00	0.0	0.00	1	50.0
		Noubariya	1	0.0	0.00	1	100.0	0.0	0.00	0.0	0.00	0.0	0.00
	Total		**3**	**0.00**	**0.00**	**2**	**66.67**	**0.00**	**0.00**	**0.00**	**0.00**	**1.0**	**33.33**

Accordingly, data in **Table (1)** indicated that snow pea pods were infected by three isolates which have been isolated from the two different locations, 2 were *Botrytis cinerea* (66.67% from El-Tahrir and Noubaria locations), one isolate was *Sclerotinia sclerotiorum* (33.3% from El-Tahrir location). On the other hand, at El-Tahrir and Noubariya no infection was recorded with *Alternaria* spp., *Fusarium* spp. and *Penicillium* sp., on snow pea pods.

Pathogenicity:

Data in **Table (2)** indicate that, all the tested fungi were able to infect pods of snap bean Paulista cv., while, only *Botrytis cinerea* and *Sclerotinia sclerotiorum* were able to infect snow pea pods (Snow Wind cv.), with insignificant differences between them. The infection of snap bean pods by different isolates ranged between 4.66 - 93.00%. The highest pod rot infection *i.e.*, 93.00 and 75.00 were recorded by *Botrytis cinerea* and *Sclerotinia sclerotiorum,* **(Photo, 3)** respectively. However, the lowest infection on snap bean pods was recorded by *Penicillium* spp. (15.00%), *Alternaria* spp. (8.33%) and *Fusarium* spp. (4.66%), respectively. No significant differences were recorded between *Penicillium* spp., *Alternaria* spp. and *Fusarium* spp. in % disease severity on snap bean pod.

Concerning snow pea (Snow Wind cv.) was only infected by *Botrytis cinerea* and *Sclerotinia sclerotiorum* and showed the highest severity diseases on pods of snow pea by 96.66 % and 94.00%, respectively. No significant differences between gray and white molds diseases. Meanwhile, no infection were caused by *Alternaria* spp., *Fusarium* spp., *Mucor* sp., and *Penicillium* spp. on snow pea.

Table (2): Severity of different isolated fungi infection on snap bean (Paulista cv.) and snow pea (snow wind cv.) pods after incubation at 20±2°C for ten days. (Pathogenicity test).

Tested isolated Fungi	%Severity of infection of pods	
	Snap bean (Paulista cv.)	Snow pea (Snow wind cv.)
Altemaria spp.	8.33	0.00
Botrytis cinerea	93.00	96.66
Fusarium spp.	4.66	0.00
Penicillium spp.	15.00	0.00
Sclerotinia sclerotiorum	75.00	94.00
L.S.D at 5%	18.54	5.05

Photo (3): Snap bean pods artificially inoculated with *B. cinerea* (left) and *S. sclerotiorum* (right) show severity infection.

1- Varietal reaction

Data in **Table (3)** and **Photo (4)** when the *B. cinerea* and *S. sclerotiorum* were tested against four snap bean cultivars *i.e.*, Bronco, Paulista, Ogzyra and Emy. Data showed that, the two pathogens were able to infect the four bean cultivars. In this respect, *B. cinerea* (68.74) was more aggressive than *S. sclerotiorum* (37.16) on all cultivars. On the other hand, Emy cultivar was most tolerant to infection with *B. cinerea* and *S. sclerotiorum* in artificial inoculation and resulted 43.33% and 6.66%, respectively. Meanwhile, Paulista and Bronco cvs. were susceptible to *B. cinerea* and recorded 90.0% and 78.33%, respectively. The same trend was shown on these cultivars against *S. sclerotiorum.* Ogzyra cultivar was moderately susceptible as it recorded 63.33% for *B. cinerea* and 11.66% of *S. sclerotiorum.* Data also indicated that, Emy cv. was highly tolerant to infection with the two pathogens when compared with other cultivars. Also, results showed that Paulista cv. was highly tolerant under natural infection conditions when compared with other bean cultivars.

Table (3): Comparative reaction of the two pathogens fungi (*B. cinerea* and *S. sclerotiorum*) against four snap bean cvs. after incubation at 25±2°C for ten days.

Cultivars	%Severity of infection		
	Botrytis cinerea	*S. sclerotiorum*	Natural infection
Bronco	78.33	80.33	5.00
Paulista	90.00	50.00	0.00
Ogzyra	63.33	11.66	10.00
Emy	43.33	6.66	6.66
Mean	68.74	37.16	
L.S.D at 5%	NS	19.79	2.71

A = Bronco B = Paulista C = Emy D = Ogzyra

Photo (4): Snap bean pods (four tested cultivars) artificially inoculated with *B. cinerea* (upper) and *S. sclerotiorum* (lower) show different degree of severity infection.

2- *In vitro* Studies:

a- Enzymological studies of the two pathogenic fungi.

1-In culture filtrates.

Data in **Table (4)** show, the enzymatic activity (as loss of viscosity%) of polygalacturonase (PG), cellulase (Cx) and pectin methyl esterase (PME) in culture filtrates of *B. cinerea* and *S. sclerotiorum.*

Data indicated that the two tested pathogens varied in the production of PG, Cx and PME in their culture filtrates. *B. cinerea* was more active in producing PG than *S. sclerotiorum*. Also, a positive correlation between enzyme production and the culture age of the fungi. It was clear that the enzyme activities were increased by increasing the reaction time from 15 to 30 minutes at 30°C and by the

longer age of culture from 7 to 15 days. *B. cinerea* gave the highest activity (82.14% loss of viscosity) when compared with (51.61% of loss of viscosity) of *S. sclerotiorum* after 30 minutes of incubation period in 15-days-old cultures.

Data also revealed that, the two tested fungi produced Cx enzyme in carboxy methyl cellulase (CMC) medium and the same trend was noticed for increasing of the enzyme activity with incubation period of *B. cinerea* and *S. sclerotiorum*. On the other hand, *B. cinerea* was less active for production of Cx (51.61%) than *S. sclerotiorum* (73.33%) after 30 minutes from incubation period and 15 days old of the culture filtrate age.

Table (4): Determination of cell wall degrading enzymes pectin methyl esterase (PME), polygalacturonase (PG) and cellulase (Cx) produced in synthetic medium.

Incubation period (days)	Time of reaction (min)	%Loss of viscosity (enzyme activity)				PME 0.01 N (NaOH)	
		Botrytis cinerea		*S. sclerotiorum*		*B. cinerea*	*S. sclerotiorum*
		PG	Cx	PG	Cx		
7	15	38.70	31.57	32.00	23.52	7.70	6.20
	30	64.51	47.36	52.00	29.41		
15	15	46.42	31.03	32.25	36.66	9.50	8.60
	30	82.14	51.61	51.61	73.33		

Also data revealed that, *B. cinerea* and *S. sclerotiorum* varied in production of (PME) enzyme in culture filtrates. which increased by increasing of the culture filtrate age from 7 to 15 days old. The highest PME enzyme activity in culture filtrate was obtained from *B. cinerea* (9.50) compared with (8.60) from *S. sclerotiorum* in 15-day-old cultures.

2- In infected tissues of snap bean pods:

Data in **Table (5)** show, the activity of PG, Cx and PME were estimated in healthy and inoculated snap bean pods after 7 and 15 days from inoculation with *B. cinerea* and *S. sclerotiorum* after storage period at 25±2°C. Results show that the enzyme activities were varied according to pathogen, incubation period from 7 to 15 days and the time of viscosity reaction during the incubation period from 15 to 30 min at 30°C. It found a positive correlation between the enzyme activities from infected bean pods and the storage periods as well as the time of reaction. The highest PG activity was noticed in pods inoculated with *B. cinerea* after 7 and 15 days from the storage and after 30 min of reaction time (56.26 and 68% loss of viscosity) compared with *S. sclerotiorum* inoculation which resulted 37.5 and 58.33%, respectively while, the PG activity was 28.20 and 62.85% in healthy pods.

Meanwhile, cellulase Cx enzyme activity was high in healthy pods or those inoculated with *S. sclerotiorum* compared with those inoculated with *B. cinerea* which recorded 62.96, 56.00 and 36.36% loss of viscosity, respectively, after 15 days old from pods storage and 30 min. of reaction of incubation period time.

Table (5): Determination (PME), (PG) and (Cx) activities in healthy and inoculated snap bean pods after 7 and 15 days from storage period at 25±2°C.

Incubation period (days)	Time of reaction (min)	%Loss of viscosity (Enzyme activity)						PME 0.01 N (NaOH)		
		B. cinerea		*S. sclerotiorum*		Healthy		*B. cinerea*	*S. sclerotiorum*	Healthy
		PG	CX	PG	CX	PG	CX			
7	15	21.62	25.00	17.50	22.22	25.64	16.16	0.00	0.00	8.50
	30	56.26	35.00	37.50	33.33	28.20	27.77			
15	15	50.00	22.27	41.66	40.00	40.00	29.62	10.10	8.30	7.20
	30	68.42	36.36	58.33	56.00	62.85	62.96			

Also data revealed that, *B. cinerea* and *S. sclerotiorum* were not able to produce PME enzyme in bean pods after 7 days from storage period. Meanwhile, only healthy pods exhibited activity of PME after 7 days from storage period. The PME enzyme was starting, either in

healthy or both inoculated bean pods after 15 days from storage period. However infected snap bean pods with *B. cinerea* exhibited higher activity of PME after 15 days from storage followed by snap bean pods infected with *S. sclerotiorum* and healthy one, respectively.

3- In infected tissues of Snow pea pods:

Data in **Table (6)** show PG, Cx and PME enzyme activities were estimated in snow pea pods tissues after 7 and 15 days from storage at 25±2°C and inoculated with *B. cinerea* and *S. sclerotiorum* or healthy pods. Data show that enzyme activities varied according to the pathogen, the incubation period and the time of reaction. Also, positive correlation was found between the enzyme activities in the snow pea pods and the storage period and time of reaction. The highest enzyme activity was recorded in pods inoculated with *S. sclerotiorum* after 7 and 15 days from storage and after 30 min of reaction time (41.17 and 57.17%) compared with 21.05 and 42.85% in pods inoculated with *B. cinerea* and 33.33 and 37.50% in healthy pods. On the other hand, activity of cellulose by Cx enzyme was high in pea pods after inoculation with *S. sclerotiorum* (63.15%) compared with (41.17%) inoculated with *B. cinerea* and in healthy pods (40.0%) after 15 days from pea pods storage and in 30 min reaction time.

Table (6): Determination PME, PG and Cx activities in healthy and inoculated snow pea pods after 7 and 15 days from storage at 25±2°C.

Incubation period (days)	Time of reaction (min)	%Loss of viscosity (Enzyme activity)						PME 0.01 N (NaOH)		
		B. cinerea		*S. sclerotiorum*		Healthy		*B. cinerea*	*S. sclerotiorum*	Healthy
		PG	CX	PG	CX	PG	CX			
7	15	21.05	15.38	23.52	20.00	16.66	18.18	00	00	00
	30	21.05	23.07	41.17	40.00	33.33	36.36			
15	15	33.33	23.52	38.09	42.10	25.00	26.66	00	00	00
	30	42.85	41.17	57.14	63.15	37.50	40.00			

Also, **Table (6)** revealed that PME enzyme was not detected in healthy snow pea pods or those inoculated with *B. cinerea* and *S. sclerotiorum* after 7 and 15 days from storage.

b- Effect of some salts on linear growth and sclerotial yield of the causal organisms *in vitro*.

1 - linear growth:

Effect of several salts used at different concentrations on the reduction of growth of *B. cinerea* and *S. sclerotiorum* were studied. Data in **Table (7)** indicate that Max Guard and sodium bicarbonate were the best effective on the growth reduction of *B. cinerea* and *S. sclerotiorum* (88.5 - 100%). Also, Sanosil and Bafry as dis-infestants were also effective in reducing the growth of *B. cinerea* (32.15 and 24.28%) and 82.74 and 83.37% for efficacy on *S. sclerotiorum*, respectively. As well as, calcium sulphate, calcium chloride and calcium carbonate were effective in reducing growth of *S. sclerotiorum* recording 33.74, 32.11 and 25.92%, respectively.

On the other hand, no effect on the linear growth of *B. cinerea* was noticed in media containing calcium chloride, calcium sulphate, calcium carbonate and potassium chloride. Meanwhile, potassium chloride and potassium sulphate were un-effective on the growth of *S. sclerotiorum*. Data also show that, no trend relation was noticed on the growth of *B. cinerea* and *S. sclerotiorum* and with the different concentrations of salts at 1000, 2000 and 3000 ppm when used under this study.

Table (7): Effect of different concentrations of some salts on the linear growth (mm) of *B. cinerea* and *S. sclerotiorum in vitro* after 5 days at 25±2°C.

Treatments	Conc. (ppm)	*Botrytis Cinerea*		*Sclerotinia sclerotiorum*	
		Growth (mm)	Efficacy (%)	Growth (mm)	Efficacy (%)
Calcium chloride	1000	90.00	00.00	90.00	00.00
	2000	90.00	00.00	55.00	38.89
	3000	90.00	00.00	38.30	57.44
	Mean	**90.00**	**00.00**	**61.10**	**32.11**
Sodium bicarbonate	1000	22.00	75.55	00.00	100.00
	2000	10.00	88.89	00.00	100.00
	3000	00.00	100.00	00.00	100.00
	Mean	**10.67**	**88.15**	**00.00**	**100.00**
Calcium sulphate	1000	90.00	00.00	63.30	29.67
	2000	90.00	00.00	46.60	48.22
	3000	90.00	00.00	69.00	23.33
	Mean	**90.00**	**00.00**	**59.63**	**33.74**
Calcium carbonate	1000	90.00	00.00	90.00	00.00
	2000	90.00	00.00	70.00	22.22
	3000	90.00	00.00	40.00	55.55
	Mean	**90.00**	**00.00**	**66.67**	**25.92**
Bafry	1000	79.00	12.22	31.60	64.89
	2000	70.00	22.22	13.30	85.22
	3000	55.00	38.39	00.00	100.00
	Mean	**68.00**	**24.28**	**14.97**	**83.37**
Sanosil	1000	70.00	22.22	30.00	66.67
	2000	51.60	42.67	16.60	81.55
	3000	61.60	31.55	00.00	100.00
	Mean	**61.07**	**32.15**	**15.53**	**82.74**
Max Guard	1000	00.00	100.00	00.00	100.00
	2000	00.00	100.00	00.00	100.00
	3000	00.00	100.00	00.00	100.00
	Mean	**00.00**	**100.00**	**00.00**	**100.00**
Potassium chloride	1000	90.00	00.00	90.00	00.00
	2000	90.00	00.00	90.00	00.00
	3000	90.00	00.00	90.00	00.00
	Mean	**90.00**	**00.00**	**90.00**	**00.00**
Potassium sulphate	1000	90.00	00.00	90.00	00.00
	2000	90.00	00.00	90.00	00.00
	3000	90.00	00.00	90.00	00.00
	Mean	**90.00**	**00.00**	**90.00**	**00.00**
Control		90.00		90.00	
LSD at 5% for					
Treatment (T)		5.16		17.76	
Conc. (C)		2.83		9.30	
Combination T X C		8.93		NS	

2- Sclerotial yield:

The same nine different salts and compounds were used at different concentrations to study their effect on yield of sclerotia (number and weight/g) of *B. cinerea* and *S. sclerotiorum* (**Table, 8**).

Data in **Table** (**8**) revealed that, sodium bicarbonate and Max Guard were the best effective on the sclerotial formation of *B. cinerea* and *S. sclerotiorum* and caused complete reduction of sclerotia with all concentrations. While, Sanosil caused complete reduction of sclerotia formation only with *S. sclerotiorum* at all concentrations. Also, the lowest number of sclerotia was harvested from *B. cinerea* when grown on medium containing calcium chloride (2.66 as mean number of sclerotia) and potassium sulphate (6.89-as mean of the sclerotia number). Meanwhile, the highest number of sclerotia of *B. cinerea* was obtained in media containing calcium carbonate (27.22) and calcium sulphate (18.11), respectively. Concerning the sclerotial weight of *B. cinerea*, the lowest weight in sclerotia resulted from used potassium sulphate (0.01), calcium chloride (0.03) and potassium chloride (0.08), while, the highest weight of sclerotia was obtained from using Sanosil (0.30 g) and calcium carbonate (0.26 g) and calcium sulphate (0.21 g), respectively.

According to *S. sclerotiorum*, data in **Table** (**8**) show that, the highest number of sclerotia from *S. sclerotiorum* was obtained by using calcium sulphate (19.44), followed by calcium carbonate (18.66), calcium chloride (15.77) and potassium sulphate (12.89), respectively. Meanwhile, the lowest number was resulted from using Bafry (3.3) and potassium chloride (5.5), respectively. Concerning the sclerotial weight of *S. sclerotiorum*, the lowest weight in sclerotia was resulted from used potassium chloride (0.11 g) and Bafry (0.12 g), while, the highest weight of sclerotia was obtained from using calcium sulphate (0.92 g), calcium carbonate (0.86 g) and calcium chloride (0.39 g), respectively.

Table (8): Effect of different concentrations of some salts on sclerotial yield (number and weight) of *B. cinerea and S. sclerotiorum in vitro.*

Treatments	Conc. (ppm)	*Botrytis cinerea* After 15 days old		*Sclerotinia sclerotiorum* After 10 days old	
		Av. Sclerotia number	Sclerotial weight(g)	Av. Sclerotia number	Sclerotial weight(g)
Calcium chloride	1000	5.33	0.07	13.66	0.44
	2000	1.66	0.01	16.00	0.38
	3000	1.00	0.01	17.66	0.36
	Mean	**2.66**	**0.03**	**15.77**	**0.39**
Sodium bicarbonate	1000	0.00	0.00	0.00	0.00
	2000	0.00	0.00	0.00	0.00
	3000	0.00	0.00	0.00	0.00
	Mean	**00.00**	**00.00**	**00.00**	**00.00**
Calcium sulphate	1000	20.33	0.23	22.66	0.98
	2000	16.66	0.22	15.33	1.04
	3000	17.33	0.18	20.33	0.74
	Mean	**18.11**	**0.21**	**19.44**	**0.92**
Calcium carbonate	1000	26.66	0.30	25.33	0.94
	2000	27.33	0.22	18.00	0.87
	3000	27.66	0.26	12.66	0.77
	Mean	**27.22**	**0.26**	**18.66**	**0.86**
Bafry	1000	12.66	0.19	10.00	0.35
	2000	20.33	0.20	0.00	0.00
	3000	8.33	0.10	0.00	0.00
	Mean	**13.77**	**0.16**	**3.33**	**0.12**
Sanosil	1000	22.00	0.30	0.00	0.00
	2000	22.00	0.24	0.00	0.00
	3000	4.00	0.36	0.00	0.00
	Mean	**16.00**	**0.30**	**0.00**	**0.00**
Max Guard	1000	0.00	0.00	0.00	0.00
	2000	0.00	0.00	0.00	0.00
	3000	0.00	0.00	0.00	0.00
	Mean	**0.00**	**0.00**	**0.00**	**0.00**
Potassium chloride	1000	13.66	0.22	9.66	0.20
	2000	20.00	0.03	3.33	0.07
	3000	1.00	0.01	3.66	0.05
	Mean	**11.55**	**0.08**	**5.55**	**0.11**
Potassium sulphate	1000	20.66	0.04	17.00	0.36
	2000	0.00	0.00	12.00	0.29
	3000	0.00	0.00	9.66	0.28
	Mean	**6.89**	**0.01**	**12.89**	**0.31**
Control		18.33	0.36	30.66	1.31
LSD at 5% for					
Treatment (T)		3.80	0.045	2.45	0.076
Conc. (C)		2.08	0.029	1.34	0.042
Combination T X C		6.59	0.076	4.25	0.132

c- Effect of some organic acids on the growth and sclerotial yield of the causal organisms *in vitro*.

1- linear growth:

Five organic acids *i.e.*, ascorbic, boric, citric, palmitic and salicylic acids were used at different concentrations to study their effect on the growth of *B. cinerea* and *S. sclerotiorum* which caused the gray and white moulds on snap bean and snow pea pods *in vitro*. Data in **Table (9)** indicated that, from the all organic acids used, salicylic acid only caused complete inhibition in the growth of *B. cinerea* and *S. sclerotiorum* at all concentrations. While, boric acid was the least effective on the growth of *S. sclerotiorum* as it recorded 19.00, 17.00 and 15.00 mm when used at 1000, 2000 and 3000 ppm, respectively, although it don't effect on the growth of *B. cinerea*. On the other hand, ascorbic, citric and palmitic acids were not effective on the growth of the two pathogenic fungi at all different concentrations.

2- Sclerotial yield:

The same five organic acids were also used for study their effective on the sclerotial yield (number and weight/g) of *B. cinerea* and *S. sclerotiorum*. Data in **Table (10)** indicated that salicylic acid was the most effective on sclerotial that formed from the two pathogenic fungi *B. cinerea* and *S. sclerotiorum* and caused complete inhibition at all concentration followed by boric acid on *S. sclerotiorum*. The highest number of sclerotia were formed when used palmitic and ascorbic acids (18.8 and 12.8 as mean of sclerotia number) with *B. cinerea* and (11.55 and 12.55 as mean of sclerotia number) with *S. sclerotiorum*, respectively. No trend relation was noticed between the number of sclerotia which formed by the two pathogenic fungi and the three concentration of the organic acids.

Table (9): Effect of different concentrations of some organic acids on the linear growth (mm) of *Botrytis cinerea* and *Sclerotinia sclerotiorum in vitro* after 5 days at 25±2°C.

Treatments	Conc. (ppm)	*Botrytis cinerea*		*Sclerotinia sclerotiorum*	
		Growth (mm)	Efficacy (%)	Growth (mm)	Efficacy (%)
Ascorbic acid	1000	90.00	0.00	90.00	0.00
	2000	90.00	0.00	90.00	0.00
	3000	90.00	0.00	90.00	0.00
Boric acid	1000	90.00	0.00	19.00	78.89
	2000	90.00	0.00	17.00	81.11
	3000	90.00	0.00	15.00	83.33
Citric acid	1000	90.00	0.00	90.00	0.00
	2000	90.00	0.00	90.00	0.00
	3000	90.00	0.00	90.00	0.00
Palmitic acid	1000	90.00	0.00	90.00	0.00
	2000	90.00	0.00	90.00	0.00
	3000	90.00	0.00	90.00	0.00
Salicylic acid	1000	0.00	100.00	0.00	100.00
	2000	0.00	100.00	0.00	100.00
	3000	0.00	100.00	0.00	100.00
Control		90.00		90.00	
LSD at 5% for					
Treatment (T)		0.00		0.48	
Conc. (C)		0.00		NS	
Combination T X C		0.00		NS	

According to the weight of sclerotia that collected after used organic acids, data in **Table (10)** revealed that, the highest weight of sclerotia (g) of *B. cinerea* was obtained from the medium containing boric (0.26 g) and palmitic (0.19 g) acids, respectively when compared with other organic acids. Meanwhile, ascorbic and citric acids were favorable for producing the highest weight of sclerotia of *S. sclerotiorum*.

Table (10): Effect of different concentrations of some organic acids on sclerotial yield (number and weight) of *Botrytis cinerea and Sclerotinia sclerotiorum in vitro.*

Treatments	Conc. (ppm)	*Botrytis cinerea* After 15 days old		*Sclerotinia sclerotiorum* After 10 days old	
		Av. Sclerotial number	Sclerotial weight (g)	Av. Sclerotial number	Sclerotial weight (g)
Ascorbic acid	1000	6.66	0.13	15.33	0.30
	2000	9.00	0.16	12.00	0.19
	3000	22.66	0.03	10.33	0.16
	Mean	**12.8**	**0.11**	**12.55**	**0.22**
Boric acid	1000	9.33	0.30	0.00	0.00
	2000	12.00	0.25	0.00	0.00
	3000	14.00	0.24	0.00	0.00
	Mean	**11.8**	**0.26**	**0.00**	**0.00**
Citric acid	1000	10.33	0.20	10.00	0.24
	2000	6.33	0.12	10.00	0.17
	3000	10.66	0.17	9.66	0.15
	Mean	**9.1**	**0.16**	**9.88**	**0.19**
Palmitic acid	1000	25.33	0.23	11.00	0.17
	2000	13.66	0.20	10.66	0.16
	3000	17.33	0.16	13.00	0.15
	Mean	**18.8**	**0.19**	**11.55**	**0.16**
Salicylic acid	1000	0.00	0.00	0.00	0.00
	2000	0.00	0.00	0.00	0.00
	3000	0.00	0.00	0.00	0.00
	Mean	**00.0**	**0.00**	**0.00**	**0.00**
Control		18.33	0.36	30.66	1.31
LSD at 5% for					
Treatment (T)		3.23	0.053	3.97	0.083
Conc. (C)		NS	NS	NS	NS
Combination T X C		5.59	NS	NS	NS

d- Effect of modified atmospheric gases conditions on the linear growth of the casual pathogens *in vitro.*

Three levels of atmosphere condition consisting of oxygen O_2, carbon dioxide CO_2 and nitrogen N gases were used to study their effect on the growth of *B. cinerea* and *S. sclerotiorum.* Data in **Table (11)** indicate that all treatments were significantly effective on decreased the growth of *B. cinerea* and *S. sclerotiorum.* Level of 3%

O_2, 15% CO_2 and 82%N was more effective on the reduction of *B. cinerea* and *S. Sclerotiorum* growth than other levels therefore recorded the best efficacy, and followed by the level 3%O, 10%CO_2, 87%N. The least effective on the growth of *B. cinerea* and *S. sclerotiorum* was obtained when used the level of 2%O, 5%CO_2, 93 %N which recoded 72.20 mm and 74.20 mm for the two pathogen fungi, respectively in vitro studies.

Table (11): Effect of modified atmospheres on the growth of *B. cinerea* and *S. sclerotiorum*, which caused gray and white moulds on snap bean pods, *in* vitro after 5 days at 25±2°C.

Treatments			*Botrytis cinerea*		*Sclerotinia sclerotiorum*	
O_2	CO_2	N	Growth (mm)	Efficacy (%)	Growth (mm)	Efficacy (%)
2 :	5 :	93	72.20	19.77	74.20	17.55
3 :	10 :	87	59.20	34.22	73.50	18.33
3 :	15 :	82	57.20	36.44	69.20	23.11
21:	0.3:	78*	90.00	0.00	90.00	0.00
LSD at 5%			1.01		0.78	

*** Control = natural fresh air**

3- Storage Experiments:

a- Effect of using some salts on disease severity% of snap bean pod rots under cold storage.

Six of different salts *i.e.*, Bafry, Sanosil, Max Guard, sodium bicarbonate, calcium carbonate and calcium sulphate were used for study their effect on the disease incidence on snap bean pods after inoculation with *B. cinerea* and *S. sclerotiorum* fungi, and storage at 8±1°C and 90 - 95%RH for two weeks.

Data in **Table (12)** indicated that, all salts treatments were effective for reducing the moulds on snap bean pods when compared with the control treatments. Also, positive correlation was found between the concentration of these salts and the diseases reduction. Max Guard compound at 3000 ppm was more effective for reduction the disease severity of *B. cinerea* and *S. sclerotiorum* on snap bean pods than other salts by results 9.11% and 2.24%, respectively. Also,

it showed good effect on the other microorganisms that infected snap bean pods under natural infections. While, calcium sulphate was the least effective in these respect.

On the other hand, sodium bicarbonate salt were more effective on the reduction of snap bean pod rots disease severity caused by *B. cinerea* and *S. sclerotiorum* in artificial infection when used at 3000 ppm with efficacy 87.19 and 86.62 as % to control disease severity, respectively. Sanosil and calcium carbonate salts at 3000 ppm were highly effect in the artificial infection of *B. cinerea* (89.51 and 87.91% efficacy) and the natural infection (84.61 and 79.22% efficacy) when compared with *S. sclerotiorum* in artificial infection (74.60 and 50.40% efficacy), respectively.

Table (12): Effect of some salts on snap bean pod-rots caused by the tested pathogens under cold storage at 8±1°C and 90 - 95%RH. for 15 days.

Treatments	Conc. (ppm)	Disease severity (%) (D.S)					
		Botrytis cinerea		*S. sclerotiorum*		Natural infection	
		D.S	Efficacy	D.S	Efficacy	D.S	Efficacy
Bafry	2000	21.07	70.92	23.62	69.11	18.55	60.18
	3000	18.99	73.79	13.80	80.48	6.26	86.56
Sanosil	2000	26.67	63.19	34.10	51.75	9.80	78.97
	3000	7.60	89.51	17.95	74.60	7.17	84.61
Max Guard	2000	18.87	73.96	3.31	95.32	3.15	93.24
	3000	9.11	87.43	2.24	96.83	1.62	96.52
Sodium bicarbonate	2000	12.12	83.27	38.31	45.79	20.69	55.59
	3000	9.28	87.19	9.46	86.62	10.72	76.99
Calcium Carbonate	2000	27.96	61.41	54.19	23.33	11.71	74.87
	3000	8.76	87.91	35.06	50.40	9.68	79.22
Calcium sulphate	2000	49.93	31.09	60.05	15.04	41.15	11.68
	3000	44.00	39.28	59.00	16.53	22.18	52.93
Control*		72.46		70.68		46.59	
LSD at 5% for							
Treatment (T)		9.68		8.63		5.56	
Conc. (C)		3.71		4.60		2.98	
Combination T X C		9.85		12.23		7.88	

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

b- Effect of using some acids on the disease severity of snap bean pod rots, under cold storage.

Five of acids *i.e.*, ascorbic, boric, citric, palmitic and salicylic acids for two concentration at 2000 and 3000 ppm were used to study their effect on the disease severity of snap bean pod rots after artificial inoculation with *B. cinerea*, *S. sclerotiorum* and natural infection, and storage at 8±1°C and 90 - 95%RH. for two weeks .

Data in **Table (13)** indicated that, all organic acids showed significant reduction for disease incidence on bean pods compared with the control treatment. Also, positive correlation was found with the concentration of these acids and the reduction of disease severity. Data also revealed that, boric and palmitic acids were highly effective in reducing on disease severity when used at 3000 ppm under artificial inoculation with the two pathogenic fungi also on naturally infected pods.

Data in **Table (13)** revealed that, the highest disease reduction in pods infected by *B. cinerea* (6.1 and 9.0%) and *S. sclerotiorum* (6.7 and 1.4%) was obtained when using palmitic and boric acids at 3000 ppm, respectively. Meanwhile, citric acid showed moderate effect as well as under natural infection when used at 3000 ppm against *B. cinerea, S. sclerotiorum* and natural infection by resulted 28.6, 17.29 and 18.5%, respectively. On the other hand, salicylic acid gave the least effect for the reduction of disease when used at 2000 ppm and resulted 54.4 and 61.9% of disease severity on bean pods after inoculation with *B. cinerea* and *S. sclerotiorum*, respectively, followed by ascorbic acid on *S. sclerotiorum* by 8.18% efficacy only.

Table (13): Effect of some acids on the reduction of *B. cinerea* and *S. sclerotiorum* disease incidence on snap bean pod under cold storage for 15 days.

Treatments	Conc. (ppm)	Disease severity (%) (D.S)					
		Botrytis cinerea		*S. sclerotiorum*		Natural infection	
		D.S	Efficacy	D.S	Efficacy	D.S	Efficacy
Ascorbic acid	2000	27.20	62.46	64.91	8.16	7.90	83.40
	3000	19.60	72.95	42.29	40.17	0.00	100.00
Boric acid	2000	20.40	71.85	21.40	69.72	5.70	87.77
	3000	9.00	87.58	1.40	98.02	4.00	91.41
Citric acid	2000	30.40	58.05	45.90	35.06	17.90	61.58
	3000	28.60	60.53	17.29	75.54	18.50	60.29
Palmitic acid	2000	18.20	74.88	32.20	54.44	2.30	95.06
	3000	6.10	91.89	6.70	90.52	0.00	100.00
Salicylic acid	2000	54.40	24.92	61.90	12.42	19.30	58.57
	3000	43.70	39.69	41.70	41.00	11.00	76.39
Control*		72.46		70.68		46.59	
LSD at 5% for							
Treatment (T)		14.36		10.23		6.16	
Conc. (C)		NS		5.97		NS	
Combination T X C		NS		NS		NS	

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

c- Effect of using some salts on the disease severity% of snow pea pods rots, under cold storage for two weeks.

Data in **Table (14)** show the effect of five different salts used against of the disease incidence caused by *B. cinerea* and *S. sclerotiorum* on snow pea pods. All salts treatments were effective in disease reduction when compared with the control treatment. Also, negative correlation was found between the disease severity and the salts concentration. Data revealed that, sodium bicarbonate, Sanosil and Max Guard were more effective in reducing snow pea pod rots severity caused by *B. cinerea* when used at 3000ppm with reading 21.30, 24.95 and 29.09% disease severity, respectively, compared with the control treatment (82.2%). Meanwhile, Max Guard and sodium bicarbonate were the best salts for control *S. sclerotiorum* on pea (22.5 and 24.5% disease), respectively compared with 77.4% disease in the control check. On the other hand,

calcium carbonate and calcium sulphate were the least effective in reducing disease severity caused by both pathogens.

Concerning the effect of these salts on the reduction of disease severity% that caused by natural infection. Data indicated that, all salts were effective in reducing disease severity which (arranged from 4.7% to 15.9%) compared with the control treatment which equal (33.45%). In this respect, highly significant differences were noticed between these salts and their concentrations for disease reduction. Organic salts efficacy diseases mould were arranged as follows, Max Guard, Sanosil, calcium sulphate, sodium bicarbonate and calcium carbonate causing 4.7, 5.5, 6.14, 7.10 and 14.8% disease severity on pea pods, respectively.

Table (14): Effect of some salts on the reduction of incidence on snow pea pods rot under cold storage for 15 days.

Treatments	Conc. (ppm)	Disease severity (%) (D.S)					
		Botrytis cinerea		*S. sclerotiorum*		Natural infection	
		D.S	Efficacy	D.S	Efficacy	D.S	Efficacy
Sanosil	2000	29.89	63.64	43.00	44.44	12.50	62.63
	3000	24.95	69.65	41.50	46.38	5.50	83.56
Max Guard	2000	33.04	59.81	42.30	45.35	9.40	71.90
	3000	29.09	64.61	22.50	70.93	4.70	85.95
Sodium bicarbonate	2000	22.50	72.63	38.20	50.65	15.30	54.26
	3000	21.30	74.09	24.50	68.35	7.10	78.77
Calcium Carbonate	2000	57.90	29.56	48.40	37.47	15.90	52.47
	3000	50.60	38.44	47.20	39.02	14.80	55.75
Calcium sulphate	2000	50.28	38.83	50.90	34.23	8.85	73.54
	3000	43.40	47.20	40.96	47.08	6.14	81.64
Control*		82.20		77.40		33.45	
LSD at 5% for							
Treatment (T)		11.08		13.12		4.94	
Conc. (C)		NS		NS		2.85	
Combination T X C		NS		NS		NS	

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

d- Effect of using some organic acids on the disease severity% of snow pea pod rots, under cold storage for two weeks.

The same five organic acids, (*i.e.*, ascorbic, boric, citric, palmitic and salicylic) in two concentrations at 2000 and 3000 ppm were used to control disease severity of snow pea pod rots after artificial inoculation with *B. cinerea*, *S. sclerotiorum* and natural infection. Data in **Table (15)** indicated that, all organic acids showed significant reduction for the disease incidence % of pea pod rots when compared with the control treatment (natural). Also, it found positive correlation with high concentration of acids treatment and disease reduction.

Data also revealed that, ascorbic and citric acids resulted highly effect on disease reduction of the two pathogenic fungi as well as on the natural infection when used at 3000 ppm on pea pods, where recorded in **Table (15)** 17.10 - 32.79% disease severity with *B. cinerea* inoculation, 27.08 - 33.75% with *S. sclerotiorum* inoculation and 2.45 - 6.27% with natural infection, for the two acids, respectively. Meanwhile, boric acid showed moderate effect on the disease control which caused by *B. cinerea, S. sclerotiorum* and natural infection of the snow pea pod rots.

Palmitic acid was more efficacy on *S. sclerotiorum* than *B. cinerea* mould infection and natural infection on pea pods when used at 3000ppm by resulted 75.74, 54.7 and 68.31% efficacy, respectively. On the other hand, salicylic acid was the least effective on the disease incidence of *B. cinerea* and *S. sclerotiorum* by results 50.16 and 49.77% disease on pea pods although it was more effect on natural inoculation (2.52% disease only) when compared with the control treatment (**Table, 15**).

Table (15): Effect of some acids on the reduction of *B. cinerea* and *S. sclerotiorum* disease incidence on snow pea pods under cold storage at 8±1°C and 90 - 95%RH. for 15 days.

Treatments	Conc. (ppm)	Disease severity (%) (D.S)					
		Botrytis cinerea		*S. sclerotiorum*		Natural infection	
		D.S	Efficacy	D.S	Efficacy	D.S	Efficacy
Ascorbic acid	2000	26.50	67.76	30.70	60.34	5.30	84.16
	3000	17.10	79.20	27.08	64.99	2.45	92.53
	Mean	**21.80**	**73.48**	**29.89**	**62.67**	**3.88**	**88.35**
Boric acid	2000	49.00	40.39	48.78	36.95	14.58	56.35
	3000	48.09	41.49	33.75	56.33	10.79	67.71
	Mean	**48.55**	**40.94**	**41.26**	**46.64**	**12.69**	**59.03**
Citric acid	2000	38.67	52.95	41.19	46.78	10.89	67.44
	3000	32.79	60.1	33.75	56.39	6.27	81.25
	Mean	**35.73**	**56.53**	**37.47**	**51.59**	**8.58**	**74.35**
Palmitic acid	2000	41.09	50.01	58.76	24.03	16.36	48.43
	3000	37.23	54.70	18.61	75.74	10.55	68.31
	Mean	**39.16**	**52.36**	**38.69**	**49.89**	**13.46**	**58.37**
Salicylic acid	2000	58.24	29.14	54.84	29.14	7.72	76.92
	3000	50.16	38.97	49.77	35.69	2.52	92.46
	Mean	**54.20**		**34.06**		**52.31**	
Control*		82.20		77.40		33.45	
LSD at 5% for							
Treatment (T)		13.64		13.24		5.64	
Conc. (C)		NS		7.62		3.25	
Combination T X C		NS		18.71		NS	

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

e- Effect of modified atmospheric gases conditions on disease severity% of snap bean pod rots, under cold storage for three weeks.

Data in **Table (16)** illustrated that; three levels of modified atmosphere were applied to study their effect on the disease incidence of *B. cinerea* and *S. sclerotiorum* on snap bean pods. Result, indicated that, using atmosphere containing 3% O_2, 10% CO_2 and 87% N was significantly better than the other two levels of modified atmosphere condition. Also it was more effective in reducing disease severity on snap bean pod rots after artificial inoculation with *B. cinerea and S. sclerotiorum* where, it gave 32.76 and 31.71% of disease severity, respectively compared with 100% and 88.2% of disease severity in the control check (natural air), followed by the level containing 2%O_2, 5%CO_2 and 93%N, its results were 37. 46 and 48.94% of disease severity

compared with control (natural air). Meanwhile the level 3%O_2, 15%CO_2 and 82%N was the least effective on reducing disease severity of snap bean pod rots caused by the two pathogenic fungi and resulted 100% and 80.57% of disease severity compared with control.

Table (16): Effect of modified atmospheres condition on the reduction of *B. cinerea* and *S. sclerotiorum* disease incidence on snap bean pods under cold storage For 21 days.

Treatments			Disease severity (%) (D.S)					
			B. cinerea		*S. sclerotiorum*		Control (natural Infection)	
O_2	CO_2	N	D.S	Efficacy (%)	D.S	Efficacy (%)	D.S	Efficacy (%)
2 :	5 :	93	37.46	62.54	48.94	44.89	2.40	96.00
3 :	10 :	87	32.76	67.24	31.71	64.29	2.15	96.34
3 :	15 :	82	100.00	0.00	80.57	9.29	1.48	97.48
Natural air*			100.00		88.82		58.79	
LSD at 5%			4.07		8.47		11.54	

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

On the other hand, the same snap bean pods were storage under the same conditions with natural infection. Results in **Table (16)** revealed that, using of the all modified atmosphere was effective on reduction of the disease severity of the two pathogen and others from natural infection which only gave the following values 1.48- 2.40% of disease severity compared with natural air condition treatment which gave 58.79% of disease severity.

4-Field experiment:

Five of certain salts *i.e.*, calcium chloride, calcium sulphate, calcium carbonate, potassium chloride and potassium sulphate and acids *i.e.*, salicylic and boric acids were used as a pre-harvest treatments on snap bean and pea plants, during seasons 2005 and 2006, to study their effect on reducing disease severity of stored pods:

4.a- Effectiveness of salts and acids as a pre-harvest treatments on snap bean plant on the disease severity% after natural and artificial inoculation with *B. cinerea*, *S. sclerotiorum* treatments, under storage conditions.

The effect of some salts and acids in different concentrations were sprayed on bean plants under field conditions (seasons 2005 and 2006) as pre-harvesting treatment against diseases incidence of inoculation with *B. cinerea* and *S. sclerotiorum* as well as natural infection during the storage at 8±1°C and 90 - 95%RH. for two weeks. Data in **Table (17)** indicated that, all treatment were effective for reducing the disease severity under storage conditions. In general, acids were more effective than salts under the inoculation with *S. sclerotiorum* and natural infection, meanwhile, no trend was notice in case *B. cinerea* inoculation during the two seasons. On the other hand, negative correlation was noticed between the level of concentrations and the disease incidence on bean pods under storage conditions. Concerning the salts, calcium sulphate and potassium sulphate were more effective on decreasing the disease and showed highly significance on the efficacy than other salts under inoculation with *B. cinerea* and *S. sclerotiorum* especially of high concentrations. Meanwhile, the least effects was obtained when bean plants sprayed with calcium carbonate (28.78 and 25.84%) and potassium chloride (22.97 and 29.22%), to control *S. sclerotiorum* under storage conditions during the two seasons.

On the other hand, salicylic acid was more effective on the reduction of disease severity that caused by *B. cinerea* than boric acid and resulted 91.44 and 88.32% efficacy during the two seasons, respectively. Under natural infection, all treatments, salts and acids were effective on disease severity and recorded 86.08 and 86.13% efficacy and 91.71 and 100% efficacy during the two seasons, respectively. Also, no significant differences were noticed for bean plants spraying with salicylic and boric acids to control bean pod rots under natural infection in season 2006 (**Table, 17**).

Table (17): Comparative effectiveness of certain salts and acids spray as a pre-harvest treatments on *B. cinerea*, *S. sclerotiorum* and natural infection disease severity for snap bean pods under cold storage conditions for 15 days.

Treatments	Conc. (ppm)	Disease Severity (%) (D.S) 2005 season						Disease Severity (%) (D.S) 2006 season					
		Botrytis cinerea		*S. sclerotiorum*		Natural infection		*Botrytis cinerea*		*S. sclerotiorum*		Natural Infection	
		D.S	Efficacy	D.S	Efficacy	D.S	Efficacy	D.S	Efficacy	D.S	Efficacy	D.S	Efficacy
Calcium chloride	2000	11.14	85.65	24.16	62.39	6.11	82.02	18.30	68.68	30.24	54.60	8.73	70.53
	3000	10.82	86.06	18.94	70.52	3.08	90.94	16.40	71.93	24.18	63.70	0.00	100.00
	Mean	**10.98**	**85.86**	**21.55**	**66.46**	**4.60**	**86.48**	**17.35**	**70.31**	**27.21**	**59.15**	**4.37**	**85.27**
Calcium sulphate	2000	18.61	76.03	16.66	74.07	6.41	81.14	16.40	71.93	20.32	69.50	6.57	77.82
	3000	4.66	94.00	10.33	83.92	3.14	90.76	9.22	84.21	12.46	81.30	1.21	95.91
	Mean	**11.64**	**85.02**	**13.50**	**78.79**	**4.78**	**85.95**	**12.81**	**78.07**	**16.39**	**75.40**	**3.89**	**86.87**
Calcium carbonate	2000	22.33	71.24	32.67	49.14	6.33	81.38	20.50	64.91	28.50	57.22	7.33	75.25
	3000	13.57	82.52	24.88	61.27	2.67	92.14	10.30	82.36	23.18	65.20	0.00	100.00
	Mean	**17.95**	**76.88**	**28.78**	**55.21**	**4.50**	**86.76**	**15.40**	**73.64**	**25.84**	**61.21**	**3.67**	**87.63**
Potassium chloride	2000	28.91	62.76	32.61	49.24	4.33	87.26	32.70	44.03	40.24	39.60	6.25	78.87
	3000	9.72	87.48	13.33	79.25	2.41	92.91	13.30	77.23	18.19	72.70	0.00	100.00
	Mean	**19.32**	**75.12**	**22.97**	**64.25**	**3.37**	**90.09**	**23.00**	**60.64**	**29.22**	**56.15**	**3.13**	**89.44**
Potassium sulphate	2000	8.76	88.72	24.38	62.05	7.64	77.52	6.49	88.90	22.25	66.60	9.00	69.62
	3000	6.69	91.38	8.72	86.43	5.19	84.73	2.78	95.24	11.26	83.10	2.00	93.25
	Mean	**7.73**	**90.05**	**16.55**	**74.24**	**6.42**	**81.13**	**4.65**	**92.07**	**16.75**	**74.85**	**5.50**	**81.44**
Mean		**13.52**	**82.58**	**20.67**	**67.79**	**4.73**	**86.08**	**14.64**	**74.95**	**23.08**	**65.35**	**4.11**	**86.13**
Salicylic acid	2000	7.96	89.75	12.74	80.17	7.77	77.14	10.20	82.54	14.72	77.90	0.00	100.00
	3000	5.33	93.13	4.00	93.77	1.44	95.76	3.45	94.09	0.00	100.00	0.00	100.00
	Mean	**6.65**	**91.44**	**8.37**	**86.97**	**4.61**	**86.45**	**6.98**	**88.32**	**7.36**	**88.95**	**0.00**	**100.00**
Boric acid	2000	28.27	53.59	12.58	80.42	2.07	93.91	21.90	62.51	9.32	86.00	0.00	100.00
	3000	16.67	78.53	6.94	89.20	0.00	100	10.60	81.85	2.39	96.40	0.00	100.00
	Mean	**22.47**	**66.06**	**9.76**	**84.81**	**1.04**	**96.96**	**16.25**	**72.18**	**5.86**	**91.20**	**0.00**	**100.00**
Mean		**14.56**	**78.75**	**9.07**	**85.89**	**2.83**	**91.71**	**11.62**	**80.25**	**6.62**	**90.08**	**0.00**	**100.00**
Control		**77.64**		**64.24**		**33.99**		**58.42**		**66.62**		**29.62**	
LSD at 5% for													
Treatment (T)		8.76		14.13		6.51		5.65		8.82		1.99	
Conc. (C)		4.38		7.15		NS		2.76		4.41		1.41	
Combination T X C		NS		NS		NS		7.99		NS		4.03	

4.b- Effectiveness of salts and acids as a pre-harvest treatments on snow pea plant on the disease severity% after natural and artificial inoculation with *B. cinerea*, *S. sclerotiorum* treatments, under storage conditions.

Also, the same salts and acids at different concentrations were sprayed on pea plants under field conditions (seasons 2005 and 2006) as pre-harvesting to study their effect on disease severity of pea pods under the inoculation with *B. cinerea* and *S. sclerotiorum* as well natural infection and storage at 8±1°C and 90 - 95% RH. for two weeks. Data in **Table (18)** revealed that, all treatments were effective for reducing the disease severity compared with control treatment. In this respect, organic acids were more effective than salts on disease severity due to *B. cinerea*, *S. sclerotiorum* inoculation and natural infection, hence, the efficacy was 88.12, 87.89 and 99.28% during season 2005 and 90.36, 89.04 and 100.00% efficacy during season 2006, respectively. On the other hand, calcium chloride and potassium sulphate were more effective than other salts on the reduction of disease severity on pea pods with *S. sclerotiourm* inoculation and natural infection during seasons 2005 and 2006. Meanwhile, potassium and calcium sulphate were the best effective on reduction of disease severity which gave 83.93 and 92.59% efficacy and 83.56 and 86.36% efficacy to control *B. cinerea* infection during the two seasons, respectively. Potassium chloride was the less effective to control *B. cinerea* infection by resulting 35.15% of disease severity on pea pods under storage conditions. Also, data indicated that, positive correlation was noticed between the increasing of concentrations and the efficacy of their treatments to control mould disease on pea pods under storage conditions.

Concerning the acids, data in **Table (18)** salicylic acid was effective than boric acid on the reduction of disease severity on pea pods which inoculated with *B. cinerea* and its resulted 89.68 and 91.42% efficacy during seasons 2005 and 2006, respectively. Under the natural infection, all treatments, salts and acids were effective for controlling pea pods moulds during the two seasons. Also, no significant differences was noticed for salicylic and boric acids treatment on pea plants to control of pea pod rots under the natural infection treatment during the two seasons.

Table (18): Comparative effectiveness of certain salts and acids spray as a pre-harvest treatments on *B. cinerea*, *S. sclerotiorum* and natural infection disease severity for snow pea pods under cold storage conditions for 15 days

Treatments	Conc. (ppm)	Disease Severity (%) (D.S) 2005 season						Disease Severity (%) (D.S) 2006 season					
		Botrytis cinerea		*S. sclerotiorum*		Natural infection		*Botrytis cinerea*		*S. sclerotiorum*		Natural infection	
		D.S	Efficacy	D.S	Efficacy	D.S	Efficacy	D.S	Efficacy	D.S	Efficacy	D.S	Efficacy
Calcium chloride	2000	25.68	68.25	16.53	81.68	2.93	93.72	29.04	66.35	15.00	82.59	0.00	100
	3000	15.08	81.35	9.72	89.23	0.00	100	12.38	85.65	4.56	94.70	0.00	100
	Mean	**20.38**	**74.80**	**13.13**	**85.46**	**1.47**	**96.86**	**20.71**	**76.00**	**9.78**	**88.65**	**0.00**	**100.00**
Calcium sulphate	2000	14.86	81.63	25.51	71.74	3.28	92.97	14.73	82.93	22.00	74.76	5.28	86.10
	3000	11.73	85.49	14.77	83.64	1.60	96.56	8.80	89.79	12.3	85.73	2.68	92.90
	Mean	**13.30**	**83.56**	**19.98**	**77.69**	**2.44**	**94.77**	**11.77**	**86.36**	**17.15**	**80.25**	**3.98**	**89.50**
Calcium carbonate	2000	26.10	67.72	26.13	71.05	7.01	85.00	34.03	60.57	17.7	79.45	6.87	82.00
	3000	21.58	73.32	20.32	77.49	3.09	93.3	18.92	78.08	10.1	88.28	1.49	96.10
	Mean	**23.84**	**70.52**	**23.23**	**74.27**	**5.05**	**89.15**	**26.48**	**69.33**	**13.90**	**83.87**	**4.18**	**89.05**
Potassium chloride	2000	36.65	54.68	37.12	58.88	0.00	100	22.98	73.37	32.3	62.53	0.40	99.00
	3000	33.65	58.4	13.61	84.92	0.00	100	17.71	79.48	10.8	87.47	1.78	95.30
	Mean	**35.15**	**56.54**	**25.37**	**71.90**	**0.00**	100.00	**20.35**	**76.43**	**21.55**	**75.00**	**1.09**	**97.15**
Potassium sulphate	2000	14.98	81.47	13.59	84.95	6.5	86.08	8.44	90.21	10.3	88.05	0.00	100
	3000	11.01	86.38	7.06	92.17	2.14	95.40	4.33	94.97	3.81	95.58	0.00	100
	Mean	**12.10**	**83.93**	**10.33**	**88.56**	**4.32**	**90.74**	**6.39**	**92.59**	**7.06**	**91.82**	**0.00**	**100.00**
Mean		**20.95**	**73.87**	**18.41**	**79.58**	**2.66**	**94.30**	**17014**	**80.14**	**13.89**	**83.91**	**1.85**	**95.14**
Salicylic acid	2000	10.88	86.54	20.21	77.61	1.34	97.12	9.41	89.09	17.6	79.58	0.00	100
	3000	5.80	92.82	6.10	93.24	0.00	100	5.39	93.75	6.38	92.59	0.00	100
	Mean	**8.34**	**89.68**	**13.16**	**85.43**	**0.67**	**98.56**	**7.40**	**91.42**	**11.99**	**86.09**	**0.00**	**100.00**
Boric acid	2000	13.29	83.56	13.43	85.11	0.00	100	13.62	84.22	11.2	86.98	0.00	100
	3000	8.46	89.53	3.97	95.59	0.00	100	4.84	94.38	2.59	96.99	0.00	100
	Mean	**10.88**	**86.55**	**8.70**	**90.35**	**0.00**	**100.00**	**9.23**	**89.30**	**6.90**	**91.99**	**0.00**	**100.00**
Mean		**9.61**	**88.12**	**10.93**	**87.89**	**.34**	**99.28**	**8.32**	**90.36**	**9.45**	**89.04**	**0.00**	**100.00**
Control		**80.9**		**90.30**		**46.76**		**86.33**		**86.20**		**38.10**	
LSD at 5% for													
Treatment (T)		9.96		7.80		3.28		8.26		8.98		4.06	
Conc. (C)		NS		3.88		NS		4.11		4.49		NS	
Combination T X C		NS		NS		NS		NS		NS		NS	

5- Biochemical changes associated with natural and fungal inoculation to snap bean and snow pea pods under different conditions:

A- Comparison between phenol and sugar contents of some snap bean pods cultivars after ten days from natural infection.

Four of snap bean cultivars *i.e.*, Bronco, Paulista, Ogzyra and Emy were used for study the phenol and sugar contents under the natural infection with mould fungi. Data in **Table (19)** revealed that, Paulista cv. has the highest content of free and total phenols in naturally infected pods compared with other bean cultivars. Also, Emy and Paulista cvs. contain the highest amount of conjugated phenols which recorded 4.30 and 3.08 mg/g of fresh weight (fw) of pods, respectively. The least content of phenol was found in pods of Bronco cv. (3.48, 2.92 and 0.56 mg/g – as total, free and conjugated phenols), respectively. On the other hand, Ogzyra cv. was has a moderate content for phenols as compared with other bean varieties *i.e.* 4.44 mg/g total phenols.

Table (19): Comparison between phenol and sugar contents (mg/g fresh weight) of some snap bean pods cultivars after ten days of natural mould fungi infection.

Cultivars	Phenol contents			Sugar contents		
	Free	Conjugated	Total	Non-reducing	Reducing	Total
Bronco	2.92	0.56	3.48	0.02	3.46	3.48
Paulista	3.64	3.08	6.72	0.27	0.00	0.27
Ogzyra	2.68	1.76	4.44	0.04	2.28	2.32
Emy	1.32	4.30	5.62	0.38	0.00	0.38

Concerning of sugar contents, data in **Table (19)** also indicated that, Paulista and Emy varieties resulted the lowest content for total sugars after natural infection compared with Ogzyra and Bronco varieties. Also, Emy and Paulista cvs. did not contain reducing sugars, but contained 0.38 and 0.27 mg/g non-reducing sugars. Meanwhile, the highest sugars content was obtained from Bronco and Ogzyra bean

varieties by results 3.48 and 2.31 mg/g as total sugars, non-reducing (0.02 and 0.04 mg/g) and reducing sugars (3.46 and 2.28 mg/g), respectively.

B- Effect of some salts and acids used to control grey and white moulds diseases under storage conditions on:

1- Chlorophyll contents in snap bean pods:

Different salts compounds (*i.e.* Bafry, Sanosil, Max Guard, sodium bicarbonate and calcium carbonate) and acids (ascorbic, salicylic, boric and palmitic) were used in two concentrations (2000 and 3000 ppm) to study their effect on chlorophyll A, B and A+B in snap bean pods that stored at 8±1°C and 90 - 95% RH. for 15 days.

Table (20): Effect of some salts and acids treatments on snap bean pods chlorophyll contents after harvest and cold storage for 15 days.

Treatments	Conc. (ppm)	Chlorophyll contents mg/L		
		Ch.A	Ch.B	Ch.A+B
Salts				
Bafry	2000	3.02	3.79	6.81
	3000	3.24	5.87	9.11
Sanosil	2000	4.04	5.38	9.42
	3000	3.18	5.12	8.30
Max Guard	2000	4.94	6.30	11.24
	3000	5.81	10.70	16.51
Sodium bicarbonate	2000	4.67	5.53	10.20
	3000	3.23	5.57	8.80
Calcium carbonate	2000	3.24	3.93	7.17
	3000	3.42	5.82	9.24
Acids				
Ascorbic acid	2000	3.68	5.55	9.23
	3000	4.12	5.41	9.53
Salicylic acid	2000	5.85	8.08	13.93
	3000	4.53	8.89	13.42
Boric acid	2000	1.66	2.42	4.08
	3000	3.80	5.87	9.67
Palmitic acid	2000	5.61	6.64	12.25
	3000	1.82	3.60	5.42
Control		4.99	9.14	14.13

Data in **Table (20)** revealed that, Max Guard at 3000 ppm keep the green color of pods and gave highest amounts of chlorophyll A (5.81 mg/L) and chlorophyll B (10.70 mg/L), compared with control check treatment which gave the following results: chlorophyll A (4.99 mg/L) and chlorophyll B (9.14 mg/L). While, salicylic and palmitic acids were more effective on protection chlorophyll A when used at 2000 ppm (5.85 and 5.61 mg/L, respectively).

2- Sugar contents in snap bean pods:

All chemicals and acids were used of concentration at of 3000 ppm to study their effect on sugar contents of snap bean inoculated with *B. cinerea* and *S. sclerotiorum* as well as under natural infection after 15 days from storage at 8±1°C and 90 - 95% RH. Data in **Table (21)** show that, all chemicals were effective in reducing sugar content in bean pods compared relative to control treatment. The total sugar contents were 3.24 and 2.74 mg/g fw of pods that inoculated with *B. cinerea*, while was 3.97 and 2.36 mg/g fw in pods inoculated with *S. sclerotiorum* and 1.81 and 2.14 mg/g for natural infection after using salts and acids, respectively compared with control treatment which gave 4.65, 3.71 and 4.80 mg/g fw, respectively.

On the other hand, salts were less effective than acids in reducing sugar contents of bean pods inoculated with *B. cinerea* and S. *sclerotiorum* by gave an increase in sugars content, meanwhile, it showed reduction in sugar content under natural infection. In this regard, sodium bicarbonate gave the least content of sugars (1.36, 0.18 and 1.54 mg/g fw) under inoculation with *B. cinerea* compared with max Guard (2.03, 1.73 and 3.76 mg/g fw) and Sanosil (0.82, 3.61 and 4.43 mg/g fw) as non-reducing, reducing and total sugars, respectively. The highest sugars content 1.67, 6.57 and 8.24 mg/g fw were recorded in pods treated with Max Guard and inoculated with *S. sclerotiorum*. Similar trend was recorded in naturally infected pods.

Table (21): Effect of some salts and acids on sugar contents of snap bean pods under natural infection and artificial inoculation with the two pathogens fungi after harvest and storage conditions for 15 days (postharvest).

Treatment	*Botrytis cinerea*			*Sclerotinia sclerotiorum*			Natural infection		
	Non-reducing	Reducing	Total	Non-reducing	Reducing	Total	Non-reducing	Reducing	Total
Salts									
Sanosil	0.82	3.61	4.43	0.55	1.50	2.05	0.30	1.67	1.97
Max guard	2.03	1.73	3.76	1.67	6.57	8.24	0.25	1.88	2.13
Sodium bicarbonate	1.36	0.18	1.54	0.15	1.48	1.63	0.63	0.72	1.35
Mean	1.40	1.84	3.24	0.79	3.18	3.97	0.39	1.42	1.81
Acids									
Boric acid	0.20	2.22	2.42	0.80	2.18	2.98	0.15	1.01	1.16
Palmitic acid	2.40	0.93	3.33	1.51	0.92	2.43	0.93	1.34	2.27
Salicylic acid	0.61	1.86	2.47	0.41	1.25	1.66	1.24	1.76	3.00
Mean	1.07	1.67	2.74	0.91	1.45	2.36	0.77	1.37	2.14
Control*	0.82	3.83	4.65	0.63	3.08	3.71	1.58	3.22	4.80

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

Concerning the effect of different acids on the sugar content, data revealed that, all acids were effect on reduction of sugars content under inoculation with the two pathogenic fungi as well as natural infection compared with control treatment. In this respect, boric acid was most effective in reducing sugars content in pods inoculated with *B. cinerea* (0.20, 2.22 and 2.42 mg/g fw) and naturally infected ones (0.15, 1.01 and 1.16 mg/g fw) of non-reducing, reducing and total sugars, respectively (**Table, 21**).

3- Phenol contents in snap bean pods:

Three salts (*i.e.*, Sanosil, Max Guard and sodium bicarbonate), and acids (boric, palmitic and salicylic), were used (at 3000 ppm) as treatments on snap bean pods to control different moulds and studies their effect on the phenol content after storage for 15 days at 8±1°C and 90 – 95% RH. Data in **Table (22)** revealed that, using of different chemicals varied for their effect on the phenol content when compared with control treatment. Also, organic acids were more effective than salts on increasing phenol content of bean pods when inoculated with

B. cinerea and *S. sclerotiorum* which gave the following values of total phenols, 11.42 and 13.97 mg/g fw for acids and 10.12 and 13.24 mg/g fw for salts, respectively. While, using different salts were effective on total phenol which gave 11.36 mg/g fw under natural infection compared with 7.71 mg/g fw with acids treatment. In this respect, Max Guard and boric acid were the most effective on increasing phenol content under inoculation with *B. cinerea* compared with other treatments. Mean while, Sanosil and boric acid were effective in cases of inoculation with *S. sclerotiorum* (6.25, 8.01, 8.15, 8.27 and 14.4, 16.28 mg/g fw of pods) and under natural infection (10.70, 3.00, 1.66, 5.73 and 12.36, 8.73 mg/g fw), for free, conjugated and total phenols compared with other treatments and control **(Table, 22)**.

Table (22): Effect of some salts and acids on phenol contents of snap bean pods under natural infection and artificial inoculation with the two pathogens after harvest and storage conditions. for 15 days (postharvest).

Treatment	*Botrytis cinerea*			*Sclerotinia sclerotiorum*			Natural infection		
	Free	Conjugated	Total	Free	Conjugated	Total	Free	Conjugated	Total
Salts									
Sanosil	6.41	3.48	9.89	6.25	8.15	14.40	10.70	1.66	12.36
Max Guard	5.24	5.67	10.91	7.86	5.34	13.20	7.87	2.63	10.50
Sodium bicarbonate	6.23	3.33	9.56	9.49	2.65	12.14	1.81	9.43	11.24
Mean	5.96	4.16	10.12	7.86	5.38	13.24	6.79	4.57	11.36
Acids									
Boric acid	6.45	6.97	13.42	8.01	8.27	16.28	3.00	5.73	8.73
Palmitic acid	3.60	5.89	9.49	3.97	9.10	13.07	4.57	2.25	6.82
Salicylic acid	1.84	9.90	11.74	5.02	7.56	12.58	4.01	3.57	7.58
Mean	3.84	7.58	11.42	5.66	8.31	13.97	3.86	3.85	7.71
Control*	9.49	1.61	11.10	1.64	6.94	8.58	3.63	2.86	6.49

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

4- Sugar contents in snow pea pods:

Sugar contents as non-reducing, reducing and total sugars were estimated as a reflection to the effect of using different salts and acids in concentration (at 3000 ppm) to control grey and white moulds as well as under natural infection of pea pods. Data in **Table (23)** revealed that, all salts and acids treatments were effective in reducing of pea pods sugar contents under inoculation with *B. cinerea*, *S. sclerotiorum* and in naturally infected pods after storage when compared with control treatment. On the other hand, organic acids were more effective on reduction of total sugar contents under natural infection (0.50 mg/g fw) and inoculation with *S. sclerotiorum* (2.83 mg/g fw) than salts 0.72 and 5.87 mg/g fw, respectively. Meanwhile, less sugar content 2.28 mg/g fw in pea pods under inoculation with *B. cinerea* was obtained after using salts than 3.06 mg/g fw of total sugars when using organic acids.

Table (23): Effect of some salts and acids on sugar contents of snow pea pods under natural infection and artificial inoculation with the two pathogens after harvest and storage conditions for 15 days (postharvest).

Treatment	*Botrytis cinerea*			*Sclerotinia sclerotiorum*			Natural infection		
	Non-reducing	Reducing	Total	Non-reducing	Reducing	Total	Non-reducing	Reducing	Total
Salts									
Calcium carbonate	1.60	1.34	**2.94**	3.94	2.97	**6.91**	0.71	0.07	**0.78**
Max guard	0.20	0.77	**0.97**	3.27	4.82	**8.09**	0.69	0.08	**0.77**
Sodium bicarbonate	1.24	1.71	**2.95**	1.32	1.32	**2.64**	0.10	0.51	**0.61**
Mean	**1.01**	**1.27**	**2.28**	**2.84**	**3.03**	**5.87**	**0.5**	**0.22**	**0.72**
Acids									
Boric acid	0.45	5.82	**6.27**	0.91	0.64	**1.55**	0.08	0.31	**0.39**
Palmitic acid	0.72	0.36	**1.08**	1.71	2.05	**3.76**	0.06	0.97	**1.03**
Salicylic acid	1.21	0.65	**1.86**	0.64	2.54	**3.18**	0.12	0.00	**0.12**
Mean	**0.79**	**2.27**	**3.06**	**1.08**	**1.74**	**2.83**	**0.08**	**0.42**	**0.50**
Control*	**2.85**	**6.54**	**9.39**	**4.12**	**7.15**	**11.27**	**0.23**	**1.45**	**1.68**

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

Data in **Table (23)** indicated that, all salts and acids varied in their effect on sugars content, hence, Max Guard and palmitic acid were more effective in reducing sugar contents in pea pods inoculated with *B. cinerea* (0.2, 0.77 and 0.97mg/g fw and 0.72, 0.36 and 1.08 mg/g fw) compared with 2.85, 6.54 and 9.39 mg/g fw of non-reducing, reducing and total sugars of control treatment, respectively. Meanwhile, sodium bicarbonate and boric acid were effective in reducing sugar contents in pea pods inoculation with *S. sclerotiorum* (1.32, 1.32 and 2.64 mg/g fw) and (0.91, 0.64 and 1.55 mg/g fw) compared with 4.12, 7.15 and 11.27 mg/g fw of non-reducing, reducing and total sugars of control treatment, respectively. On the other hand, sodium bicarbonate and salicylic acid were more effective in naturally infected pods (0.10, 0.51 and 0.61mg/g fw) and (0.12, 0.00 and 0.12 mg/g fw) compared with control treatment that resulted 0.23, 1.45 and 1.68 mg/g fw of non-reducing, reducing and total sugars, respectively.

5- Phenol contents in snow pea pods:

Data in **Table (24)** illustrate that, free, conjugated and total phenols were estimated in pea pods as reflection of using salts and acids treatment in concentration (at 3000 ppm) to control *B. cinerea*, *S. sclerotiorum* as well as under natural infection after storage at 8±1°C and 90 - 95% RH for 15 days. Results showed that, all treatments varied in their effect in increasing phenol content in pea pods compared with the control treatment under storage conditions. In this respect, their increasing were 11.00, 11.68 and 13.89 mg/g and 12.14, 11.46 and 12.91 mg/g fw as a total phenols in pea pods treated with salts and acids, compared with 8.47, 5.03 and 9.17 mg/g fw of inoculated pods with *B. cinerea*, *S. sclerotiorum* and natural infection, respectively.

Table (24): Effect of some salts and acids on phenol contents of snow pea pods under natural infection and artificial inoculation with the two pathogens after harvest and storage conditions for 15 days (postharvest).

Treatment	*Botrytis cinerea*			*Sclerotinia sclerotiorum*			Natural infection		
	Free	Conjugated	Total	Free	Conjugated	Total	Free	Conjugated	Total
Salts									
Calcium carbonate	2.74	5.92	8.66	7.99	12.28	20.27	6.68	5.20	11.88
Max Guard	10.14	0.30	10.44	1.48	2.74	4.22	9.92	5.77	15.69
Sodium bicarbonate	3.52	10.41	13.93	3.98	6.60	10.58	4.14	9.99	14.13
Mean	5.46	5.54	11.00	4.48	7.20	11.68	6.91	6.98	13.89
Acids									
Boric acid	4.44	1.85	6.29	1.08	8.91	9.99	6.90	6.20	13.10
Palmitic acid	9.92	9.18	19.10	0.00	11.10	11.10	8.26	1.42	9.68
Salicylic acid	3.54	7.53	11.07	3.20	10.12	13.32	3.40	12.58	15.98
Mean	**5.96**	**6.18**	**12.14**	**1.42**	**10.04**	**11.46**	**6.18**	**6.73**	**12.91**
Control*	**6.22**	**2.25**	**8.47**	**1.92**	**3.11**	**5.03**	**5.94**	**3.23**	**9.17**

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

On the other hand, sodium bicarbonate (3.52, 10.41 and 13.93 mg/g fw) and palmitic acid (9.92, 9.18 and 19.10 mg/g fw) were the most effective for increasing phenol "free, conjugated and total phenol" in pea pods after the inoculation with *B. cinerea* under storage. While, calcium carbonate (7.99, 12.28 and 20.27 mg/g fw) and salicylic acids (3.20, 10.12 and 13.32 mg/g fw) were the most effective under inoculation with *S. sclerotiorum* compared with control treatment (1.92, 3.11 and 5.03 mg/g fw) of free, conjugated and total phenols, respectively. Under natural infection, Max Guard (9.92, 5.77 and 15.69 mg/g fw) and salicylic acid (3.40, 12.58 and 15.98 mg/g fw) were effective to increase phenols content in pea pods compared with control treatment (5.94, 3.23 and 9.17 mg/g fw) of free, conjugated and total phenol, respectively, (**Table, 24**).

C- Effect of modified atmospheric gases used to control grey and white moulds diseases under storage condition on:

1- Chlorophyll contents of snap bean pods:

The effect of different atmospheres condition on chlorophyll A, B and A+B in non-inoculated of Paulista snap bean pods stored at 8±1°C and 90-95% R.H. for 21 days were study. Data in **Table (25)** demonstrate that, the levels of atmosphere condition *i.e.*, 3% O_2, 15% CO_2 and N 82% and 3% O_2, 10% CO_2 and N 87% gave the best protection of green color of pods and gave highest amounts of chlorophyll A (2.97 and 2.29 mg/L), chlorophyll B (4.22 and 3.02 mg/L) and A+B (7.19 and 5.31 mg/L), respectively compared with control (Natural air). Meanwhile, gas mixture of 2% O_2, 5% CO_2 and N 93% was the least effective on protection of green color pigments when compared with other the two levels and control treatment.

Table (25): Effect of different levels of atmosphere condition on chlorophyll contents of natural inoculation snap bean pods after harvest and storage conditions for 21 days.

Atmosphere (%)			Chlorophyll contents mg/L		
O_2	CO_2	N	Chlorophyll A	Chlorophyll B	Chlorophyll A+B
2 :	5 :	93	1.79	2.88	4.67
3 :	10 :	87	2.29	3.02	5.31
3 :	15 :	82	2.97	4.22	7.19
21:	0.3 :	78*	2.97	3.80	6.99

* Control: natural fresh air

2- Sugar contents of snap bean pods:

The effect of different modified atmosphere on sugar contents in snap bean pods artificially inoculated with *B. cinerea* and *S. sclerotiorum* as well as natural infection after 21 days from storage at 8±1°C and 90 - 95% RH. were used in this study. Data in **Table (26)** indicated that, the first 2% O_2: 5% CO_2: 93% N and second 3% O_2: 10% CO_2: 87% N levels of mixtures gases were the most effective in

reducing sugars content, non-reducing, reducing and total sugars in pods inoculated with *B. cinerea* and *S. sclerotiorum*, respectively.

Data also revealed that, the all three levels of modified atmosphere for controlling other storage mould fungi under the natural inoculation on bean pods caused highly reduction of non-reducing and reducing sugars as well as total sugars when compared with control treatment. The second and last levels of modified atmosphere were more effective than the first level for decreasing of sugars contents in bean pods with natural infection. In this respect, 0.07 mg/g fw, 0.0 mg/g fw and 0.07 mg/g fw of non-reducing, reducing and total sugars, respectively, were resulted under using the second atmosphere level 3% O_2: 10% CO_2: 87% N compared with 1.67 mg/g fw, 2.15 mg/g fw and 3.82 mg/g fw of control treatment, (**Table, 26**).

Table (26): Effect of different levels atmosphere on the sugar contents (as mg/g fw) of snap bean pods under natural infection and artificial inoculation with the two pathogens after harvest and storage conditions. for 21 days.

Treatments			*B. cinerea*			*S. sclerotiorum*			Natural infection		
O_2	CO_2	N	Non-reducing	Reducing	Total	Non-reducing	Reducing	Total	Non-reducing	Reducing	Total
2 :	5 :	93	0.07	0.22	0.29	0.59	0.00	0.59	0.64	0.76	1.40
3 :	10 :	87	0.04	0.01	0.05	0.07	0.64	0.70	0.07	0.00	0.07
3 :	15 :	82	0.16	2.77	2.93	0.40	3.45	3.84	0.69	0.30	0.99
Control*			0.24	1.53	1.77	0.48	1.58	2.06	1.67	2.15	3.82

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

3- phenol contents of snap bean pods:

Free, conjugated and total phenols (as mg/g fresh weight of pods) were estimated as a reflection to the effect of using different levels of atmosphere condition on snap bean pods after artificial inoculation with *B. cinerea* and *S. sclerotiorum* as well natural infection and storage at 8±1°C and 90 - 95% RH. for 21 days. Data in **Table (27)**

illustrated that, using the first level atmosphere that content 2% O_2: 5% CO_2: 93% N was the best effective to increase total phenol in snap bean pods inoculated with *B. cinerea* and *S. sclerotiorum* which gave 11.5 mg/g fw and 12.14 mg/g fw compared with the control treatment results 9.58 and 9.21 mg/g fw, respectively. Meanwhile, the second level of atmosphere 3% O_2: 10% CO_2: 87% N was more effective with *S. sclerotiorum* inoculation that gave 17.61 mg/g fw than *B. cinerea* inoculation which gave 6.82 mg/g fw of total phenol. The least content of phenols was obtained when using the level atmosphere 3% O_2: 15% CO_2: 82% N which gave 4.03 mg/g fw and 4.00 mg/g fw as total phenol in bean pods after artificial inoculation with *B. cinerea* and *S. sclerotiorum*, respectively.

Table (27): Effect of different levels atmosphere on the phenol contents (as mg/g fw) of snap bean pods under natural infection and artificial inoculation with the two pathogens after harvest and storage conditions. for 21 days.

Treatments			*B. cinerea*			*S. sclerotiorum*			Natural infection		
O_2	CO_2	N	Free	Conjugated	Total	Free	Conjugated	Total	Free	Conjugated	Total
2 :	5 :	93	1.18	10.32	11.50	2.87	9.27	12.14	8.98	1.63	10.61
3 :	10 :	87	2.61	4.22	6.82	6.57	11.04	17.61	3.09	7.30	10.39
3 :	15 :	82	1.52	2.51	4.03	1.41	2.59	4.00	8.16	5.92	14.08
Control*			3.85	5.73	9.58	2.22	6.99	9.21	1.48	4.19	5.67

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

Data also indicated that, the highest conjugated phenols (10.32 mg/g fw) was obtained from using the first level of atmosphere compared with control treatment (5.73 mg/g fw) in case *B. cinerea*. Also, the highly content of free and conjugated phenols after using the first and the second atmosphere levels for controlling *S. sclerotiorum* on bean pods resulted 2.87 and 6.57 mg/g fw as free phenol and 9.27 and 11.04 mg/g fw as conjugated phenol compared with control

treatment that result of free and conjugated phenols were 2.22 and 6.99 mg/g fw, respectively.

On the other hand, the natural infection, data in **Table (27)** revealed that, all levels of atmosphere showed highly effective to increase free, conjugated and total phenols compared with the control treatment. Although the last level of atmosphere 3% O_2: 15% CO_2: 82% N showed less effect to increase phenol content when snap bean pods inoculation with *B. cinerea* and *S. sclerotiorum* while gave more effective under natural infection treatment by resulting 8.16, 5.92 and 14.08 mg/g of free, conjugated and total phenols compared with the control treatment which gave 1.48, 4.19 and 5.67 mg/g fw, respectively.

D-Effect of spraying of some salts and acids on snap bean plant under field condition and its pods storage for 15 days at 8±1°C and 90 - 95% RH on:

1- chlorophyll contents in snap bean pods:

Data in **Table (28)** showed estimated, chlorophyll a, b and (a+b) in bean pods, after 15 days from storage at 8±1°C and 90 - 95% RH, as reflection of spraying some salts and acids in two concentrations (2000 and 3000 ppm) on bean plants during season 2005.

Data indicated that 3000 ppm potassium sulphate treatment caused maximum increase in chlorophyll a (4.83 mg/L) and b (6.77 mg/L). Also, no considerable variation was noticed between different salts and acids as well as their concentrations in increasing bean pods chlorophyll content. The less increase in chlorophyll content was obtained in bean pods sprayed with calcium carbonate (2.04, 2.47 and 4.51 mg/L) and salicylic acid (2.21, 2.43 and 4.64 mg/L) at concentration of 3000 ppm compared with control check (**Table, 28**).

Table (28): Effect of spraying of some different salts and acids, under field conditions on the chlorophyll contents of snap bean pods and storage conditions for 15 days.

Treatments	Conc. (ppm)	Chlorophyll contents mg/L		
		Ch.A	Ch.B	Ch.A+B
Calcium chloride	2000	3.39	4.07	7.45
	3000	2.19	3.48	5.67
Calcium sulphate	2000	2.41	4.00	6.41
	3000	2.75	4.17	6.92
Calcium carbonate	2000	3.02	4.37	7.39
	3000	2.04	2.47	4.51
Potassium chloride	2000	2.63	4.16	6.80
	3000	2.36	2.67	5.03
Potassium sulphate	2000	2.49	2.77	5.26
	3000	4.83	6.77	11.60
Boric acid	2000	2.55	2.73	5.28
	3000	2.46	3.06	5.65
Salicylic acid	2000	2.31	2.77	5.09
	3000	2.21	2.43	4.64
Control		3.08	5.16	8.45

2- Sugar contents in snap bean pods:

Spraying of snap bean plants with different salts and acids in concentration (3000 ppm) used to study their effect on the sugar contents of pods under inoculation with *B. cinerea*, *S. sclerotiorum* and natural infection after 15 days from storage at 8±1°C and 90 - 95% RH. Data in **Table (29)** indicated that, all treatments of salts (calcium chloride and calcium sulphate) and acids (boric and salicylic) were effective in reducing of sugar content in snap bean pods under all treatments compared with control. In this regard, the less sugar content was record in snap bean pods after spraying with salts (1.33, 2.91 and 1.55 mg/g fw) and organic acids (1.95, 2.48 and 2.56 mg/g fw) under inoculation with *S. sclerotiorum*, *B. cinerea* and natural infection when compared with the control treatment 4.68, 6.71 and 4.02 mg/g fw, respectively.

Spraying of bean plants with salts was more effective than acids on reduction of sugar contents under inoculation with *S. sclerotiorum* and

natural infection, mean while, opposite effect was only obtained for using organic acids in case of *B. cinerea* inoculation compared with the control treatment. On the other hand, data revealed that, calcium chloride was more effective on the reduction of sugar content than calcium sulphate in cases of *B. cinerea* inoculation (0.07, 2.59 and 2.66 mg/g fw) and natural infection (0.14, 1.35 and 1.49 mg/g fw) for non-reducing, reducing and total sugars, respectively. Meanwhile, calcium sulphate was best reduction effective with *S. sclerotiorum* inoculation which recorded 0.30, 0.61 and 0.91 mg/g fw of non-reducing, reducing and total sugars, respectively. Concerning of spraying organic acids, data in **Table (29)** indicated that, salicylic acids was more effective on the reduction of sugars content in bean pods after the inoculation with *B. cinerea* (0.01, 1.38 and 1.39 mg/g fw) and under natural infection (0.96, 1.08 and 2.04 mg/g fw) than boric acid (.13, 3.44 and 3.57mg/g fw under inoculation with *B. cinerea*) and (0.65, 2.44 and 3.09 mg/g fw under natural infection). While, boric acid was most effective under the inoculation with *S. sclerotiorum* and resulted 0.07, 1.73 and 1.80 mg/g fw for non-reducing, reducing and total sugars, respectively.

Table (29): Effect of spraying of some salts and acids under field condition on sugar contents of snap bean pods under natural infection and artificial inoculation with the two pathogens and storage conditions for 15 days.

Treatment	*Botrytis cinerea*			*Sclerotinia sclerotiorum*			Natural infection		
	Non-reducing	Reducing	Total	Non-reducing	Reducing	Total	Non-reducing	Reducing	Total
Salts									
Calcium chloride	0.07	2.59	2.66	0.07	1.70	1.77	0.14	1.35	1.49
Calcium sulphate	0.66	2.52	3.18	0.30	0.61	0.91	0.15	1.47	1.62
Mean	**0.36**	**2.55**	**2.91**	**0.18**	**1.15**	**1.33**	**0.14**	**1.41**	**1.55**
Acids									
Boric acid	0.13	3.44	3.57	0.07	1.73	1.80	0.65	2.44	3.09
Salicylic acid	0.01	1.38	1.39	0.29	1.81	2.10	0.96	1.08	2.04
Mean	**0.07**	**2.41**	**2.48**	**0.18**	**1.77**	**1.95**	**0.80**	**1.76**	**2.56**
Control*	2.22	4.49	6.71	0.40	4.28	4.68	1.24	2.78	4.02

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.

3- Phenol contents in snap bean pods:

Data in **Table (30)** illustrated that, free, conjugated and total phenol were estimated in pods as a reflection to spray of different salts and acids in concentration (at 3000 ppm) on snap bean plants and storage for 15 days at 8±1°C and 90 - 95% RH. Results revealed that all treatments were effective for increasing phenols in bean pods compared with control treatment. The highest increase in phenols content in bean pods (12.2 mg/g fw as mean) was obtained after spraying salts on bean plants and pods inoculated with *B. cinerea* compared with other treatments. In general, spraying organic acids on bean plants caused increasing in pods phenols which were inoculated with *S. sclerotiorum* and natural infection. Concerning for used salts, calcium chloride was more effective in increasing phenols content and resulted 5.18, 8.84 and 14.02 mg/g fw under inoculation with *B. cinerea* and 12.33, 3.66 and 15.99 mg/g fw under inoculation with *S. sclerotiorum* as free, conjugated and total phenols, respectively. Compared with calcium sulphate which gave 5.88, 4.50 and 10.38 mg/g fw under inoculation with *B. cinerea* and 1.33, 9.95 and 11.28 mg/g fw under inoculation with *S. sclerotiorum* as free, conjugated and total phenols, respectively. While, calcium sulphate was more effective for increasing phenols content (1.41, 5.58 and 6.99 mg/g fw under natural infection) compared with calcium chloride (1.33, 5.51 and 6.84 mg/g fw under natural infection) as free, conjugated and total phenols, respectively.

Meanwhile, boric acid was more effective under inoculation with *B. cinerea* and natural infection and caused highest increasing of phenol contents compared with salicylic acid the value given were 9.28, 3.64 and 12.92 and 2.03, 6.75 and 8.78 mg/g fw of free, conjugated and total phenol, respectively. Meanwhile, salicylic acid was more effective on increasing total phenols in bean pods after storage and inoculation with *S. sclerotiorum* (14.65 mg/g fw) compared with boric acid and control treatment (**Table, 30**).

Table (30): Effect of spraying of some salts and acids under field conditions on phenol contents of snap bean pods under natural infection and artificial inoculation with the two pathogens fungi and storage conditions for 15 days.

Treatment	*Botrytis cinerea*			*Sclerotinia sclerotiorum*			Natural infection		
	Free	Conjugated	Total	Free	Conjugated	Total	Free	Conjugated	Total
Salts									
Calcium chloride	5.18	8.84	14.02	12.33	3.66	15.99	1.33	5.51	6.84
Calcium sulphate	5.88	4.50	10.38	1.33	9.95	11.28	1.41	5.58	6.99
Mean	**5.53**	**6.67**	**12.20**	**6.83**	**6.81**	**13.64**	**1.37**	**5.55**	**6.92**
Acids									
Boric acid	9.28	3.64	12.92	2.07	5.57	7.64	2.03	6.75	8.78
Salicylic acid	4.65	2.64	7.29	1.70	12.95	14.65	5.12	2.44	7.56
Mean	**6.97**	**3.14**	**10.11**	**1.89**	**9.26**	**11.15**	**3.58**	**4.60**	**8.17**
Control*	5.71	2.43	8.14	3.51	5.11	8.62	1.63	2.30	3.93

* Control was infected with *B. cinerea* or *S. sclerotiorum* or without infection.