

Full Length Research Paper

Effect of amistar and moncut fungicides on fungi of faba bean plant and amylase activity

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Amistar (Azoxystrobin 25%) and moncut (Flutolanil 25%) fungicides were used for treatment of faba bean plants in the field. Foliar application of the two fungicides by three doses exhibited a toxic effect on the total and individual fungal species associated with the roots and shoots of plant. The inhibitive effect of these fungicides depended mainly on the fungicide concentration. The inhibitive effect increased with increasing concentration of fungicide at different periods of treatment. The ability of different fungal isolates to produce amylase enzymes was tested. Among 44 fungal isolates screened for amylase production, 19 isolates (43.2% of total isolates) exhibited high amylase activity. However 16 isolates (36.4% of total isolates) exhibited moderate amylase activity whereas the remaining 9 isolates (20.4% of total isolates) were low producers of amylase. When the two fungicides individually incorporated into the culture medium for amylase production (at 100 to 800 ppm) an inhibitive effect was exerted on the fungal growth and amylase production of *Aspergillus flavus* var. *columnaris*, *Aspergillus tamarii*, *Penicillium chrysogenum* and *Penicillium funiculosum*.

Key words: Fungicides, faba bean fungi, amylase enzymes.

INTRODUCTION

Faba bean (*Vicia faba* L.) is cultivated for use as a green or dried, fresh or canned vegetable or for green manure in many parts of the world. It is one of the most important winter crops for human consumption in the Middle East, and roast seeds are eaten like peanuts in India (Rabie, 1998). The world cultivated area of this crop, was 26.92 million ha producing 19.29 million metric tons in 2007. In Egypt, the cultivated area of this crop was 21,000 ha producing 55,000 metric tons of dry beans crop (FAO, 2007). Faba bean is one of the important crops grown in winter season in different types of Egyptian soils. Also, it is considered as one of the basic sources of protein for human nutrition (El-Ghandour et al., 1996).

Faba bean plants are invaded by several pathogenic fungi which causes many plant diseases that greatly influence crop production, thus several studies were conducted on some pathogens of broad bean plants and their chemical control by using different types of

pesticides (Nan et al., 1991; McKay et al., 1992; Rahman et al., 2002; Rubiales and Sillero, 2003; Moharram et al., 2004; Mohamed and Gomaa, 2005; Valenciano et al., 2006; Sahile et al., 2008).

Fungicides are used to eradicate or prevent the undesirable growth of fungal microorganisms in many agricultural, horticultural, and industrial situations. Numerous substances possess antifungal activity, and their chemical structural spectrum is wide and diverse, covering both inorganic and organic substances. Different authors have differing classification systems according to chemical composition and structure (Gruzdyev et al., 1983; Kamrin, 1997; Marrs and Ballantyne, 2004). Concerning the effect of fungicides on the production of fungal enzymes, there are several reports indicating the varying effect of fungicides on both mycelial growth and extracellular enzyme production according to different factors including the kinds and doses of fungicides and the fungal species tested (Peterbauer et al., 1992; Hasan 1993; Choi et al., 1997; Tsuji et al., 1997; Lamb et al., 1998; Omar and Abd-Alla, 2000; Moharram et al., 2004; Meyer et al., 2006). This work was conducted to

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Table 1. Fungicides used, their names, active ingredients and manufacturers.

Fungicides	Amistar	Moncut
Chemical name	methyl(α E)-2-[6-(2-cyanophenoxy)-4-pyrimidinyl]oxy]- α (methoxymethylene) benzeneacetate.	N-[3-(1-methylethoxy) phenyl]-2-(trifluoromethyl) benzamide
Active ingredient	Azoxystrobin 25% SC	Flutolanil 25%
Manufacturer	Syngenta Agro, Switzerland	Nihon Nohyako, Japan

Table 2. Doses of fungicides used for treatment of faba bean plants in the field.

Doses fungicides	Low	Recommended	High	Unit
Amistar	0.215	0.43	0.86	ml
Moncut	0.535	1.071	2.142	g

investigate the selective effect of Amistar and Moncut fungicides on root and leaf surface fungi of faba bean plant as well as the effect of these fungicides on amylase production by the most active fungal isolates.

MATERIALS AND METHODS

Fungicides used in the present investigation

Two fungicides commonly used in Egypt were employed in the present investigation, namely Amistar and Moncut. These fungicides are newly used in Egypt for controlling several fungal diseases of fruit trees, vegetables and economic crops. Their chemical names, active ingredients and manufacturers are shown in Table 1.

Effect of fungicides on mycobiota of faba bean plants

Treatment of plants by fungicides

Plants of 3 weeks age were sprayed by three doses of fungicides solution (low, recommended (field dose) and high doses) in addition to the control (plants without fungicides) as shown in Table 2.

Determination of mycobiota of rhizosphere, rhizoplane, phyllosphere and phylloplane

During the growing season, plants treated and untreated with fungicides were assayed for their fungal content of rhizosphere, rhizoplane, phyllosphere and phylloplane at intervals of 1, 2, 4, 6, 8 and 10 weeks of treatment.

Determination of rhizosphere soil fungi: Plants were randomly chosen and pulled from the soil. Soil particles adhered to roots treated or untreated with fungicides were collected. The rhizosphere soil fungi were estimated using the dilution plate method (Johnson and Curl, 1972) and the numbers of fungi were counted and calculated per mg of dry soil.

Determination of root-surface (Rhizoplane) fungi: Roots were subjected to series of washing by sterile distilled water. They were thoroughly dried between sterile filter papers, cut into equal

segments (1 cm each) which were then placed on the surface of the agar plates (4 plates). Cultures were incubated at 28°C for 7 days and the developing fungi were identified, counted and calculated per 20 root segments.

Determination of phyllosphere fungi: Known weights of treated and untreated leaves of faba bean were placed individually in sterile conical flasks containing 100 ml sterile distilled water. Flasks were shaken for 10 min. 10 ml of the suspension were transferred into another flask (250 ml) containing 90 ml sterile distilled water. After 5 min of shaking, one ml of the final dilution was transferred to a sterile Petri-dish followed by addition of 15 ml of liquid glucose Czapek's agar medium. Four replicates were prepared for each treatment and control. Plates were incubated at 28°C for 7 days and the developing fungi were identified, counted and calculated per mg of fresh weight of leaves.

Determination of leaf-surface (Phylloplane) fungi: Leaf samples from pesticide-treated and untreated plants were subjected to a series of washing with sterile distilled water. They were thoroughly dried between sterile filter papers, cut into segments (1 cm² each). 5 segments were placed on the surface of each plate containing glucose Czapek's agar medium. 4 replicates were prepared for each treatment and control. Cultures were incubated at 28°C for 7 days, and the developing fungi were identified, counted and calculated per 20 leaf segments.

Medium used for isolation of fungi

Glucose-Czapek's agar medium (g/L), sodium nitrate, 3.0 and potassium dihydride were poured into 250 ml Erlenmeyer flasks and then autoclaved for 15 min at 1.5 atm. Different doses (100, 200, 400, 600 and 800 ppm a.i.) of fungicides were individually added under aseptic conditions to the sterilized liquid medium. Media without fungicides served as control. Each flask was inoculated with two agar mycelial discs (10 mm diameter) obtained from 7 days old cultures. Inoculated flasks were incubated for 7 days at 28°C, and then filtered. Clear supernatants obtained after centrifugation of filtrates, were used for assaying of amylase activity. Mycelial dry weights were also determined.

Assay of extracellular α -amylase

The method described by Nelson (1944) and modified by Naguib

(1964) was employed. The reaction mixture containing 1 ml of 0.5 % soluble starch in acetate buffer (pH=5.6) and 1 ml of the fungal filtrate was incubated at 30°C for 30 min. The amount of reducing sugars (mainly maltose) released was estimated by determining the optical density (absorption spectrum) at 700 nm wave length using a spectrophotometer (Bausch and Lomb Spectronic 2000 Colorimeter). Reducing sugars were assessed by comparison to a standard curve of maltose.

Statistical analysis

Statistical analysis of data was carried out by one way analysis of variance and the means were separated by Tukey's honest significant difference test phosphate, 1.0; magnesium sulphate, 0.5; potassium chloride, 0.5; iron sulphate, 0.01; glucose, 10.0; agar 15.0) was used for isolation of glucophilic fungi. Rose bengal (0.1 mg/ml) and chloramphenicol (0.5 mg/ml) were used as bacteriostatic agents (Smith and Dawson, 1944; Al-Doory, 1980).

Amylase enzymes

Screening of fungi for amylase production

Forty-four fungal isolates (recovered from different parts of faba bean plants) representing 35 species and 2 varieties including 19 genera were screened for their abilities to produce amylases. Fungal isolates were cultured on solid starch yeast extract agar (SYE) medium with a composition (g/L) of soluble starch, 5.0; yeast extract, 2.0; KH₂PO₄, 1.0; MgSO₄.7H₂O, 0.5 and agar, 15 (Barnett and Fergus, 1971). The activity of amylase produced in culture filtrates was determined according to the method described by the Society of American Bacteriologists (1957).

Effect of fungicides on amylase production by some fungi

Cultivation and culture conditions: Four fungal isolates including *Aspergillus flavus* var. *columnaris*, *Aspergillus tamarii*, *Penicillium chrysogenum* and *Penicillium funiculosum* were selected on the basis of their high productivity of amylase. 50 ml of SYE liquid medium with pH= 6 were dispensed using Biostat 2008 statistical analysis program (Copyright © 2001-2009 Analystsoft).

RESULTS AND DISCUSSION

Effect of fungicides on root surface fungi

The two fungicides (amistar and moncut) exerted a depressive effect on the total counts of rhizosphere and rhizoplane fungi by all doses used after all periods of treatment. The inhibitive effect of both fungicides depends mainly on the doses used. The inhibitive effect increased with increasing fungicide concentration at different periods of treatment (Tables 3 to 6). *Aspergillus*, *Emericella*, *Fusarium*, *Gibberella* and *Nectria* were the most common genera recovered from rhizosphere and rhizoplane of faba bean plant on glucose-Czapek's agar at 28°C. The counts of these genera were reduced or completely eliminated by all doses used after all periods of treatment; except in some cases, the counts were not affected at certain periods and doses. From the previous

genera, *A. flavus*, *A. fumigatus*, *A. niger*, *A. terreus*, *E. nidulans*, *Fusarium oxysporum*, *F. poae*, *Gibberella fujikuroi* and *Nectria haematococca* were the most common species and their counts were decreased or completely eliminated by all doses used after all periods of treatment except in some cases, the counts of these fungi were not affected. Moharram et al. (2004) studied the effect of Kocide and Ridomil plus fungicides on rhizosphere and rhizoplane fungi of tomato plant. They showed that the two fungicides exerted a depressive effect on the total and individual counts of rhizosphere and rhizoplane fungi. The most common fungi isolated from rhizosphere and rhizoplane of tomato were *Alternaria alternata*, *A. flavus*, *A. fumigatus*, *A. niger*, *A. terreus*, *Cochliobolus spicifer*, *Emericella nidulans*, *E. nidulans* var. *lata*, *Mycosphaerella tassiana*, *Penicillium chrysogenum* and *P. oxalicum*. The selective effect of various fungicides on root surface and root infected fungi was recorded by many workers in different places of the world (Nan et al., 1991; Nan, 1995; Magarey et al., 1997; Thirup et al., 2001; Benignia and Bompeix, 2004; Moharram et al., 2004).

Effect of fungicides on leaf surface fungi

The two fungicides tested induced an inhibitive effect on the total counts of phyllosphere and phylloplane fungi by all doses used after all periods of treatment. The inhibitive effect of these fungicides was increased with increasing fungicide concentration at different periods of treatment (Tables 7 to 10).

A. alternata, *A. flavus*, *A. fumigatus*, *A. niger*, *C. spicifer*, *E. nidulans* var. *lata*, *M. tassiana*, *N. haematococca*, *P. chrysogenum* and *Rhizopus stolonifer* were the most common fungi isolated from phyllosphere and phylloplane of faba bean plant on glucose-Czapek's agar at 28°C. The counts of these fungi were decreased or eliminated by all doses after different periods of treatment, except in some cases, the counts were not affected. The inhibitive effect of several fungicides on leaf surface and leaf pathogen fungi was recorded by several workers in many parts of the world. In Egypt, Moharram et al. (2004) reported that Kocide and Ridomil plus fungicides exerted a depressive effect on the total and individual counts of cellulose-decomposing fungi isolated from phyllosphere and phylloplane of tomato plant. The selective effect of various fungicides on leaf surface and leaf pathogen fungi was reported by several workers (Mckay et al., 1992; O'Brien 1992; Scott 1995; Reuveni et al., 1998; Buck and Williams, 2003; Khan and Smith, 2005; Das et al., 2007; Obonor et al., 2008).

Screening of fungi for amylase production

44 fungal isolates represent 35 species and 2 varieties including 19 genera were screened for amylase production. All isolates were recovered from different

Table 3. Count (per mg of dry soil) of rhizosphere fungi after different periods of faba bean treatment with various doses of Amistar on glucose-Czapek's agar at 28°C.

Weeks after treatment	1				2				4			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	3.1	1.9*	1.6*	1.3*	3.1	1.7*	1.5*	1.3*	5.0	3.5*	2.6*	1.6*
<i>Aspergillus</i>	1.3	0.8*	0.5*	0.5*	2.4	1.4*	1.1*	0.8*	3.9	2.7*	2.1*	1.6*
<i>A. flavus</i>	0.0	0.0	0.0	0.0	0.8	0.2*	0.2*	0.2*	0.6	0.6	0.6	0.5
<i>A. flavus</i> var. <i>columnaris</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.3	0.2	0.2
<i>A. fumigatus</i>	0.5	0.0*	0.0*	0.0*	0.4	0.2	0.2	0.2	1.4	0.8*	0.6*	0.6*
<i>A. niger</i>	0.5	0.4	0.2	0.2	0.6	0.5	0.2*	0.2*	0.4	0.3	0.2	0.2
<i>A. ochraceous</i>	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. tamari</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
<i>A. terreus</i>	0.3	0.2	0.3	0.3	0.4	0.5	0.5	0.2	0.3	0.3	0.3	0.1
<i>A. ustus</i>	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.5	0.4	0.2	0.0*
<i>Emericella</i>	0.4	0.4	0.4	0.2	0.4	0.1	0.1	0.2	0.7	0.6	0.4	0.0*
<i>E. nidulans</i>	0.4	0.4	0.4	0.2	0.3	0.1	0.1	0.2	0.2	0.2	0.2	0.0
<i>E. nidulans</i> var. <i>lata</i>	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.5	0.4	0.2	0.0*
<i>Gibberella fujikuroi</i>	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
<i>Mycosphaerella tassiana</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.0
<i>Nectria haematococca</i>	0.5	0.6	0.6	0.5	0.3	0.2	0.2	0.2	0.2	0.0	0.0	0.0
<i>Penicillium chrysogenum</i>	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Stachybotrys chartarum</i>	0.5	0.3	0.1*	0.1*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 3. Continues.

Weeks after treatment	6				8				10			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	4.9	3.1*	1.9*	1.2*	5.2	2.8*	2.1*	1.5*	4.9	3.0*	1.9*	1.2*
<i>Aspergillus</i>	3.3	2.2*	1.3*	0.9*	3.5	1.5*	1.1*	0.8*	3.6	2.3*	1.4*	1.0*
<i>A. flavus</i>	0.6	0.6	0.3	0.3	0.3	0.1	0.1	0.1	0.8	0.5	0.2*	0.2*
<i>A. flavus</i> var. <i>olumnaris</i>	0.5	0.2	0.1*	0.0*	0.3	0.1	0.0	0.0	0.7	0.4	0.2*	0.0*
<i>A. fumigatus</i>	1.3	1.0	0.6*	0.3*	1.3	0.3*	0.3*	0.2*	1.4	1.0*	0.8*	0.6*
<i>A. niger</i>	0.4	0.3	0.3	0.3	0.7	0.3	0.3	0.2*	0.4	0.2	0.0*	0.0*
<i>A. ochraceous</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. tamari</i>	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
<i>A. terreus</i>	0.2	0.1	0.0	0.0	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2
<i>A. ustus</i>	0.0	0.0	0.0	0.0	0.7	0.6	0.2*	0.1*	0.0	0.0	0.0	0.0
<i>Emericella</i>	0.4	0.2	0.2	0.2	1.1	0.8	0.6*	0.3*	0.6	0.2*	0.2*	0.0*
<i>E. nidulans</i>	0.4	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.6	0.2*	0.2*	0.0*
<i>E. nidulans</i> var. <i>lata</i>	0.0	0.0	0.0	0.0	1.0	0.7	0.5*	0.2*	0.0	0.0	0.0	0.0
<i>Gibberella fujikuroi</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mycosphaerella tassiana</i>	0.4	0.3	0.2	0.0*	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0
<i>Nectria haematococca</i>	0.1	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
<i>Penicillium chrysogenum</i>	0.7	0.4	0.2*	0.1*	0.3	0.2	0.1	0.1	0.3	0.2	0.1	0.0
<i>Stachybotrys chartarum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 4. Count (per mg of dry soil) of rhizosphere fungi after different periods of faba bean treatment with various doses of Moncut on glucose-Czapek's agar at 28°C.

Weeks after treatment Doses	1				2				4			
	C	L	R	H	C	L	R	H	C	L	R	H
Genera and species												
Total count	3.1	1.7*	1.3*	0.9*	3.1	2.1*	1.4*	1.2*	5.0	2.8*	2.8*	1.7*
<i>Alternaria alternata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
<i>Aspergillus</i>	1.3	0.7*	0.4*	0.3*	2.4	1.4*	1.1*	1.0*	3.9	2.2*	2.1*	1.2*
<i>A. flavus</i>	0.0	0.1	0.1	0.0	0.8	0.5	0.2*	0.3*	0.6	0.6	0.6	0.7
<i>A. flavus</i> var. <i>columnaris</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0*	0.0*	0.0*
<i>A. fumigatus</i>	0.5	0.3	0.1*	0.1*	0.4	0.4	0.3	0.2	1.4	1.0*	1.0*	0.4*
<i>A. niger</i>	0.5	0.3	0.2	0.2	0.6	0.2*	0.2*	0.1*	0.4	0.2	0.2	0.1
<i>A. ochraceous</i>	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
<i>A. tamarii</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.0	0.0
<i>A. terreus</i>	0.3	0.0	0.0	0.0	0.4	0.3	0.3	0.1	0.3	0.0	0.1	0.0
<i>A. ustus</i>	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.5	0.3	0.2	0.0*
<i>Emericella</i>	0.4	0.2	0.2	0.2	0.4	0.1	0.1	0.1	0.7	0.3*	0.1*	0.1*
<i>E. nidulans</i>	0.4	0.2	0.2	0.2	0.3	0.1	0.1	0.0	0.2	0.1	0.0	0.0
<i>E. nidulans</i> var. <i>lata</i>	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.5	0.2	0.1*	0.1*
<i>Fusarium oxysporum</i>	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Gibberella fujikuroi</i>	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mucor racemosus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mycosphaerella tassiana</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0
<i>Nectria haematococca</i>	0.5	0.4	0.4	0.2	0.3	0.3	0.2	0.1	0.2	0.2	0.2	0.1
<i>Penicillium</i>	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>P. chrysogenum</i>	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>P. funiculosum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Rhizopus stolonifer</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2
<i>Stachybotrys chartarum</i>	0.5	0.2	0.1*	0.0*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

C = Control; L = Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 4 continues.

Weeks after treatment Doses	6				8				10			
	C	L	R	H	C	L	R	H	C	L	R	H
Genera and species												
Total count	4.9	2.1*	1.6*	1.2*	5.2	3.6*	2.6*	1.4*	4.9	2.9*	1.7*	1.2*
<i>Alternaria alternata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Aspergillus</i>	3.3	1.5*	1.0*	0.7*	3.5	2.1*	1.2*	0.5*	3.6	2.2*	1.3*	1.0*
<i>A. flavus</i>	0.6	0.2*	0.2*	0.1*	0.3	0.3	0.3	0.1	0.8	0.5	0.2*	0.2*
<i>A. flavus</i> var. <i>columnaris</i>	0.5	0.5	0.2	0.0*	0.3	0.2	0.0	0.0	0.7	0.4	0.2*	0.1*
<i>A. fumigatus</i>	1.3	0.4*	0.6*	0.6*	1.3	0.8*	0.6*	0.3*	1.4	0.8*	0.5*	0.3*
<i>A. niger</i>	0.4	0.2	0.0*	0.0*	0.7	0.4*	0.2*	0.1*	0.4	0.2	0.2	0.2
<i>A. ochraceous</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. tamarii</i>	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
<i>A. terreus</i>	0.2	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.2	0.2	0.2
<i>A. ustus</i>	0.0	0.0	0.0	0.0	0.7	0.4	0.1*	0.0*	0.0	0.0	0.0	0.0
<i>Emericella</i>	0.4	0.2	0.2	0.1	1.1	0.6*	0.5*	0.2*	0.6	0.2*	0.2*	0.2*
<i>E. nidulans</i>	0.4	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.6	0.2*	0.2*	0.2*
<i>E. nidulans</i> var. <i>lata</i>	0.0	0.0	0.0	0.0	1.0	0.5*	0.4*	0.2*	0.0	0.0	0.0	0.0
<i>Fusarium oxysporum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Gibberella fujikuroi</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mucor racemosus</i>	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0

Table 4 continues.

<i>Mycosphaerella tassiana</i>	0.4	0.2	0.2	0.0*	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0
<i>Nectria haematococca</i>	0.1	0.0	0.0	0.0	0.3	0.2	0.2	0.1	0.2	0.2	0.1	0.0
<i>Penicillium</i>	0.7	0.2*	0.2*	0.4	0.3	0.4	0.4	0.3	0.3	0.1	0.1	0.0
<i>P. chrysogenum</i>	0.7	0.2*	0.2*	0.4	0.3	0.3	0.3	0.2	0.3	0.1	0.1	0.0
<i>P. funiculosum</i>	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
<i>Rhizopus stolonifer</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Stachybotrys chartarum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5. Count (per 20 root segments) of rhizoplane fungi after different periods of faba bean treatment with various doses of Amistar on glucose-Czapek's agar at 28°C.

Weeks after treatment	1				2				4				10			
	Doses				Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H	C	L	R	H
Total count	33	28	24*	19*	37	27*	20*	15*	36	29	21*	15*	44	35	28*	18*
<i>Alternaria alternata</i>	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
<i>Aspergillus</i>	8	7	5	3*	11	7*	4*	2*	6	5	3	2*	12	9	8*	5*
<i>A. flavus</i>	4	4	3	2	3	2	1	1	2	2	1	0	5	4	4	1*
<i>A. fumigatus</i>	2	1	1	0	2	1	1	0	2	1	1	1	3	3	2	2
<i>A. niger</i>	2	2	1	1	2	2	0	1	2	2	1	1	4	2	2	2
<i>A. terreus</i>	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0
<i>A. ustus</i>	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0
<i>Cochliobolus spicifer</i>	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	0
<i>Emericella</i>	2	1	1	1	0	0	1	1	0	0	0	0	1	1	0	0
<i>E. nidulans</i>	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
<i>E. nidulans var. lata</i>	2	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0
<i>Fusarium</i>	5	5	3	3	4	3	1	1	5	4	3	1*	5	5	3	2
<i>F. oxysporum</i>	2	2	1	1	2	2	0	0	3	2	2	0	3	3	2	1
<i>F. poae</i>	3	3	2	2	2	1	1	1	2	2	1	1	2	2	1	1
<i>F. semitectum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Gibberella</i>	8	6	6	4*	4	2	2	0*	4	3	1	1	6	5	4	1*
<i>G. fujikuroi</i>	4	3	3	2	2	1	1	0	1	1	0	0	3	2	2	1
<i>G. intricans</i>	2	2	2	1	1	0	1	0	1	1	0	0	1	1	1	0
<i>G. pulicaris</i>	2	1	1	1	1	1	0	0	2	1	1	1	2	2	1	0
<i>Nectria haematococca</i>	10	9	9	8	14	12	10*	10*	16	14	14	10*	14	11	11	9*
<i>Penicillium chrysogenum</i>	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0
<i>Phoma herbarum</i>	0	0	0	0	2	2	1	0	0	0	0	0	0	0	0	0
<i>Rhizopus stolonifer</i>	0	0	0	0	0	0	0	0	2	2	0	1	4	3	1	1

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 5. Continues.

Weeks after treatment	6				8				10			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	39	33	25*	17*	40	29*	21*	14*	44	35	28*	18*
<i>Alternaria alternata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Aspergillus</i>	7	6	4	2*	6	5	2*	2*	12	9	8*	5*
<i>A. flavus</i>	2	2	1	0	2	1	1	1	5	4	4	1*
<i>A. fumigatus</i>	3	2	2	1	1	1	0	0	3	3	2	2
<i>A. niger</i>	2	2	1	1	2	2	0	1	4	2	2	2

Table 5. Continues.

<i>A. terreus</i>	0	0	0	0	1	1	1	0	0	0	0	0
<i>A. ustus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cochliobolus spicifer</i>	0	0	0	0	0	0	0	0	0	1	1	0
<i>Emericella</i>	0	0	0	0	0	0	0	0	1	1	0	0
<i>E. nidulans</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>E. nidulans</i> var. <i>lata</i>	0	0	0	0	0	0	0	0	1	1	0	0
<i>Fusarium</i>	5	3	2	2	9	7	4*	3*	5	5	3	2
<i>F. oxysporum</i>	2	2	1	1	4	3	3	2	3	3	2	1
<i>F. poae</i>	3	1	1	1	3	2	1	1	2	2	1	1
<i>F. semitectum</i>	0	0	0	0	2	2	0	0	0	0	0	0
<i>Gibberella</i>	5	4	2	1*	5	3	2	0*	6	5	4	1*
<i>G. fujikuroi</i>	2	1	1	0	2	1	1	0	3	2	2	1
<i>G. intricans</i>	2	2	1	1	2	1	1	0	1	1	1	0
<i>G. pulicaris</i>	1	1	0	0	1	1	0	0	2	2	1	0
<i>Nectria haematococca</i>	16	14	13	10*	14	12	12	8*	14	11	11	9*
<i>Penicillium chrysogenum</i>	0	0	0	0	2	0	0	0	0	0	0	0
<i>Phoma herbarum</i>	4	4	3	1	1	0	0	0	0	0	0	0
<i>Rhizopus stolonifer</i>	2	2	1	1	3	2	1	1	4	3	1	1

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 6. Count (per 20 root segments) of rhizoplane fungi after different periods of faba bean treatment with various doses of Moncut on glucose-Czapek's agar at 28°C.

Weeks after treatment	1				2				4			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	33	24*	19*	15*	37	32	20*	21*	36	32	23*	17*
<i>Alternaria alternata</i>	0	0	0	0	0	0	0	0	2	1	1	0
<i>Aspergillus</i>	8	6	2*	2*	11	8	5*	5*	6	5	2*	3
<i>A. flavus</i>	4	4	2	2	3	2	1	1	2	2	0	1
<i>A. fumigatus</i>	2	1	0	0	2	1	1	1	2	2	1	1
<i>A. niger</i>	2	1	0	0	2	2	1	1	2	1	1	1
<i>A. ochraceous</i>	0	0	0	0	0	0	0	2	0	0	0	0
<i>A. terreus</i>	0	0	0	0	2	1	1	0	0	0	0	0
<i>A. ustus</i>	0	0	0	0	2	2	1	0	0	0	0	0
<i>Cochliobolus spicifer</i>	0	0	0	0	0	1	1	1	1	1	0	0
<i>Emericella nidulans</i> var. <i>lata</i>	2	1	1	0	0	0	0	0	0	0	0	0
<i>Fusarium</i>	5	3	3	2	4	4	3	2	5	4	3	3
<i>F. oxysporum</i>	2	1	1	1	2	2	2	1	3	3	2	2
<i>F. poae</i>	3	2	2	1	2	2	1	1	2	1	1	1
<i>F. semitectum</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Gibberella</i>	8	5	4*	3*	4	4	2	3	4	3	3	0*
<i>G. fujikuroi</i>	4	3	2	2	2	2	1	1	1	1	1	0
<i>G. intricans</i>	2	0	1	1	1	1	0	1	1	1	1	0
<i>G. pulicaris</i>	2	2	1	0	1	1	1	1	2	1	1	0
<i>Nectria haematococca</i>	10	9	9	8	14	12	9*	9*	16	16	12*	10*
<i>Penicillium chrysogenum</i>	0	0	0	0	2	1	1	0	0	0	0	0
<i>Phoma herbarum</i>	0	0	0	0	2	2	0	1	0	0	1	0
<i>Rhizopus stolonifer</i>	0	0	0	0	0	0	1	0	2	2	1	1

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 6. continues.

Weeks after treatment	6				8				10			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	39	34	20*	17*	40	36	24*	14*	44	38	29*	26*
<i>Alternaria alternata</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Aspergillus</i>	7	6	3*	2*	6	6	2*	2*	12	10	7*	6*
<i>A. flavus</i>	2	2	1	1	2	1	1	0	5	4	2	2
<i>A. fumigatus</i>	3	3	2	1	1	2	0	0	3	2	2	1
<i>A. niger</i>	2	1	0	0	2	2	1	1	4	4	3	3
<i>A. ochraceous</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>A. terreus</i>	0	0	0	0	1	1	0	1	0	0	0	0
<i>A. ustus</i>	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cochliobolus spicifer</i>	0	0	0	0	0	0	0	0	2	2	1	1
<i>Emicella nidulans var. lata</i>	0	0	0	0	0	0	0	0	1	1	0	0
<i>Fusarium</i>	5	4	2	2	9	7	4*	2*	5	4	3	3
<i>F. oxysporum</i>	2	2	1	1	4	3	2	2	3	3	2	2
<i>F. poae</i>	3	2	1	1	3	2	2	0	2	1	1	1
<i>F. semitectum</i>	0	0	0	0	2	2	0	0	0	0	0	0
<i>Gibberella</i>	5	5	2	2	5	5	4	0*	6	6	4	3
<i>G. fujikuroi</i>	2	2	1	1	2	2	2	0	3	3	3	2
<i>G. intricans</i>	2	2	1	1	2	2	1	0	1	1	0	0
<i>G. pulicaris</i>	1	1	0	0	1	1	1	0	2	2	1	1
<i>Nectria haematococca</i>	16	14	11*	9*	14	14	12	8*	14	13	12	12
<i>Penicillium chrysogenum</i>	0	0	0	0	2	1	0	1	0	0	0	0
<i>Phoma herbarum</i>	4	3	1	1	1	1	0	0	0	0	0	0
<i>Rhizopus stolonifer</i>	2	2	1	1	3	2	2	1	4	2	2	1

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 7. Count (per mg of leaves) of phyllosphere fungi after different periods of faba bean treatment with various doses of Amistar on glucose-Czapek's agar at 28°C.

Weeks after treatment	1				2				4			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	3.9	2.3*	1.6*	1.0*	4.8	3.3*	2.2*	1.6*	4.9	3.1*	2.1*	1.6*
<i>Alternaria</i>	0.0	0.0	0.0	0.0	0.4	0.2	0.1	0.0*	0.6	0.5	0.4	0.4
<i>A. alternata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.4	0.4
<i>A. tenuissima</i>	0.0	0.0	0.0	0.0	0.4	0.2	0.1	0.0*	0.0	0.0	0.0	0.0
<i>Aspergillus</i>	1.8	1.1*	0.8*	0.4*	3.0	2.3	1.6*	1.4*	2.7	1.4*	1.0*	0.6*
<i>A. carneus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. flavus</i>	0.4	0.3	0.3	0.1	1.7	1.4	1.0*	0.8*	0.5	0.3	0.3	0.2
<i>A. flavus var. columnaris</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.2	0.1*
<i>A. fumigatus</i>	0.2	0.1	0.1	0.0	0.5	0.3	0.2	0.2	1.0	0.6*	0.3*	0.3*
<i>A. niger</i>	0.4	0.2	0.2	0.1	0.6	0.4	0.3	0.3	0.4	0.2	0.2	0.0*
<i>A. ochraceous</i>	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0
<i>A. sydowi</i>	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. tamarii</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. terreus</i>	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
<i>A. ustus</i>	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0

Table 7. Continues

<i>Cladosporium cladosporioides</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.1
<i>Emericella</i>	0.5	0.3	0.2	0.2	0.4	0.1	0.1	0.0*	0.0	0.0	0.0	0.0
<i>E. nidulans</i>	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>E. nidulans var. lata</i>	0.3	0.2	0.1	0.1	0.4	0.1	0.1	0.0*	0.0	0.0	0.0	0.0
<i>Fusarium oxysporum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.1	0.1
<i>Mucor hiemalis</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mycosphaerella tassiana</i>	1.3	0.9*	0.6*	0.4*	0.5	0.4	0.2	0.1*	0.0	0.0	0.0	0.0
<i>Nectria haematococca</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.4	0.4
<i>Penicillium chrysogenum</i>	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0
<i>Scopulariopsis brevicaulis</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0
<i>Trichoderma harizianum</i>	0.0	0.0	0.0	0.0	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0
<i>Ulocladium botrytis</i>	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 7. Continues.

Weeks after treatment	6				8				10			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	5.2	3.4*	2.3*	1.8*	7.6	4.5*	2.9*	1.9*	4.5	3.2*	2.0*	1.1*
<i>Alternaria</i>	0.7	0.4	0.4	0.2*	1.0	0.6*	0.2*	0.2*	0.2	0.2	0.1	0.1
<i>A. alternata</i>	0.7	0.4	0.4	0.2*	1.0	0.6*	0.2*	0.2*	0.0	0.0	0.0	0.0
<i>A. tenuissima</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.1
<i>Aspergillus</i>	1.1	0.8	0.5*	0.3*	2.8	1.4*	0.7*	0.3*	2.5	1.8	1.3*	0.6*
<i>A. carneus</i>	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.1	0.1	0.1	0.0
<i>A. flavus</i>	0.5	0.4	0.2	0.2	0.9	0.4*	0.3*	0.1*	0.7	0.6	0.4*	0.1*
<i>A. flavus var. columnaris</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.2	0.2
<i>A. fumigatus</i>	0.2	0.1	0.1	0.0	0.5	0.3	0.2	0.1*	0.7	0.4	0.3*	0.1*
<i>A. niger</i>	0.1	0.1	0.1	0.0	0.9	0.5*	0.2*	0.1*	0.1	0.1	0.1	0.0
<i>A. ochraceous</i>	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. sydowi</i>	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. tamarii</i>	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.1	0.1
<i>A. terreus</i>	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. ustus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1
<i>Cladosporium cladosporioides</i>	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0
<i>Emericella</i>	0.0	0.0	0.0	0.0	0.6	0.3	0.2	0.2	1.1	0.6*	0.3*	0.2*
<i>E. nidulans</i>	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.5	0.2*	0.1*	0.1*
<i>E. nidulans var. lata</i>	0.0	0.0	0.0	0.0	0.4	0.2	0.1	0.1	0.6	0.4	0.2*	0.1*
<i>Fusarium oxysporum</i>	0.8	0.5	0.2*	0.2*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mucor hiemalis</i>	0.0	0.0	0.0	0.0	0.5	0.4	0.4	0.2	0.1	0.1	0.0	0.0
<i>Mycosphaerella tassiana</i>	0.8	0.6	0.4*	0.4*	0.8	0.5	0.2*	0.2*	0.2	0.2	0.1	0.1
<i>Nectria haematococca</i>	0.5	0.3	0.2	0.2	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0
<i>Penicillium chrysogenum</i>	0.9	0.6	0.4*	0.4*	0.8	0.6	0.6	0.4*	0.2	0.1	0.1	0.0
<i>Scopulariopsis brevicaulis</i>	0.0	0.0	0.0	0.0	0.5	0.3	0.2	0.2	0.0	0.0	0.0	0.0
<i>Trichoderma harizianum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.1
<i>Ulocladium botrytis</i>	0.4	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 8. Count (per mg of leaves) of phyllosphere fungi after different periods of faba bean treatment with various doses of Moncut on glucose-Czapek's agar at 28°C.

Weeks after treatment	1				2				4			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	3.9	2.4*	1.5*	0.7*	4.8	3.5*	2.4*	1.3*	4.9	3.1*	2.1*	1.0*
<i>Alternaria</i>	0.0	0.0	0.0	0.0	0.4	0.3	0.1	0.1	0.6	0.5	0.4	0.4
<i>A. alternata</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.4	0.4
<i>A. tenuissima</i>	0.0	0.0	0.0	0.0	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0
<i>Aspergillus</i>	1.8	0.9*	0.6*	0.1*	3.0	2.3	1.8*	1.1*	2.7	1.5*	1.1*	0.4*
<i>A. carneus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. flavus</i>	0.4	0.3	0.2	0.0*	1.7	1.1*	0.7*	0.5	0.5	0.2	0.2	0.1*
<i>A. flavus</i> var. <i>columnaris</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.3	0.1*	0.1*
<i>A. fumigatus</i>	0.2	0.1	0.1	0.0	0.5	0.4	0.4	0.2	1.0	0.6*	0.4*	0.1*
<i>A. niger</i>	0.4	0.2	0.2	0.1	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.0*
<i>A. ochraceous</i>	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0
<i>A. sydowi</i>	0.4	0.1	0.0*	0.0*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. tamarii</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. terreus</i>	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
<i>A. ustus</i>	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1
<i>Cladosporium cladosporioides</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0
<i>Emericella</i>	0.5	0.3	0.1*	0.0*	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0
<i>E. nidulans</i>	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>E. nidulans</i> var. <i>lata</i>	0.3	0.2	0.0	0.0	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0
<i>Fusarium oxysporum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.1	0.1
<i>Mucor hiemalis</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mycosphaerella tassiana</i>	1.3	1.1	0.7*	0.5*	0.5	0.3	0.2	0.0*	0.0	0.0	0.0	0.0
<i>Nectria haematococca</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.4	0.1*
<i>Penicillium</i>	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.2	0.1	0.1	0.0
<i>P. chrysogenum</i>	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.2	0.1	0.1	0.0
<i>P. funiculosum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Scopulariopsis brevicaulis</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0
<i>Trichoderma harizianum</i>	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>Ulocladium botrytis</i>	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 8. continues.

Weeks after treatment	6				8				10			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	5.2	3.4*	2.2*	1.6*	7.6	4.2*	3.8*	2.2*	4.5	2.4*	1.8*	1.4*
<i>Alternaria</i>	0.7	0.3*	0.2*	0.2*	1.0	0.2*	0.4*	0.4*	0.2	0.1	0.1	0.1
<i>A. alternata</i>	0.7	0.3*	0.2*	0.2*	1.0	0.2*	0.4*	0.4*	0.0	0.0	0.0	0.0
<i>A. tenuissima</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1
<i>Aspergillus</i>	1.1	0.7*	0.3*	0.2*	2.8	1.7*	1.6*	0.7*	2.5	1.1*	1.1*	0.7*
<i>A. carneus</i>	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.1	0.0	0.0	0.0
<i>A. flavus</i>	0.5	0.3	0.1*	0.1*	0.9	0.6	0.6	0.2*	0.7	0.3*	0.3*	0.2*
<i>A. flavus</i> var. <i>columnaris</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0*	0.0*	0.0*

Table 8. continues.

<i>A. fumigatus</i>	0.2	0.2	0.1	0.1	0.5	0.4	0.3	0.1*	0.7	0.6	0.6	0.4
<i>A. niger</i>	0.1	0.1	0.0	0.0	0.9	0.4*	0.4*	0.3*	0.1	0.0	0.0	0.0
<i>A. ochraceous</i>	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
<i>A. sydowi</i>	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
<i>A. tamarii</i>	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.1	0.1
<i>A. terreus</i>	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>A. ustus</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0
<i>Cladosporium cladosporioides</i>	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0
<i>Emericella</i>	0.0	0.0	0.0	0.0	0.6	0.3	0.3	0.1*	1.1	0.7	0.4*	0.4*
<i>E. nidulans</i>	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.5	0.3	0.1*	0.1*
<i>E. nidulans var. lata</i>	0.0	0.0	0.0	0.0	0.4	0.2	0.2	0.0*	0.6	0.4	0.3	0.3
<i>Fusarium oxysporum</i>	0.8	0.6	0.6	0.3*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Mucor hiemalis</i>	0.0	0.0	0.0	0.0	0.5	0.2	0.2	0.0*	0.1	0.1	0.0	0.0
<i>Mycosphaerella tassiana</i>	0.8	0.6	0.2*	0.1*	0.8	0.5	0.1*	0.0*	0.2	0.1	0.1	0.1
<i>Nectria haematococca</i>	0.5	0.3	0.2	0.2	0.3	0.1	0.1	0.1	0.0	0.0	0.0	0.0
<i>Penicillium</i>	0.9	0.7	0.6	0.6	0.8	0.7	0.7	0.6	0.2	0.2	0.0	0.0
<i>P. chrysogenum</i>	0.9	0.7	0.6	0.6	0.8	0.6	0.6	0.6	0.2	0.1	0.0	0.0
<i>P. funiculosum</i>	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0
<i>Scopulariopsis brevicaulis</i>	0.0	0.0	0.0	0.0	0.5	0.3	0.2	0.2	0.0	0.0	0.0	0.0
<i>Trichoderma harizianum</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1
<i>Ulocladium botrytis</i>	0.4	0.2	0.1	0.0*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 9. Count (per 20 leaf segments) of phylloplane fungi after different periods of faba bean treatment with various doses of Amistar on glucose-Czapek's agar at 28°C.

Weeks after treatment	1				2				4			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	79	54*	35*	26*	68	51*	38*	30*	63	52	32*	30*
<i>Acremonium strictum</i>	3	1	1	0	2	1	1	1	0	0	0	0
<i>Alternaria alternata</i>	6	3	3	2*	8	4*	2*	2*	4	3	1	1
<i>Aspergillus</i>	37	30	21*	16*	42	35	29*	25*	37	32	22*	20*
<i>A. flavus</i>	16	15	12*	8*	20	20	18	15*	18	18	12*	10*
<i>A. fumigatus</i>	6	5	4	4	6	4	3	3	4	3	3	2
<i>A. niger</i>	5	4	1*	1*	7	4	4	4	7	7	5	6
<i>A. ochraceous</i>	3	2	2	1	2	3	1	1	4	2	1	1
<i>A. sydowi</i>	2	1	1	1	2	2	1	1	0	0	0	0
<i>A. terreus</i>	3	1	0	0	2	0	0	0	0	0	0	0
<i>A. ustus</i>	2	2	1	0	3	2	2	1	2	1	0	0
<i>A. versicolor</i>	0	0	0	1	0	0	0	0	2	1	1	1
<i>Cochliobolus spicifer</i>	10	6*	2*	2*	0	0	0	0	0	0	0	0
<i>Emericella</i>	13	8	5*	3*	10	8	5*	2*	0	2	0	2
<i>E. nidulans</i>	6	4	2*	2*	5	4	2	1*	0	0	0	2
<i>E. nidulans var. lata</i>	7	4	3*	1*	5	4	3	1*	0	2	0	0
<i>Fusarium oxysporum</i>	0	0	0	0	0	0	0	0	4	2	2	1
<i>Mycosphaerella tassiana</i>	4	3	2	2	2	1	0	0	2	2	1	1
<i>Nectria haematococca</i>	0	0	0	0	0	0	0	0	4	3	2	2
<i>Penicillium</i>	6	3	1*	1*	4	2	1	0*	7	4	4	3*
<i>P. brevicompactum</i>	1	0	0	0	0	0	0	0	2	1	1	0

Table 9. Continues

<i>P. chrysogenum</i>	2	1	0	0	2	1	1	0	2	1	1	1
<i>P. funiculosum</i>	3	2	1	1	2	1	0	0	3	2	2	2
<i>Rhizopus stolonifer</i>	0	0	0	0	0	0	0	0	5	4	0*	0*

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 9. continues.

Weeks after treatment	6				8				10			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	75	61*	52*	47*	92	66*	53*	44*	91	75*	53*	48*
<i>Acremonium strictum</i>	3	2	1	1	3	1	1	1	1	1	1	0
<i>Alternaria alternata</i>	4	3	3	3	5	6	6	4	7	8	4	4
<i>Aspergillus</i>	36	32	25*	22*	48	32*	21*	21*	51	43	36*	32*
<i>A. flavus</i>	20	20	16*	16*	20	16*	8*	10*	20	20	18	15*
<i>A. fumigatus</i>	5	5	4	3	6	4	4	2*	7	5	5	5
<i>A. niger</i>	4	3	2	2	8	4*	4*	4*	9	9	7	7
<i>A. ochraceous</i>	4	3	2	1	3	1	2	2	4	2	2	2
<i>A. sydowi</i>	0	0	0	0	2	1	0	0	3	1	1	1
<i>A. terreus</i>	3	1	1	0	6	4	2*	2*	5	4	1*	1*
<i>A. ustus</i>	0	0	0	0	0	0	0	0	3	2	2	1
<i>A. versicolor</i>	0	0	0	0	3	2	1	1	0	0	0	0
<i>Cochliobolus spicifer</i>	8	6	4*	4*	5	4	4	2	4	3	2	2
<i>Emericella</i>	0	0	0	0	0	0	0	0	8	7	3	3
<i>E. nidulans</i>	0	0	0	0	0	0	0	0	4	4	2	2
<i>E. nidulans var. lata</i>	0	0	0	0	0	0	0	0	4	3	1	1
<i>Fusarium oxysporum</i>	3	1	2	2	2	2	1	1	2	1	1	1
<i>Mycosphaerella tassiana</i>	4	2	2	1	2	1	1	0	3	2	1	1
<i>Nectria haematococca</i>	3	3	2	2	3	2	1	1	2	1	0	0
<i>Penicillium</i>	4	3	3	2	14	9*	9*	5*	7	5	2*	2*
<i>P. brevicompactum</i>	0	0	0	0	4	2	2	0*	0	0	0	0
<i>P. chrysogenum</i>	4	3	3	2	8	6	6	4*	5	3	1*	1*
<i>P. funiculosum</i>	0	0	0	0	2	1	1	1	2	2	1	1
<i>Rhizopus stolonifer</i>	10	9	10	10	10	9	9	9	6	4	3	3

Table 10. Count (per 20 leaf segments) of phylloplane fungi after different periods of faba bean treatment with various doses of Moncut on glucose-Czapek's agar at 28°C.

Weeks after treatment	1				2				4			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	79	47*	35*	22*	68	48*	33*	33*	63	45*	33*	30*
<i>Acremonium strictum</i>	3	1	0	0	2	1	0	0	0	0	0	0
<i>Alternaria alternata</i>	6	4	2*	1*	8	6	4*	4*	4	3	3	2
<i>Aspergillus</i>	37	27*	22*	15*	42	33	24*	23*	37	28	21*	22*
<i>A. flavus</i>	16	14	14	11*	20	18	16*	16*	18	14*	12*	12*
<i>A. fumigatus</i>	6	4	2*	2*	6	4	2*	1*	4	4	3	3
<i>A. niger</i>	5	4	3	2	7	6	5	5	7	6	4	3*
<i>A. ochraceous</i>	3	2	2	0	2	2	0	0	4	2	2	2

Table 10. Continues.

<i>A. sydowi</i>	2	1	0	0	2	0	0	0	0	0	0	0
<i>A. terreus</i>	3	1	1	0	2	1	0	0	0	0	0	2
<i>A. ustus</i>	2	1	0	0	3	2	1	1	2	1	0	0
<i>A. versicolour</i>	0	0	0	0	0	0	0	0	2	1	0	0
<i>Cochliobolus spicifer</i>	10	5*	4*	2*	0	0	0	0	0	0	0	0
<i>Emericella</i>	13	5*	4*	2*	10	5*	3*	3*	0	0	0	0
<i>E. nidulans</i>	6	2*	2*	0*	5	2	1*	1*	0	0	0	0
<i>E. nidulans var. lata</i>	7	3*	2*	2*	5	3	2	2	0	0	0	0
<i>Fusarium oxysporum</i>	0	0	0	0	0	0	0	0	4	3	1	1
<i>Mycosphaerella tassiana</i>	4	1	1	1	2	1	0	0	2	2	1	1
<i>Nectria haematococca</i>	0	0	0	0	0	0	0	0	4	4	2	1
<i>Penicillium</i>	6	4	2*	1*	4	2	2	3	7	2*	2*	1*
<i>P. brevicompactum</i>	1	1	0	0	0	0	0	2	2	0	0	0
<i>P. chrysogenum</i>	2	1	1	0	2	1	1	1	2	1	1	0
<i>P. funiculosum</i>	3	2	1	1	2	1	1	0	3	1	1	1
<i>Rhizopus stolonifer</i>	0	0	0	0	0	0	0	0	5	3	3	2

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 10. Continues.

Weeks after treatment	6				8				10			
	Doses				Doses				Doses			
Genera and species	C	L	R	H	C	L	R	H	C	L	R	H
Total count	75	53*	46*	37*	92	70*	57*	46*	91	70*	57*	50*
<i>Acremonium strictum</i>	3	2	0	0	3	1	1	0	1	1	0	0
<i>Alternaria alternata</i>	4	3	2	2	5	4	4	4	7	8	4	4
<i>Aspergillus</i>	36	26*	24*	21*	48	36	33*	29*	51	41	37*	33*
<i>A. flavus</i>	20	16*	16*	14*	20	16*	16*	15*	20	20	20	16*
<i>A. fumigatus</i>	5	4	3	3	6	5	4	2*	7	8	4	4
<i>A. niger</i>	4	3	2	2	8	7	7	6	9	8	8	8
<i>A. ochraceous</i>	4	2	2	1	3	1	1	1	4	2	1	1
<i>A. sydowi</i>	0	0	0	0	2	1	1	1	3	1	1	1
<i>A. terreus</i>	3	1	1	1	6	4	3	3	5	2	2	2
<i>A. ustus</i>	0	0	0	0	0	0	0	0	3	0	1	1
<i>A. versicolour</i>	0	0	0	0	3	2	1	1	0	0	0	0
<i>Cochliobolus spicifer</i>	8	4*	4*	2*	5	3	1*	1*	4	3	3	3
<i>Emericella</i>	0	0	0	0	0	0	0	0	8	6	4*	4*
<i>E. nidulans</i>	0	0	0	0	0	0	0	0	4	4	2	2
<i>E. nidulans var. lata</i>	0	0	0	0	0	0	0	0	4	2	2	2
<i>Fusarium oxysporum</i>	3	2	2	1	2	2	0	0	2	1	1	1
<i>Mycosphaerella tassiana</i>	4	2	2	1	2	2	0	0	3	2	1	1
<i>Nectria haematococca</i>	3	3	2	1	3	2	2	0	2	1	0	1
<i>Penicillium</i>	4	3	3	2	14	11	10*	6*	7	3*	3*	2*
<i>P. brevicompactum</i>	0	0	0	0	4	4	4	2	0	0	0	0
<i>P. chrysogenum</i>	4	3	3	2	8	6	6	4*	5	2	2	1*
<i>P. funiculosum</i>	0	0	0	0	2	1	0	0	2	1	1	1
<i>Rhizopus stolonifer</i>	10	8	7	7	10	9	6*	6*	6	4	4	1*

C = Control; L= Low dose; R = Recommended dose; H = High dose; Astrisked values mean significant difference from control.

Table 11. Screening of fungal isolates for their abilities to produce amylase enzymes.

Fungal isolates	Source	Amylase activity
<i>Acremonium strictum</i>	Phylloplane	30 H
<i>Alternaria alternata</i>	Phylloplane	29 H
<i>Aspergillus carneus</i>	Phyllosphere	27 M
<i>A. flavus</i>	Phyllosphere	26 M
<i>A. flavus</i>	Rhizosphere	27 M
<i>A. flavus</i> var. <i>columnaris</i>	Phyllosphere	31 H
<i>A. fumigatus</i>	Phylloplane	31 H
<i>A. fumigatus</i>	Phyllosphere	30 H
<i>A. fumigates</i>	Rhizosphere	30 H
<i>A. niger</i>	Rhizosphere	29 H
<i>A. ochraceous</i>	Rhizoplane	28 H
<i>A. ochraceous</i>	Phylloplane	26 M
<i>A. sydowii</i>	Phyllosphere	19 L
<i>A. sydowii</i>	Rhizosphere	21 M
<i>A. tamarii</i>	Phyllosphere	31 H
<i>A. terreus</i>	Phyllosphere	30 H
<i>A. terreus</i>	Rhizosphere	26 M
<i>A. ustus</i>	Rhizosphere	23 M
<i>A. versicolor</i>	Phylloplane	28 H
<i>Cladosporium cladosporioides</i>	Phyllosphere	22 M
<i>Chaetomium globosum</i>	Phylloplane	24 M
<i>Curvularia lunata</i>	Phyllosphere	23 M
<i>Emericella nidulans</i>	Phyllosphere	28 H
<i>E. nidulans</i> var. <i>lata</i>	Phyllosphere	28 H
<i>Fusarium oxysporum</i>	Rhizoplane	29 H
<i>F. poae</i>	Rhizoplane	25 M
<i>F. semitectum</i>	Rhizoplane	19 L
<i>Gibberella fujikuroi</i>	Rhizoplane	28 H
<i>G. intricans</i>	Rhizoplane	20 L
<i>G. pulicaris</i>	Rhizoplane	20 L
<i>Mucor hiemalis</i>	Rhizosphere	21 M
<i>M. racemosus</i>	Phyllosphere	20 L
<i>Mycosphaerella tassiana</i>	Phylloplane	20 L
<i>Myrothecium roridum</i>	Phylloplane	22 M
<i>Nectria haematococca</i>	Rhizoplane	23 M
<i>Penicillium brevicompactum</i>	Phylloplane	20 L
<i>P. chrysogenum</i>	Phylloplane	30 H
<i>P. chrysogenum</i>	Phyllosphere	31 H
<i>P. funiculosum</i>	Phyllosphere	30 H
<i>Phoma herbarum</i>	Rhizoplane	30 H
<i>Rhizopus stolonifer</i>	Rhizosphere	26 M
<i>Setosphaeria rostrata</i>	Phylloplane	25 M
<i>Stachybotrys chartarum</i>	Phyllosphere	19 L
<i>Trichoderma harzianum</i>	Phyllosphere	20 L

High amylase (H)> 27 mm; Moderate amylase (M)= 21-27 mm; Low amylase (L)<21 mm.

parts of faba bean plant. All fungal isolates tested had the ability to produce amylase enzyme, but with variable degrees. 19 isolates (43.2% of total isolates) showed high amylase activity. However, 16 isolates (36.4% of

total isolates) were found to have moderate amylase activity. The remaining isolates (9 isolates, 20.4% of total isolates) were low producers of amylase (Table 11).

Moharram et al. (2004) screened 72 fungal isolates

Table 12. Effect of amistar on growth and amylase production by some fungi after 6 days of incubation at 28°C.

Fungal species	<i>Aspergillus flavus</i> var. <i>columnaris</i>		<i>Aspergillus tamarii</i>		<i>Penicillium chrysogenum</i>		<i>Penicillium funiculosum</i>	
Doses	RS	D. wt	RS	D. wt	RS	D. wt	RS	D. wt
0	751	175	425	202	427	217	316	174
100	705*	146*	358*	146*	405*	173*	296*	159
200	663*	136*	344*	132*	389*	158*	281*	146*
400	519*	119*	339*	110*	373*	131*	266*	127*
600	399*	97*	311*	91*	358*	107*	250*	113*
800	280*	73*	286*	76*	341*	86*	231*	97*

Table 13. Effect of moncut on growth and amylase production by some fungi after 6 days of incubation at 28°C.

Fungal species	<i>Aspergillus flavus</i> var. <i>columnaris</i>		<i>Aspergillus tamarii</i>		<i>Penicillium chrysogenum</i>		<i>Penicillium funiculosum</i>	
Doses	RS	D. wt	RS	D. wt	RS	D. wt	RS	D. wt
0	751	175	425	202	427	217	316	174
100	716*	163	409	170*	399*	185*	306	167
200	662*	153*	382*	157*	374*	171*	294*	158*
400	567*	128*	363*	138*	358*	158*	281*	142*
600	508*	104*	326*	121*	334*	136*	263*	126*
800	341*	93*	272*	97*	316*	113*	247*	110*

RS = Reducing sugar; D. wt = Dry weight.

recovered from tomato plant for their ability to produce amylase enzymes. They showed that all fungal isolates tested had the ability to produce amylase enzymes, but with variable degrees. *A. flavus*, *Cunninghamella echinulata*, *F. oxysporum*, *Mucor hiemalis* and *P. chrysogenum* were the most active amylase producers.

Effect of fungicides on mycelial growth and amylase production of some fungi

Since these fungi (*Aspergillus flavus* var. *columnaris*, *A. tamarii*, *P. chrysogenum* and *P. funiculosum*) were found to be the most active amylase producers. They were used to study the effect of fungicides on amylase production.

Amylase production of *Aspergillus flavus* var. *columnaris*, *A. tamarii*, *Penicillium chrysogenum* and *P. funiculosum* was inhibited by all doses of fungicides. The degree of inhibition depended mainly on the fungicide concentration in the culture medium for enzyme production. Mycelial growth of *A. flavus* var. *columnaris*, *A. tamarii*, *P. chrysogenum* and *P. funiculosum* was decreased by all doses tested (Tables 12 and 13). These results are in agreement with those reported by Hassan (1993), he found that, the fungicides Dicloran, Iprodione and Vinclozilin significantly inhibited the mycelial growth and α -amylase of *A. flavus* and *F. graminearum* when used by 100, 250 and 500 ppm. Moharram et al. (2004)

found that Kocide and Ridomil plus fungicides inhibited vegetative growth and amylase production of *A. flavus*, *C. echinulata*, *F. oxysporum*, *M. hiemalis* and *P. chrysogenum* when applied by 200, 300 and 400 ppm.

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