SUMMARY

Cucumber (*Cucumis sativus* .L) is one of the most important vegetable crops, not only in Egypt but also all over the world. Cucumber is subject to many destructive diseases, which causes great losses. Powdery mildew caused by *Sphaerotheca fuliginea* and *Erysiphe cichoracearum* is one of the most destructive diseases which attack cucumber causing considerable reduction yield and quality. Results obtained can be summarized as follows:

1. Different cucumber leaves showed typical powdery mildew disease symptoms collected from six different localities of different governorates in Egypt.
2. Microscopic examination of different powdery mildew isolates collected from different governorates revraled that, the causal organism of cucumber powdery mildew is *Sphaerotheca fuliginea* and not Erysiphe *cichoracearum*.
3. Pathogenicity test revealed that all isolates of powdery mildew collected from six different localities were capable for infected cucumber plants but they varied in their virulence. Isolate of Kalubeia governorate was the most virulent one followed by Minufeia while Giza, Sharkeia, Sakha and ELbehera isolates were the less virulent.

4. Cucumber cultivars varied in their reaction to infection by powdery mildew causal organism under greenhouse conditions. Beita alpha and Rawa were highly susceptible cultivars; Pasandra and Zena hybrid were susceptible while Celebrity was resistance. The other cultivars tested ranged as moderate resistance and/or moderate susceptible.
5. Three concentrations of biotic and abiotic inducers were examined as seed or foliar treatments and the results indicated that the most effective concentrations as biotic inducers was 10^8 cfu/ml in *Bacillus subtillus*, *Pseudomonas fluorescens*, 10^6 spores/ml in *Trichoderma harzianum* and 0.03 g/l in AQ-10 treatment. On the other hand, the most effective concentration of abiotic inducers were 10, 2, 10, 5, 20 and 4 Mm in oxalic acid, salicylic acid, potassium oxalate, potassium phosphate and photophore, respectively and 0.04%, 0.05% in citric acid and potassium chloride while 0.18 g/l was in bion treatment when these inducers applied as seed or foliar treatment.
6. Results obtained recorded that AQ-10 was the most effective biotic inducers in reducing disease severity when applied as seed treatments while bion recorded the most effective abiotic inducer.
7. Data obtained revealed that *T. harzianum* followed by AQ-10 treatments recorded the most effective biotic inducer as leaves treatments when applied as single or booster spray, while bion and photophor recorded the most effective abiotic inducer when applied as booster spray.
8. Data obtained revealed that leaves treatment with different biotic and abiotic inducers was more effective than seed treatments. Also booster spray of these inducers was more effective than single spray.
9. Results of greenhouse experiments indicated that application of biotic and abiotic inducers as foliar treatments resulted in a significant increase in crop parameters (shoots and roots length, shoots and roots weight) of cucumber

plants compared with untreated infected plants (control). Also booster application was more effective than single one in increasing crop parameters of cucumber plants

9.1. Data obtained revealed that salicylic acid followed by potassium phosphate, fungastop and citric acid treatments recorded the highest increase in shoots length at single spray compared with other treatments while salicylic acid and potassium phosphate treatments recorded the heighest increase in shoots length when applied as booster spray. In addition, salicylic acid, fungastop and citric acid recorded the heighest increase in roots length at both single and booster spray.

9.2. Results also revealed that photophor followed by *T. harzianum*, bion and fungastop treatments recorded the heighest increase in shoots fresh weight at single spray, while photophor followed by potassium chloride, citric acid and oxalic acid treatments recorded the heighest increase when applied as booster spray compared with other treatments.

9.3. Data obtained recorded an increase in fresh weight of roots at both single and booster spray compared with untreated infected control. The heighest increase in roots fresh weight was recorded in photophor and fungastop treatments at single spray while fungastop, photophor and *B. subtillus* treatments recorded the heighest increase at booster spray compared with other treatments.

9.4. Obtained results indicated that the heighest increase in shoots dry weight was recorded in potassium phosphate and potassium chloride treatements using both single and booster spray compared with other treatments. On the other hand, potassium chloride treatment recorded the heighest increase in roots dry weight using single spray, while *B. subtillus* followed by citric

acid and potassium oxalate treatments recorded the heighest increase using booster spray compared with other treatments.

10. Obtained data recorded biochemical changes in cucumber plants as the results of different biotic and abiotic applications before inoculation and 1, 2, 4, 6 days after inoculation comparing with untreated infected control.

10.1. All biotic and abiotic inducers increased free and total phenol contents during the examined periods comparing with untreated infected control. The heighest increase in free phenol contents was recorded in bion, *Ps. fluorescens* and *B. subtillus* treatments when applied as single spray compared with other treatments, while bion, *Ps. fluorescens* and salicylic acid treatments recorded the heighest increase when applied as booster spray. In addition bion and *Ps. fluorescens* recorded the heighest increase in total phenol contents when applied as single spray, while photophor, bion, *Ps. fluorescens* and oxalic acid recorded the heighest increase using booster spray compared with other treatments.

10.2. Data obtained revealed that application of biotic and abiotic inducers increase reducing and total sugar contents during the examined periods compared with untreated infected control using both single and booster spray. The heighest increase in reducing sugar contents was recorded in salicylic acid, bion and potassium chloride treatments when applied as single spray while *Ps. fluorescens*, citric acis and bion recorded the heighest increase at booster spray. Also data obtained revealed an increase in total sugar contents especially in potassium chloride and oxalic acid treatments compared with other inducers when applied as single spray while *Ps. fluorescens* and *T. harzianum* recorded the heighest increase at booster spray.

10.3. All biotic and abiotic inducers resulted in an increase in peroxidase activity comparing with untreated infected control. The highest increase in peoxidase

activity at single spray was recorded in plants treated with *T. harzianum*, fungastop, *B. subtillus* and bion compared with other treatments while at booster spray fungastop followed by potassium oxalate and salicylic acid treatments recorded the heighest increase in enzyme activity.

10.4. All biotic and abiotic inducers recorded an increase in polyphenoloxidase activity during the examined periods comparing with untreated infected (control). Oxalic acid followed by fungastop treatments recorded the highest increase in enzyme activity when applied as single spray while salicylic acid, oxalic acid and potassium chloride treatments recorded the heighest increase when applied as booster spray compared with other treatments.

10.5. Data obtained revealed that all biotic and abiotic inducers recorded an increase in chitinase activity during the examined periods comparing with untreated infected control. *T. harzianum* followed by *B. subtillus* and photophor treatments recorded the heighest increase in chitinase activity using single spray. In addition *T. harzianum*, *B. subtillus* and *Ps. fluorescens* recorded the highest increase using booster spray compared with other treatments.

10.6. Application of cucumber plants with biotic and abiotic treatments resulted in increasing ß-1, 3 glucanase activity (during the examined periods) compared with untreated infected control. *B. subtillus*, topas-100 and potassium oxalate treatments recorded the heighest increase in enzyme activity when applied as single spray, while citric *Ps. fluorescens*, bion and topas-100 treatments recorded the heighest increase using booster spray compared with other treatments.

10.7. An increase in total protein contents was recorded in cucumber plants treated with biotic and abiotic inducers during the examined periods compared with untreated infected (control). *T. harzianum* followed by *B.*

subtillus treatments recorded the heighest increase in total protein contents when applied as single spray, while bion and fungastop treatments recorded the heighest increase when applied as booster spray compared with other treatments.

10.8. Chlorophyll and carotene contents of cucumber plants treated with biotic and abiotic inducers showed an increase in their contents comparing with untreated infected control. The highest increase in total chlorophyll contents was recorded in fungastop, potassium chloride and citric acid treatments at single spray compared with other treatments while, potassium chloride and fungastop treatments recorded the highest increase at booster spray. In addition the highest increase in carotene contents was recorded in citric acid, salicylic acid, oxalic acid, potassium phosphate and potassium oxalate treatments using single spray while potassium oxalate, citric acid, oxalic acid, bion and *T. harzianum* treatments recorded the heighest increase using booster spray compared with other treatments.

10.9. An increase in salicylic acid contents was recorded as the plants treated with biotic and abiotic inducers during the examined periods compared with untreated infected control. Two biotic and abiotic inducers were examined, oxalic acid, bion, *T. harzianum* and *Ps. fluorescens*. The maximum increase in salicylic acid contents as the plants treated with oxalic acid was recorded at 1 day using single spray and at 2 days of booster one. Also bion resulted in an increase in salicylic acid contents and the maximum increase was recorded at 4 days using single spray and at 2 days using booster one. At the same time biotic inducer, *T. harzianum* resulted in an increase in salicylic acid contents and the maximum increase was recorded at 4 days using both single and booster spray. In addition *Ps. fluorescens* recorded an increase in salicylic acid contents comparing with untreated infected control and the

maximum increase was recorded at 4 days using single spray and at 2 days of booster one.

10.10. Data revealed that application of biotic and abiotic inducers resulted in an increase in phytoaexin contents during the examined periods comparing with untreated infected control. Two biotic and abiotic inducers were examined. Oxalic acid resulted in an accumulation of phytoalexin especially at 1, 2 and 4 days comparing with untreated infected control and the maximum increase in phytoalexin contents was recorded at 4 days using single spray while at booster spray, There is an increase in phytoalexin accumulation during all the examined periods comparing with control and the maximum increase was recorded at 2 days. Application of bion also resulted in an increase in phytoalexin accumulation especially at 1, 4 and 6 days and the maximum increase was recorded at 1 day using single spray, while booster spray revealed an increase in phytoalexin accumulation especially at 1 and 4 days and the maximum increase were recorded at 4 days. On the other hand, biotic inducers also revealed an increase in phytoalexin accumulation using both single and booster sprays. *T. harzianum* recorded an increase in phytoalexin contents only at 2 days when applied at single spray and at 1 day of booster spray. While *Ps. fluorescens* resulted in an accumulation of phytoalexin during all the examined periods at both single and booster sprays and the maximum increase was recorded at 4 days using single spray and at 2 days of booster spray.

10.11. Data obtained revealed that treatment of cucumber plants with different biotic and abiotic inducers resulted in a decrease in abscisic acid (ABA) contents at both single and booster spray comparing with untreated infected control. Two abiotic inducers oxalic acid and bion was examined, the maximum decrease in ABA was in case of oxalic acid treatment recorded at

6 days using single spray and at 1 day of booster spray while bion resulted in a decrease in ABA contents at 1 day using single spray and at 6 days of booster spray. On the other hand, two biotic inducers *T. harzianum* and *Ps. fluorescens* was examined and the maximum decrease in ABA as the plants treated with *T. harzianum* was recorded at 1 day using sinle spray and at 6 days of booster one. In addition the maximum decrease in ABA in *Ps. fluorescens* treatment was recorded at 4 days using single spray and 1 day at booster spray.

10.12. Data obtained revealed that treatment of cucmber plants with different biotic and abiotic inducers resulted in an increase in gibberellic acid (GA) contents comparing with untreated infected control. Two biotic and abiotic inducers were examined *T. harzianum*, *Ps. fluorescens*, oxalic acid and bion. Concerning of biotic inducers the maximum increase in GA was recorded at 4 days at both single and booster spray in *T. harzianum* treatment. No GA was found in plants treated with *Ps. fluorescens* at both single and booster spray. On the other hand, abiotic inducers oxalic acid recorded the maximum increase in GA contents at 2 days at both single and booster sprays, while bion treatment recorded the maximum, increase in GA contents at 2 days using single spray and at 1 days of booster one.