STUDIES ON SOME ROT DISEASES OF *ZEA MAYS* IN EGYPT

BY

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C O N T E N T S

INTRODUCTION

Maize(corn) along with rice and wheat, are the three most important cereal crops in the world.Maize is grown throughout the temperate , subtropical and tropical zones wherever rain fall or irrigation is adequate.

In Egypt , 1.9 million feddan are grown annually with maize, yielding ca 4.2 million tons of grains (Gomaa et al. , 1989) .

Maize is a subject to the attack of different diseases in Egypt i.e. late wilt, downy mildew and common smut, also is subject to the attack of kernel and ear rots in both field and store.These diseases are caused by Fusarium moniliforme Sheld.,Penicillium spp., Aspergillus niger Van Tieghem, Aspergillus flavus Link, Nigrospora oryzae Petch, and Botryodiplodia theobromae Pat. . These pathogens play an active role in the deterioration of the kernels and there influence will extend to human and animal who depend on maize grains in their food or feed .

The present work was devoted to study and survey kernel and ear rots incidence in North Delta region, effect of sowing date, storage on disease

development in certain commercial cultivars or hybrids, methods of disease control through foliar spray or seed soaking using certain systemic fungicides,evaluation of certain commercial maize cultivars and hybrids against the disease,controlling the disease using either chemical or physical method and the best or reliable inoculation technique as a good contribution to the breeding program and the evaluation of the new released cultivars .

REVIEW OF LITERATURE

Maize is considered to be the most important staple food grains in the world . Numerous investigations were done at different locations allover the world . Stored ears and grains are subject to the attack by different fungi upon harvest i.e. Fusarium moniliforme,Aspergillus flavus, Aspergillus niger, Penicillium spp. , Nigrospora oryzae, Fusarium graminearum, Fusarium oxysporum , Mucor sp. and Rhizopus spp. (Ibrahim and Farag, 1965,Mislivec and Tuite, 1970; Gamal El-Din et al., 1987 and Wicklow, 1988). Penicillium funiculosum, Pencillium oxalicum , Acremonium strictum, Alternaria alternata and Curvularia lunata (Wicklow, 1988).

Foley (1962) reported that infection by stalk rot tends to be systemic in case of using infected kernels .

Donald (1968) mentioned that Fusarium moniliforme is seed borne in Nebraska, and primarily confined to the pedicel and the abscission layers of grains,but the latter was frequently isolated from excised embryos and endosperms. Unidentified hyphae were commonly observed in the abscission layer cavity of nongerminated kernels . Plants from infected kernels grown to maturity on sterile soil or sand and monsterile soil in greenhouses or growth chambers contained more stalk rot fungi than plants grown

from uninfected kernels. However, in field-grown corn there were no differences among plants grown from infected and uninfected kernels .

Boothroyd (1971) found that Helminthosporium maydis Race T is seed-borne, and that infected seed may be a factor in transmission of the fungus to healthy corn plants in the field.

Crosier and Braverman (1971) showed that soaking maize seeds infected by Helminthosporium maydis in a 1.5 % solution of sodium hypochlorite for 10 mins. and transfering them directly to potato dextrose agar medium (PDA), resulted in fungal colonies that grew rapidly at 25°C and produced an irregular light to moderate olivaceous gray colour, firm and thick mycelium .

Tuite and Caldwell (1971) showed that invasion of the ears by Helminthosporium maydis did not increase the numbers and kinds of fungi except for Acremoniella .

Singh et al. , (1974) evaluated four procedures for the detection of seed-borne fungi of maize i.e. blotter , deep-freezing , ragdoll (rolled towel) and

agar plate methods and found that the second method was the most suitable for routine seed health testing.

Harman (1983)showed that maize seed since the time of thier inception flowering of the parent plants until the germination and developing into seedlings are subject to attacking fungi like Fusarium moniliforme and Fusarium oxysporum which infect maize kernels by invasion through the pedicel .

Barrows-Boaddus and Dwinell (1985) demonstrated that Fusarium moniliforme var. subglutinans infected specific vegetative and reproductive structures at different maturity stages and produce different symptoms.

Gamal El-Din et al., (1987) reported that the most dominant fungi in maize grains could be arranged descendingly as Fusarium moniliforme, Nigrospora oryzae, Fusarium graminearum , Penicillium spp., Aspergillus niger, Aspergillus flavus, Helminthosporium spp. , Rhizopus spp., Mucor sp. and Alternaria spp. They mentioned that severity and percentage of infection by these fungi increased by increasing moisture content and storage time. Prolonging storage periods at 18°C generally resulted in reduced weight of both the germ and hull in either healthy or infected grains by Nigrospora oryzae, whereas no difference occurred when infected by Fusarium moniliforme .

From the work undertaken by Jayaweera et al.,(1988) it was concluded that fungi which reduced seed germination are pathogenic to host seedlings at the pre-emergence stage. Several species of Fusarium are known to invade the seed coat, endosperm and the embryo resulting in failure of germination. Further species of Fusarium are known to produce phytotoxins which probably interfere with germination.

Singh et al., (1988) indicated that infection by Fusarium moniliforme was detected in all parts of seed, however, the percent of infection depended on the severity of the seed infection. The pathogen infected the pedicel and basal ovary after 5 to 10 days of anthesis and the mycelial clumps produced in between the ovary wall and aleurone layer entered into the endosperm and embryo directly.

Interaction between insects and fungi have tradionally been studied from the perspective of the disciplines of entomology, mycology and plant pathogens and the biotic component in stored grains (Mills 1983) .

Christensen and Schneider (1950) reported that European corn borer (ECB) (Ostrinia nubilalis) is one of the most prevalent maize pests in North America

and is generally acknowledged as the number one insect problem of maize in the Northeastern States. It may lead to decrease in maize yield by reducing grain weights, increasing the incidence of lodging and ear drop, and providing entry sites for stalk and ear pathogens .

Scott and Futrell (1970) pointed out that the European corn borer (ECB) (Ostrinia nubilalis)has been reported to carry Fusarium moniliforme condia and may inoculate plants during its feeding on them .

Laemmien and Hall (1973) pointed out that the pyemotid mite Siteroptes reniformis stimulates fungal growth, probably by chemicals, transports spores in a special internal sac, and increases the efficiency of invasion of cotton bolls by the fungus. The fungus invades and obtains nourishment from the host, perpetuates the species through production of spores and stimulates growth and reproduction of the mite.

Stephenson and Russell (1974) found that insects provide transportation and entry of the fungus to seed through ovipositor and feeding wounds.

Gibertson et al., (1986) reported that Fusarium moniliforme and Fusarium subglutinans were isolated

from rootwarm-damaged sweet corn plant organs and western corn rootwarm beetles. Fusarium spp. including Fusarium maniliforme and Fusarium subglutinans were consistently isolated either from surface disinfested root section, or surface-disinfested stalk section , whereas only Fusarium moniliforme was isolated from damaged kernels and silks. Other Fusarium spp. were infrequently isolated from above ground plant parts.

Keller et al., (1986) found that the largest yield reductions associated with Colletotrichum graminicola and its interaction with European corn borer (ECB) were observed when plants were inoculated and infested at the midwhorl stage .

Payne et al., (1988) demonstrated that sporulation of the fungus Aspergillus flavus in the field was associated with injured kernels, and relationship between aflatoxin contamination and insect injury has been shown. Direct infection by Aspergillus flavus has significant role in epidemiology of this disease, and high temperature is one of the critical factors affecting the infection process .

Fields and King (1962) concluded that Peas free from storage fungi retained their original germinability

(about 97 %) for 6 months at 85 % relative humidity and 30°C, whereas samples inoculated with various storage fungi and stored under the same conditions were reduced to zero germinability within 3 - 8 months.

Kucharek and Kommedahl (1963) found that the incidence of kernels infected by Fusarium moniliforme in some varieties at planting time may be sufficiently low that it can be disregarded as an important source of root and stalk rot infection in Minnesota.

Christensen (1964) reported that seed of maize retained germinability of nearly 100 % more than 90 days at moisture contents between 16 %, and for 150 - 160 days at moisture contents between 15 and 16 %, and temperatures at 20 - 25°C .

Fathi (1966) found that the cooling test proved that seed harvested 40 days after artificial pollination had the lowest seedling emergence followed by 50 days, while, the highest seedling emergence was recorded 60 days after pollination .

Moreno-Martinez and Christensen (1971) found that after storage for 63 days at 85 % relative humidity and 20 - 25°C, in samples of 15 varieties of maize previously

inoculated by mixture of storage fungi , germination % ranged from 25 % to 97 % . After storage for 44 days at 85 % relative humidity and 26°C, germination percentage of 65 lines that had been previously inoculated by a mixture of storage fungi ranged from 0 to 91 % . At the end of the storage tests, kernels of the varieties and lines of high viability were bright and sound, and those of low viability were decayed .

Caldwell et al., (1981) suggested that Fusarium moniliforme is a better competitor in preharvested maize than Penicillium funiculosum. Initial kernel infection by the first pathogen may serve as an important deterrent to subsequent kernel invasion by other seed-infecting molds. However, from 15 species of Penicillium tested in the field, only there were Penicillium funiculosum and Penicillium oxalicum able to colonize preharvested ears and infect kernels.

Jones et al., (1981) found higher levels of aflatoxin in maize harvested at 18 % kernel moisture than in maize harvested at 28 % .

King (1981) reported that Fusarium moniliforme appeared to be an early colonist of preharvested maize ears, infecting the kernels before Pencillium and other molds.

Prasad et al., (1988) reported that maximum percent loss of total nitrogen, starch, total free sugar, total free amino acids and seed germination was due to infection by Aspergillus flavus .

Wicklow (1988) found that eleven common maize-infecting fungi grew out from surface-disinfected maize kernels from North Carolina and plated on malt extract agar . Each of these fungi was known to infest maize ears preharvest. Fusarium moniliforme was the most common fungus grew on 52 % of the kernels. Aspergillus flavus and Aspergillus niger were the two fungi commonly associated with preharvest maize and grew out from 19 and 36 % of the kernels, respectively, and other fungi observed included Acremonium strictum(7 %),Alternaria alternata(5 %) , Nigrospora oryzae (4%),Curvularia lunata (3 %) , Trichoderma viride(3 %),and Rhizopus spp. (2 %) .

Diab et al.,(1989)pointed out that the lateness of sowing date has greatly increased the disease and has induced the minimum germination in the tested maize cultivars, while the highest percentage of grain germination was recorded in grains obtained from early sown plants because of its maturity and lowest moisture contents. On the other hand seed treatment by fingicides i.e.Benlat

and Vitavax controlled grain rot and minimized loss of grains germination .

Infection by Botryodiplodia theobromae was most extensive when spore suspension was injected through the husks or sprayed on the ear top and onto the silk and/or the ear shank (Diab et al., 1984). The mode of entry into the grain by seed and stalk rot fungi of maize was reviewed and discussed by Koehler (1942). He reported that Fusarium moniliforme penetrats the region of the silk , spreads to the bracts and pedicels through the vascular cylinder, and finally spreads into the shank. Internal kernel infection did not become established until the ears were approaching maturity. Also he studied infection via the pedicel in mature undamaged kernel and observed that penetration into the kernel in any other way was rare, since differences in fungal growth and sporulation among the genotypes were visually detected at the pedicel .

Qasem and Christensen (1960) observed that if the pericarp of the kernel remained unbroken,penetration by the fungi could be accomplished through the pedicel.

Calvert and Zuber (1973) found that ears from plants with T-cytoplasm had more extensive rotting

induced by Helminthosporium maydis race T than those from normal cytoplasm plants. Ears inoculated at the ear center had the greatest amount of rot.Ear inoculations at 20 days after flowering resulted in high rotting , however it was lower at 30 and 40 days. Certain tissues of corn ears with the T-cytoplasm were much more susceptible to infection than others.

Anderegg and Guthrie (1981) suggested that seed borne Fusarium moniliforme could be used as an inoculum for seedling infection in corn. However, when seeds did not carry inoculum, soilborne inoculum was equally effective in infecting seedlings.

King and Scott (1982) found that inoculation by Aspergillus flavus conidial suspension into silk channel or by otomizing conidial suspension onto exposed kernels resulted in infection levels too low (7 %) . The kernel injection technique gave relatively high levels of infection, while pinbar technique resulted in higher levels (9 - 48 %) of kernel infection .

Latterell and Rossi (1983) reported that Diplodia macrospora is actually more aggressive than Diplodia maydis to attak young stalks and ears. Since,Diplodia maydis could attack corn plants at both early and very

late stages. While, Diplodia macrospora could attack corn plants vigorously at all stages of growth.

Diab et al., (1984)pointed out that infection, was generally most extensive in terms of number of ears infected and type of infection when the spore suspension was inoculated at the ear tip or into the husks . Injection into husks was effective as compared to ear tip, silk, and shank inoculation. Early inoculations caused more severe infection than late ones .

Styer and Cantliffe (1984)found that mature ears of two tested maize hybrids, inoculated 10 days post pollination by Fusarium moniliforme had higher levels of rot and seed infection than those inoculated later.

Tucker et al., (1986) showed that kernel infection by Aspergillus flavus was significantly greater for row one of the pinbar-inoculated and exposed-kernels. Inoculation techniques had a higher percentage of kernels with Bright greenish yellow fluorescent than were found by other inoculation techniques.

Chambers (1988) pointed out that in a program for breeding for resistance to ear rot, the time of inoculation for germ plasm evaluation is critical. Since there was rapid decrease in kernel moisture 20 days after mid-silk and ear inoculation should be made at or shortly

after this date. Inoculation at this time would best differentiate between resistant and susceptible germ plasm.

Drepper and Renfro (1990) pointed out that the nail punch was the most effective method for ear inoculation in maize, while the drill/toothpick method was most effective for stalk inoculations.

Foley (1962) found that 100 % of the kernels from maize, yielded Fusarium moniliforme when they were germinated on various media at 10 - 15°C and the seedlings aseptically cut into small sections, crushed , and incubated on mineral agar. The fungus was also frequently isolated from roots, nodes, and internodes of apparently healthy field corn. He concluded that the presence of Fusarium moniliforme in kernels and many stalk tissues without symptom expression indicated systemic infection .

Ben Doupnik (1972) reported that seed damaged by Helminthosporium maydis predisposed corn plants to invasion by secondary fungi, many of which have the potential to produce mycotoxins.

King and Scott (1981) showed that infection of inbreds and of their hybrids by Fusarium moniliforme

was 19 - 79 % and 5 - 60 % respectively. Crosses between two resistant (R) parents had 11 % average of infection compared with 55 % for crosses between two susceptible(S) parents, while R x S in crosses infection average was 33 % .

Cantone et al., (1983) found that differences among hybrids were most as great as between inbreds and hybrids, since the inbreds were generally more susceptible than the hybrids when they were inoculated by corn storage fungi under the conditions of three different environments. None of the tested genotypes expressed immunity against the invasion of storage fungi.

Bozidar (1984) concluded that the fungus i.e. Fusarium graminearum not only directly destroyed germs of maize seed but also caused the deformation of seedlings .

Scott and King (1984) reported that resistance to kernel infection by a fungus i.e. Fusarium moniliforme could result from factors in the cytoplasm or nuclear factors operating in the pericarp, endosperm,and embryo.

Zummo and Scott (1990) demonstrated that Aspergillus flavus and Aspergillus parasiticus may be equally

aggressive in maize kernels in the field after artificial inoculation of ears, but Aspergillus flavus appears to have a greater apility for survival in the field . Thus, the natural inoculum in old corn fields would be Aspergillus flavus.

Singh et al., (1971) found that seed treatment with benlate (0.75 gm./kg.) and RH 893 (0.2 ml./kg.) was very effective in reducing the maize kernel rot disease.

Salama and Mishricky (1973) suggested that corn seeds could be disinfested by soaking in tap water for 5 hr at room temperature and then for 10 min at 53 - 56°C . This technique, however, eliminated Fusarium moniliforme from seeds only if they were subsequently treated by Hg cl_2 (0.3 %) for 15 min.

Papayan et al., (1975) found that vitavax decreased germination of wheat seeds and inhibited the plant growth up to shooting stage,but increased it during later stage.

El-Khadem et al., (1979) showed that benlate was very effective in eliminating seed rot fungi. While, vitavax-captan was very effective in controlling postemergence losses caused by Fusarium moniliforme.

El-Meleigi et al., (1980) reported that seeds free of Fusarium moniliforme could be obtained by combined ethanol and hot water treatments.

Daniels (1983) found that Fusarium moniliforme was eliminated from naturally infected seeds of several corn hybrids when seeds were pretreated in distilled water for 4 hr at 18 - 22°C then placed in tap water at 60°C for 5 min. The seeds remained viable, and neither the seed nor aseptically germinating seedling yielded Fusarium moniliforme when plated on Kamada agar medium. From seeds that were treated in distilled water at 18 - 22°C for 5 hr and then in 55°C for 10 min, water with benomyl at 2,000 ppm for 24 hr , or acetone with benomyl at 6.250 or 25,000 ppm for 24 hr, Fusarium moniliforme was not isolated but was isolated often from aseptically germinating seedlings .

El-Sawah et al., (1984) showed that Benlate , Falisan HB and Arasan sf-x were the most effective fungicides against five of the seed-rot fungi. On the other hand, seed treatment by Benlate improved seed germination, also Benlate caused an increase in germination by prolonging period of storage .

Sauer and Burroughs (1986) reported that rinsing seeds in ethanol before sodium hypochlorite (Na O Cl)

was effective in reducing surface contamination especially with wheat .

Diab et al., (1989) pointed out that the recommended fungicidal doses of Benlate and Vitavax protected grains against grain rot fungi, while grain germination was affected at double dose of fungicides .

Sinha and Ranjan (1989) demonstrated that the insect damaged samples of maize grains domonstrated higher percentage of bright greenish-yellow flourescence(BGYF) and aflatoxin contamination than the insect-free ones. Reducing insect damage in corn plant through the application of insecticides resulted in less BGYF and lower aflatoxin contamination as compared to the untreated plots. In addition, the insect activity preconditions the substrate for fungal invasion.

MATERIALS AND METHODS

The present work was carried out during the period of 1988 - 1991 in the experimental farm of Sakha Agricultural Research Station and Plant Diseases Research Laboratory , Sakha Research Station .

I- Diseased samples :

Randomized samples of two kg/each,including rotted ears and/or kernels were collected from seven locations in Kafr El-Sheikh governorate i.e. Kafr El-Sheikh,Dessouk, El-Reyad, Qualine,Sedi-Salem,Beialla and Motobas. The samples were collected from different fields cultivated with Giza 2,DC 215 and TWC 310 maize cultivars during the two growing seasons 1989 and 1990 .

II- Isolation of the causal agents and determination of disease incidence :

One hundred seeds of each maize cultivar or hybrid from each location were surface sterilized in 1% sodium hypochlorite for 3 min., plated on PDA medium in 15 cm diam. petri plates, 25 kernels were used for each plate in four replicates. The plates were incubated at 25 - 27°C for 6-8 days. The developed fungi were purified using single spore and hyphal tip techniques. Obtained fungi were estimated in each location and cultivar according to their frequency of developing on isolation plates.

The identification of the causal agents was done according to Alexopolous (1968) and by the kind help

of the Division of Mycology,Istitute of Plant Pathology, ARC , Giza , Egypt. The maize cultivars which were used through out the course of this investigation were kindly supplied by Maize Res. Section at Sakha Agric. Res. St. This work included field experiments and some laboratory tests .

III- Field experiments :

1- Effect of infestation by maize stem borers on the development of maize ear rots :

The main objective of this experiment is to know how the stem borers dispose the ear to the attack of ear rots. Split plot design with four replicates was adopted for this experiment,since the main plots were cultivated by maize cultivars i.e. TWC 310 and Giza 2 and sub plots with non-treated and chemically treated plants against stem borers using theodan granules at 7 kg/Feddan after 18 days of sowing,the same dose was added after 35 days of sowing and finally lanit 90 % was applied at 300 g/Feddan after 50 days of sowing as recommended for controlling stem borers.

The experimental plot consisted of 3 rows of 6 m. long,70 cm. apart,each row has 20 hills at 30 cm distance and each contained 3 grains,the developed seedlings were thined to one plant/hill after 3 weeks of planting . All the cultural practices were applied at the proper time

and as recommended. Randomized samples of 6 ears/row were collected from each treatment to determine ear rot at different ripening stages,i.e. 110, 120 and 130 days after sowing. Ear rot was estimated as a percentage of infection per-plot in each treatment for each cultivar, on the other hand the infestation with stem borers was recorded in both treated and non-treated plots. This experiment was sown on the 15th of June during 1989 and 1990 growing seasons. The cold test technique adopted by Hoppe(1956)was followed to determine the germination rates,genera and frequency of developed fungi.

2- Effect of sowing and ripening dates on the development of ear and kernel rot .

The main objective of this experiment was to study the relation between ear and/or kernel rot and both of sowing and sampling dates in terms of seed germination.

To carry out this experiment,split plot design with four replicates was adopted. The sub plots were cultivated by maize cultivars i.e. TWC 310 DC 215,DC 204,Comp 5 and the synthetic cultivar Giza 2. The main plots included two sowing dates i.e. 1st of June and 20th of June. The experimental plot consisted of 7 rows, 6 m. long and

70 cm apart,each row has 20 hills at 30 cm. distance . Each hill was planted by 3 seeds and thined to 1 plant after 3 weeks of planting . The samples (20 ear/cultivar) were taken at random from each treatemt after three different dates of sowing i.e. 110, 120 and 130 days. These samples were subjected to determination of germination and the involved fungi by cold test method adopted by Hoppe (1956) . In this method, alominium covered dishes 20 cm. diam., were filled with sterile sand and used for sowing (25 kernel/ dish), incubated at 8-10°C for 7 days followed by 4 days at about 28°C thereafter. The developed fungi on the emerging seedlings were transferred to PDA medium . Microscopic examination was performed to confirm the identity of the resulting fungi .

3- Ear infection .

This experiment was carried out to determine the best procedure of ear infection and the proper time of inoculation to obtain ear and kernel rot . Split plot disign with four replicates was adopted . The main plot were sown with cultivars i.e. Giza 2 and TWC 310, sub plot were represented by inoculation techniques i.e. silk, ear tip and husk inoculations. The experimental plot included 5 rows 6 m. long and 70 cm. apart,containing

20 hill/row. Sown by 3 seeds, thined to one plant after 3 weeks of sowing .

Four plants were selected at random and inoculated at different times of flowering once for each cultivar i.e. 10, 20 and 30 days after flowering. Spore suspensions of the following fungi were used in this respect, Fusarium moniliforme, Penicillium spp., Aspergillus flavus Aspergillus niger and Botryodiplodia theabromae. Each plant was injected by spore suspension of either of the tested fungi, 4 plants of each cultivar were injected by certain fungus using hypodermic syring (3 ml. at 10^4 spore/ml. conc.).

The female infloresences were covered with transparent paper bags soon after their appearance. Pollination was performed manually, and the ears were left covered until complete maturity. Three femal infloresences were used for inoculation for each fungus and each period after flowering i.e. 10, 20 and 30 days using the following procedures according to the methods adopted by Diab et al. (1984).

- Silk inoculation : The spore suspension was atomized on the silk without disturbing the husk. The ear was left covered after inoculation .

- Ear tip inoculation: The husks were opened to expose ear tip, spore suspension was atomized on the top and husk were closed again .
- Husk inoculation : The spore suspension was injected into the ear and the surrounding husks by means of a hypodermic syrenge .

Ears injected by or atomized using distilled sterile water served as a control treatment. Infection was estimated after complete ear maturation. One handred kernels were selected from each treatment i.e. method of inoculation, surface strilized and plated on PDA medium to determine the effectivnees of each inoculation technique, in terms of infection in the tested seeds.

4- Chemical control of ear rot.

The main objective of this experiment is to determine the proper time after flowering and the spray numbers to control the disease. Split plot design with four replicates was used to carry out this experiment. The main treatments were the number of sprays i.e. 2 and 15 ; 2, 15 and 25 and 2,15, 25 and 35 days after flowering. Control treatment was left without spraying. Sub plots included spraying with either the systemic fungicide Benlate 50 % at 2g/L. or Dithane-M_{45} 2g/L.

The chemical structure,and commercial names for the tested fungicides are listed in Table 1 . The experimental

plot is made of 3 rows 6 m. long at 70 cm distance and 20 hills/row. Each hill was planted by 3 seeds thined to one plant after 3 weeks of sowing. The experiment was sown at the 1st of June and repeated twice in 1989 and 1990. Seed germination and the percentage of ear rot were recorded.

IV- Soil infestation technique :

This experiment is to study the effect of the isolated fungi on seed germination and the vegitative growth in maize seedlings . The tested fungi i.e. Fusarium moniliforme , Penicillium spp. , Aspergillus flavus , Aspergillus niger, B. theobromae and Fusarium semitectum, were used individually and mixture . Seed samples of the cultivars i.e. Giza 2 and TWC 310 were surface disinfected and sown in No.15 pots containing sterilized sandy soil (2 kg/pot). The soil was heavily infested, seven days before sowing, with one or a mixture of the tested fungi. Maize grain were soaked in 1 % sodium hypochlorite solution for 5 min then washed several times in sterilized distilled water before planting.

For artificial infestation of soil , each of the tested fungi was grown aseptically in 500 ml milk bottles containing 80 g. of water-barley grains in

15 ml water. After 3 weeks of incubation at 25°C. The contents of each bottle (fungal inoculum) was equally devided between four potted soil. Soil infestation with a mixture of the tested fungi was carried out by throughly mixing 5 g inoculum of each fungus with the soil in each pot according to the method adopted by Abd-Alla (1988). A total of 7 treatments were prepared , in four replicates . Control was carried out by sowing surface disinfected grains in non-infested sterilized soil. All pots were kept under the normal weather conditions during May 1990. Seed germination, seedling length, weight of both shoot and root systems was recorded after four weeks of sowing .

IIV-Laboratory experiments :

1- Effect of seed disinfectant on Fusarium moniliforme rot incidence and seed germination .

a- Seed treatments .

To carry out these experiments 100 seeds of each of Giza 2 and TWC 310 maize cultivars were used for each treatment with four replicates (25 seed for each) . The aim of this experiment is to determine seed germination % and the presence of Fusarium moniliforme in the tested seeds .

a-1 : In this treatment 100 maize seeds of each cultivar were soaked in sodium hypochlorite solution (0.525 %) for 10 min. then plated in 4 petri-plates(15 cm in diam.)containing 50 ml autoclaved PDA medium,and incubated at 27°C for 7 days . The percentage of infection was estimated according to the visible symptoms and confirmed by micro-scopic examination according to the method adopt-ed by Daniels (1983).

a-2 : Maize seeds were soaked in distilled strile water for 5 hr. at 18-20°C . to stimulate mycelial growth, then rinsed in hot water at 55°C for 10 min. to induce mycelial supression. The presence of F. moniliforme was detected through the same above mentioned creteria (1st treatment).

a-3 : Maize seeds were soaked in a water solution of Benlate 50 % at 2.000 ppm for 24 hr. before exa-mined for the presence of F. moniliforme.

a-4 : Maize seeds were soaked in acetone solution of Benlate 50 % at 6.250 ppm for 24 hr. before examination .

a-5 : Maize seeds were soaked in acetone solution of Benlate 50 % at 25.000 ppm for 24 hr. befor examination .

a-6 : Is the control, in which the seeds were plated without surface sterilization , on PDA medium.

b- Seedling treatments .

The previously mentioned steps were applied on maize seedlings , Seeds of the cultivars Giza 2 and TWC 310 were surface sterilized by sodium hypochlorite (1 % conc.) and grown in test tubes (1.5 cm. diam.) containing 10 ml. sterile water agar (one seed per each tube). Four replicates were used for each treatment to reach a total of 60 tube/treatment . The percentage of seed germination was recorded after incubation at 27°C for 12 days (12 hrs. fluorescent followed by 12 hrs. darkness). Growing seedlings were cut thereafter, and put on sterile PDA on petri-plates to determine the incidence of Fusarium moniliforme in the tested seedlings in terms of % colonies .

2- Effect of hot water treatment on the development of Fusarium moniliforme in both seeds and seedlings .

The main objective of this experiment is to determine the optimum water temperature at which maize seeds could be soaked to inhibit the development of Fusarium moniliforme in seeds and / or seedlings.

a- Seed treatments :

To cary out this experiment maize seeds of both Giza 2 and TWC 310 were soaked in distilled steril-water at 18 - 22°C for 4 hr. Then seeds were subjected to soaking in hot water for 5 min. at different temperatures i.e. 45 , 50 , 55 , 60 and 70°C . Transferring the seeds after imersion in distilled water to meida directly without any hot water treatment served as a control treatment .

The treatment included 25 seed of each cultivar with four replicates, seeds were plated on sterile PDA medium in petri-plates (15 cm diam.) and incubated at 25 - 27°C for 12 days . Percentage of seed germination and infection by Fusarium moniliforme were recorded .

b- Seedling treatments :

The previous steps were applied with few modifications , since the treated seeds were sown in test tubes (1.5 cm diam.) containing sterile water agar medium (1 seed/10 ml/tube), cotton plugged to retain moisture and incubated at 22 - 24°C for 15 days. Different parts of the growing seedlings were plated on PDA medium and incubated at 25 ± 2°C for 7 days . The percentage of infection as compared to the control was calculated .

3- Location of Fusarium moniliforme in seed parts :

Seed samples of two maize cultivars (TWC 310 and Giza 2) were used in this study. One hundred seeds from each sample were washed several times in sterilized water and soaked in sterilized water,in test tube . One seed per tube, for 24 hr. seed was then devided aseptically to different parts, i.e. endosperm, embryo, pedicel and pericarp. Each part was washed once in 1 % sodium hypochlorite solution for 5 minutes (Donald Summer 1968) and plated directly on PDA medium in the petri dishes . After seven days of incubation, under 12 hr. flourescent and 12 hr. darkness cycle at 25 ± 2°C , the seed parts were examined for fungal presence.

4- Effect of certain systemic fungicides and storage for different periods on kernel rot development :

The main objective of this experiment is to estimate the percentage of seed germination and seed mycoflora under the stress of fungicide application . On the other hand, this experiment threw high lights on the effect of storage of naturally infected seeds for different periods on disease incidence .

To carry out this experiment, 200 kernels of each maize cultivars, Giza 2 and TWC 310 were stored at room temperature. Seeds were tested soon after seed treatment,

1 month, 2 months, and three months . The detection included the presence of Penicillium spp., Aspergillus flavus, Aspergillus niger and Fusarium moniliforme by the color of originated colonies and confirmation by microscopic examination .

The following systemic fungicides were applied as seed dressers : redomil M 58 % , redomil plus 45 % , previcur N, dacober 500, benlate 50 % and vitavax 200. Seeds were mixed by the fungicides in three conc. 1,2 and 3 g/kg seed except for the application of previcur N , since the seeds were coated using 1,2 and 3 ml/kg seeds and stored for the different period. Control treatment was left without any chemical treatment and stored for the different periods mentioned above. Four replicates were prepared for each treatment. The experimental unit included 2 petri-plates , 15 cm diam. containing 50 ml. sterile PDA medium (25 seed for each) . Prepared plates were incubated at 26 - 27°C for 12 days(12 hr. floure-scente light followed by 12 hr. darkness). Percentage of seed germination was determined,and the developed visible fungal colonies were identified and grouped to the above mentioned agents.

Table (1): Rates of application of Fungicides and insecticides used in field and laboratory experiments .

Fungicides	Active ingredient	Structure formula	Rate of application
Vitavax 200	Carboxin + Thiuram	5,6-dihydro-2-methyl-N-phenyl-1,4-oxathion-3-carboxauilide	2g/kg
Benlate	Benomyl	Methyl-1-(butylcarbomoyl)benzimidazol-2-yl carbomate.	2g/kg
Dacober 500	Chlorothalonil + Copper oxychloride	Tetrachloroisophthalonitril + copper orychloride	2g/kg
Ridomil Mz	Metaloxy + Mancozeb	Methyl D,L-N-(z,6-dimethyl)-N-(2,methoxy-acetyl)-alaminate + Complex of a zinc solt and polymeric manganese ethylene his(dithiocarbamate)	2g/kg
Ridomil plus	Metaloxy	Methyl D,L-N(2,6-dimethyl phemyl)-N-(2,methoxy acetyl)-alaminate	2g/kg
Dithano M_{45}	Mancozeb	Complex of a zinc solt and polymeric manganese ethylene bis (dithocarbamate)	2g/kg
Previcur N	Propamocarb	Propyl 3-(dimethylamino)propyl carbamate.	2cm/kg
Insecticides	**Common name**	**Chemical name**	**Rote of application**
Thiodan	Endosulfan	6,7,8,9,10,10 hexochloro-1,5a,6,9,9a-hexahydro-6,9-methano-2,4-3-benzodioxathiepin-3-oxcide	7kg/feddan
Lannate	Methomyl	S-methyl N-(methyl carbamoyl) oxy thioacetimi-midate .	300g/feddan

EXPERIMENTAL RESULTS

I- Diseased samples :

The incidence of ear rot disease of maize was surveyed in 7 counties of Kafr El-Sheikh governorate. The survey was carried out on the two consecutive harvest seasons of 1989 and 1990 and included the incidence of seed rots in three maize cultivars , Giza 2, DC 215 and TWC 310. Data presented in Table 2 as percentages of rotted kernels in each county demonstrated the followings :

- The mean percentage of incidence of ear and kernel rot disease throughout the 7 counties of Kafr El-Sheikh governorate in Giza 2, DC 215 and TWC 310 cultivars were 79.7 % and 82.3 % , 60.7 % and 59.0 % , and 45.6 % and 43.3 % in 1989 and 1990 survey, respectively.

- The disease incidence was found to be varied among the different counties of Kafr El-Sheikh governorate. The percentages of infection in Giza 2 , DC 215 and TWC 310 cultivars ranged from 63.0 % to 97.0 % , 49.0 % to 77.0 % and 38.0 % to 60.0 % in 1989 and from 65.0 % to 98.0 % , 45.0 % to 78.0 % and 32.0 % to 58.0 % in 1990 respectively. The highest percentage of disease incidence,in both years,was found at Motobas county, followed by Kafr El-Sheikh and Dessouk counties . On the other hand,percentage of kernel infection in Giza 2

were generally high followed by DC 215 cultivar, while the percentages of kernels infection in TWC 310 cultivar were generally low in both years .

Table (2): Percentage of kernel rot disease of three maize cultivars in 7 counties of Kafr El-Sheikh governorate during 1989 and 1990 seasons.

County	Cultivars					
	Season 1989			Season 1990		
	Giza 2	DC215	TWC310	Giza 2	DC215	TWC310
Kafr El-Sheikh	90.0	69.0	52.0	94.0	64.0	53.0
Dussouk	91.0	70.0	47.0	92.0	68.0	47.0
El-Reyad	75.0	55.0	39.0	78.0	55.0	39.0
Qualine	66.0	49.0	39.0	65.0	46.0	33.0
Sedi-Salem	63.0	49.0	38.0	67.0	45.0	32.0
Beialla	76.0	56.0	44.0	82.0	57.0	41.0
Motobas	97.0	77.0	60.0	98.0	78.0	58.0
Mean	79.7	60.7	45.6	82.3	59.0	43.3

II- Isolation of the causal agents and determination of disease incidence :

Data presented in table 3 showed that the examined kernels of the four different cultivars were entirely surface contaminated with seven different fungal species i. e. Fusarium moniliforme Sheld. , Penicillium sp., Aspergillus niger Van. Tiehm, Aspergillus flavus Link,

Nigrospora oryzae Petch, Botryodipodia theobromae Sacc. and Fusarium semitectum Berk. & Rav. These fungi genera were found to be internally invading the kernels to various extents . Giza 2 and DC 204 cultivars were internally invaded to great extent than the other two cultivars i.e. TWC 310 and DC 215

Fusarium moniliforme was the common invador for all examined kernels. It was recovered in highest percentages from tested kernels .

Penicillium sp. and Aspergillus spp. were the next fungi that recovered from kernels in different lower percentages .

The lowest percentages of the obtained fungi were recorded for Nigrospora oryzae, B. theobromae and Fusarium semitectum, respectively.

Table(3): Percentage presence of fungi found in maize kernel samples of Giza 2, DC 204. DC 215 and TWC 310 cultivars(After 7 days incubation at 25 - 27°C on PDA medium).

Fungi	Maize cultivars			
	Giza 2	DC 204	DC 215	TWC 310
Fusarium moniliforme	28	22	19	12
Penicillium sp.	13	9	8	7
Aspergillus niger	9	8	6	4
Aspergillus flavus	6	7	5	2
Nigrospora oryzae	2	2	1	0
Botryodiplodia theobromae	2	2	1	1
Fusarium semitectum	3	2	1	0

III- Field experiments:

1- Effect of infestation by maize stem borers on the development of maize ear rots :

Table 4 and figurs 1,2,3,4 and 5 show the effect of insecticides application against maize stem borers on kernels of the two cultivars TWC 310 and Giza 2 at three times after sowing i.e. 110, 120 and 130 days. The criteria of evaluation was expressed in terms of rot and germination % .

Data presented in table 4 showed significance between treatments with the exception of both treated and untreated plots of both cultivars TWC 310 and Giza 2 by the insecticides thiodan granules and lanite 90 % after 130 days of sowing in terms of seed germination during 1989 and 1990 seasons after harvest in the laboratory . On the other hand, the rot % showed significance between treated and untreated plots , of both cultivars at 110, 120 and 130 days after sowing during 1989 and 1990 seasons .

2- Effect of sowing and ripening dates on the development of ear and kernel rot :

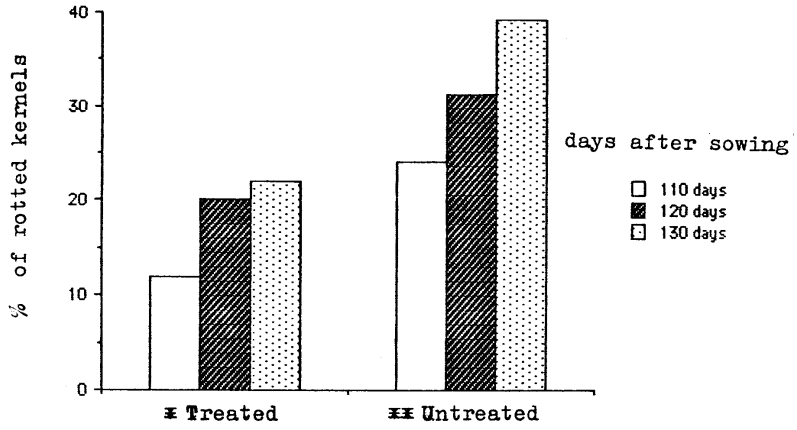
Tables 5 & 6 and figurs 6 , 7 , and 9 show the behaviour of five maize cultivars grown at the 1st of June and 20th of June. Samples of ears were harvested

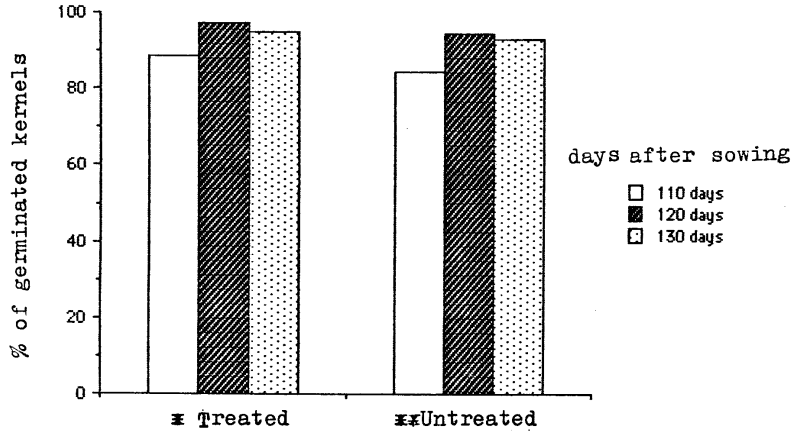
Table(4): Effect of application of insecticides against maize stem borers on seed rot % and germination % of the cultivars TWC 310 and Giza 2 at three times after sowing during 1989 and 1990 seasons .

	Season 1989												Season 1990											
Maize cultivars	TWC 310						Giza 2						TWC 310						Giza 2					
Day after sowing	110		120		130		110		120		130		110		120		130		110		120		130	
	R*	G**	R	G	R	G	R	G	R	G	R	G	R	G	R	G	R	G	R	G	R	G	R	G
Treated against stem borers	12.0	88.5	20.0	97.0	22.0	95.0	20.5	86.0	28.5	93.5	36.5	92.0	12.5	89.5	17.5	98.0	23.5	95.0	24.5	85.5	29.0	95.0	41.5	92.0
Untreated against stem borers	24.0	84.5	31.0	94.5	39.5	93.0	43.5	80.0	59.0	91.5	67.0	91.5	23.0	85.5	31.0	95.0	41.0	93.5	42.5	83.0	63.0	92.0	72.0	91.0
L. S. D. 5%	8.2	1.7	6.6	1.7	7.3	N.S***	8.2	1.7	6.6	1.7	3.7	N.S	5.4	3.0	5.0	2.4	7.4	N.S	5.4	N.S	5.0	2.4	7.4	N.S
L. S. D. 1%	12.4	2.5	10.0	2.5	11.1	N.S	12.4	2.5	10.0	2.5	11.1	N.S	8.1	4.5	7.5	3.7	11.3	N.S	8.1	N.S	7.5	3.7	11.3	N.S

* Rots(%)
** Germination (%)
*** Not-significant

Note: LSD values were calculated to differentiate between treated and untreated plots regardless of years , cultivars, and days after sowing .

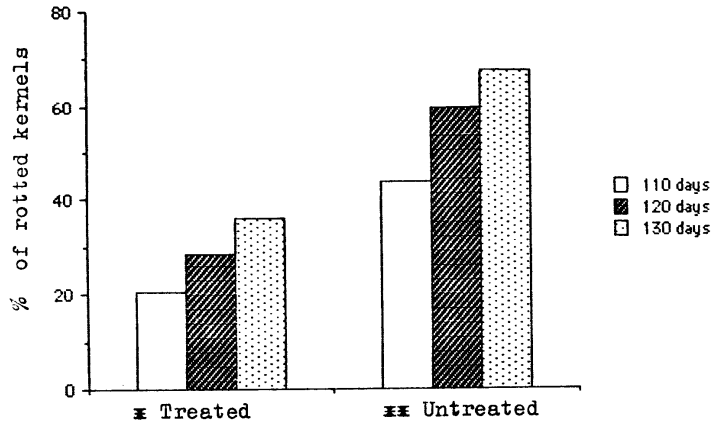


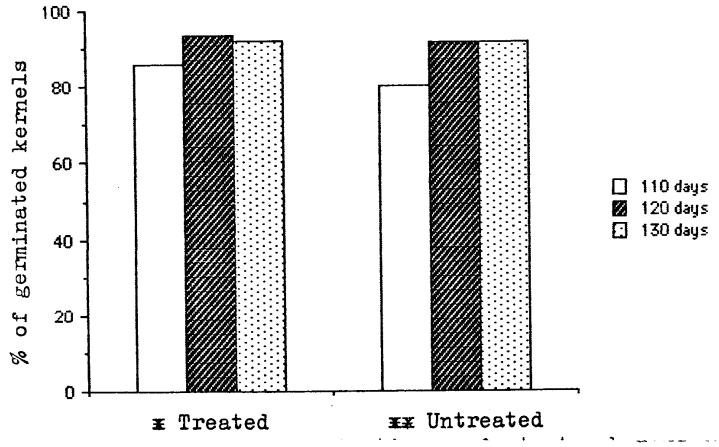


Figure(1) Effect of chemical application against stem borers on seed rot % and germination % of the cultivar TWC 310 at three times after sowing during 1989 season.

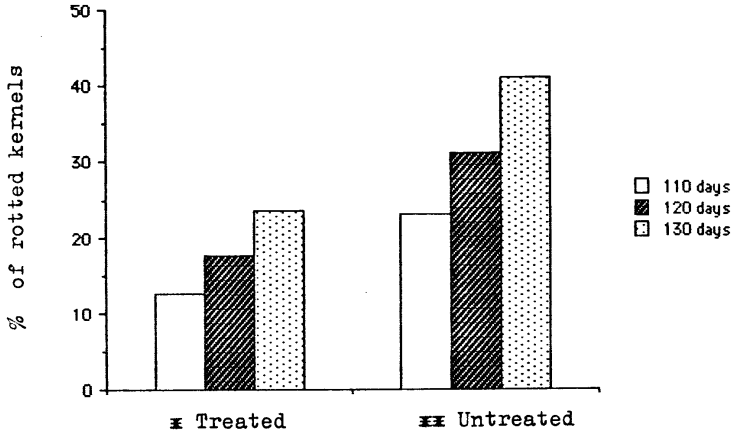
* Treated against stem borers .

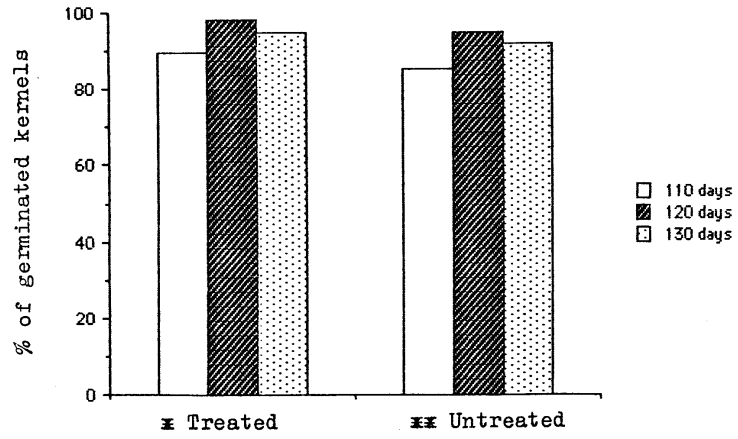
** Untreated against stem borers.



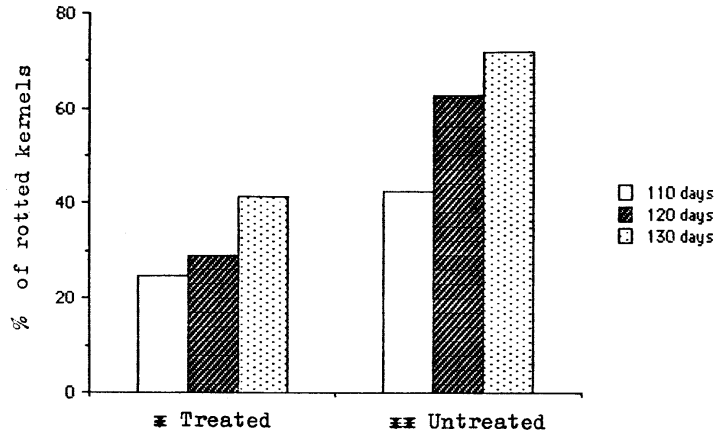


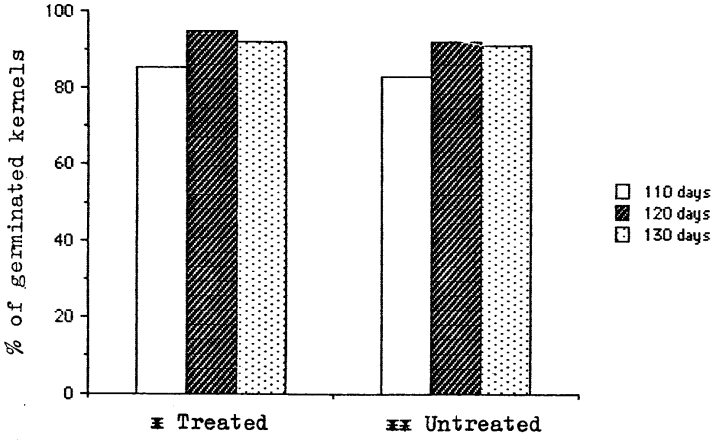
Figure(2) Effect of chemical application against stem borers on seed rot % and germination % of the cultivar Giza 2 at three times after sowing during 1989 season.





Figure(3) Effect of chemical application against stem borers on seed rot % and germination % of the cultivar TWC 310 at three times after sowing during 1990 season.





Figure(4) Effect of chemical application against stem borers on seed rot % and germination % of the cultivar Giza 2 at three times after sowing during 1990 season.

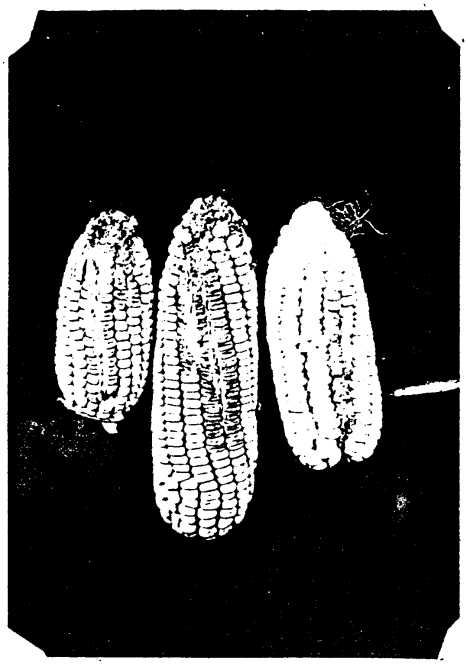


Figure (5): Predispositive effect of maize stem borers on maize kernel rot development caused by Fusarium moniliforme ont the cultivar Giza 2 .

after 110,120 and 130 days of sowing. These samples were used to determine ear rot % and seed germination % . In other term,each sowing date included 3 sampling dates .

At the 1st sowing date(1st of June),data presented sented in the tables 5,6 and the Figurs 6-9 indicate significant differences between DC 215, TWC 310 and Composite 5,Giza 2 in the severity of ear rot. While significance was observed between DC 204 , Composite 5 , Giza 2 and DC 215 , TWC 310 in seed germination % after 110 days of sowing .

After 120 days of sowing (2 nd sampling date) data also indicated that significance was observed between DC 215, TWC 310 and DC 204, Composite 5 . On the other hand,Giza 2 showed significance with the rest of the tested cultivars regarding rot severity(%). While significance was found between Composite 5, Giza 2, DC 204 and TWC 310, DC 215 as regard to seed germination % .

After 130 days of sowing (3rd sampling date) data also indicated that significance was observed between DC 204 and DC 215 . However, TWC 310 showed significance with the other cultivars regarding rot severity % . As for seed germination % the presented data indicated that there are significance between TWC 310 and DC 204, Composite 5 . While , no

significance was found between DC 215 and TWC 310,and between Composite 5 and Giza 2 cultivars .

At the second sowing date i.e. 20th of June,after 110 days of sowing i.e. 1st,sampling date the presented data in tables 5 & 6 showed that no significance was found between Composite 5 and Giza 2,while the rest of the tested cultivars showed significance regarding the severity of rot % . While significance was found between TWC 310 and DC 204, Composite 5 in respect of seed germination % .

After 120 days of sowing i.e. 2nd sampling date, presented data showed significance between the cultivars regarding rot severity % . On the other hand,no significance was observed between the cultivars regarding seed germination % .

After 130 days of sowing i.e. 3rd sampling date the data presented in tables 5 and 6 showed no significance between Composite 5 and Giza 2 cultivars . While, signfificance was found between them and each of DC 215 and TWC 310 regarding the rot severity % . However,significance was found between DC 204,Composite 5, Giza 2 and DC 215,TWC 310 cultivars as regarding seed germination % .

Table(5): The effect of sowing date and sampling date on the development of kernel rot severity % and seed germination % on five maize CVS during 1989 growing season.

sowing date	1 st of June						20 th of June					
Days after sowing	110		120		130		110		120		130	
Cultivars	R*	G**	R	G	R	G	R	G	R	G	R	G
DC 204	34.5b	81.5c	39.0b	93.0c	50.5a	93.0b	40.0b	78.0c	43.0c	91.5a	58.0a	83.0b
DC 215	26.0c	85.0ab	30.0c	96.5a	44.5b	94.5ab	30.0c	81.5ab	36.0d	93.5a	50.0b	89.0a
TWC 310	21.5c	88.0a	26.0c	98.0a	33.0c	97.0a	24.0b	82.5a	31.0e	94.0a	42.0c	90.0a
Composite 5	42.0a	82.5bc	43.0b	93.5bc	46.5ab	93.0b	49.5a	78.5bc	52.0b	94.5a	56.0a	84.0b
Giza 2	44.5a	81.5c	49.0a	96.0ab	48.5ab	93.5ab	53.5a	80.5abc	57.0a	92.5a	60.0a	83.0b

* Rots (%)

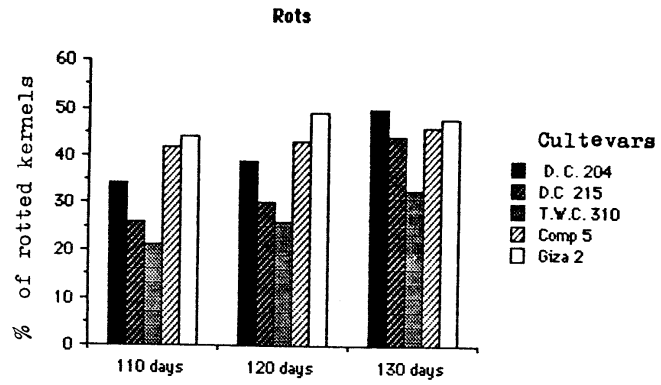
** Germination (%)

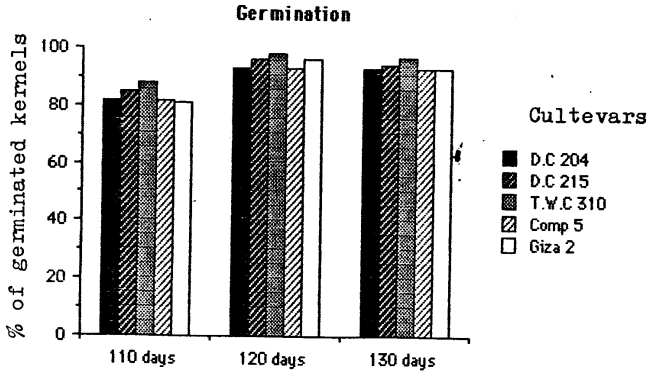
Table(6): The effect of sowing date and sampling date on the development of kernel rot severity % and seed germination % on five maize CVS during 1990 growing season.

sowing date	1 st of June						20 th of June					
Days after sowing	110		120		130		110		120		130	
Cultivars	R*	G**	R	G	R	G	R	G	R	G	R	G
DC 204	34.5c	80.0b	35.5c	95.0c	52.0b	91.5b	44.0b	78.0c	46.0c	92.5b	58.0b	82.0b
DC 215	26.0d	85.5a	29.0d	97.0ab	41.5c	95.0a	33.0c	81.5ab	38.5d	94.0b	51.0c	86.0a
TWC 310	20.5e	88.0a	27.5b	98.0a	34.5b	95.0a	28.5b	84.0a	33.5e	96.5a	37.5d	88.0a
Composite 5	40.5b	81.5b	46.b	96.0bc	53.5ab	91.5b	46.5ab	81.5b	51.5b	93.5b	64.0a	82.5b
Giza 2	45.5a	82.5b	51.0a	95.0bc	57.5a	92.0b	50.5a	79.0bc	60.5a	93.0b	67.5a	83.5b

* Rots (%)

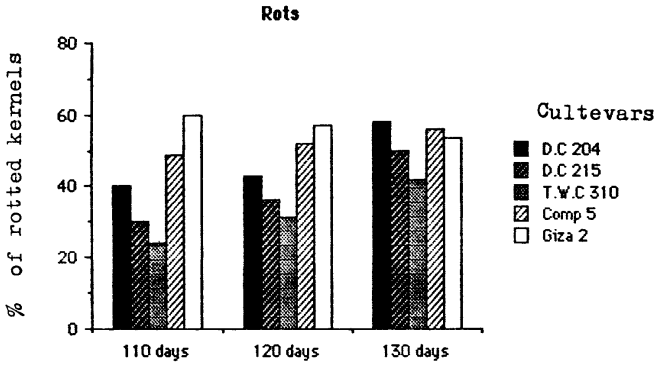
** Germination (%)

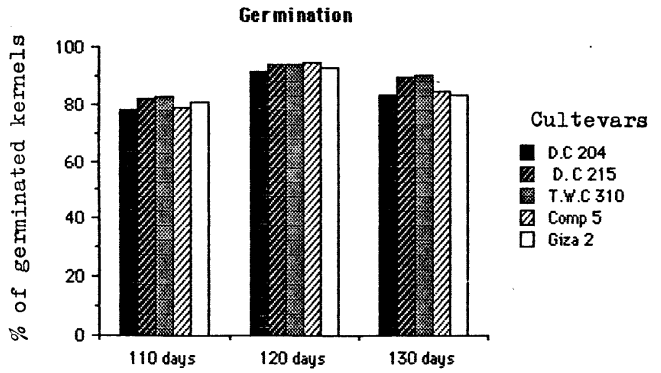




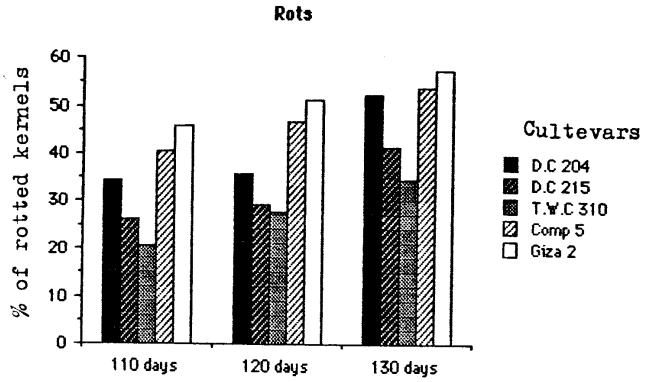
Figure(6): Pathogenic and germinative behaviour of five maize cultivars grown at the first sowing date(1st of June) with different harvesting dates during 1989 season .

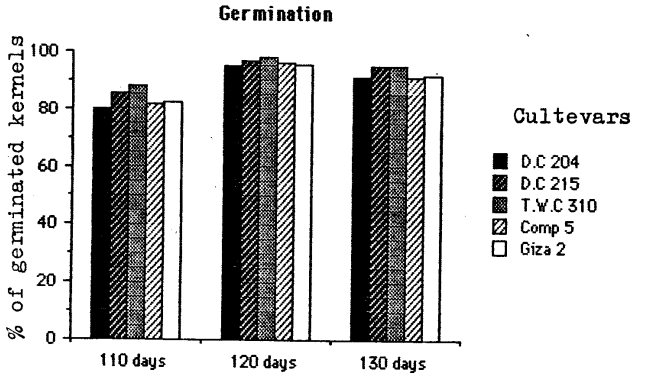
110 days = Ears were harvested after 110 days of sowing .
120 days = Ears were harvested after 120 days of sowing .
130 days = Ears were harvested after 130 days of sowing .



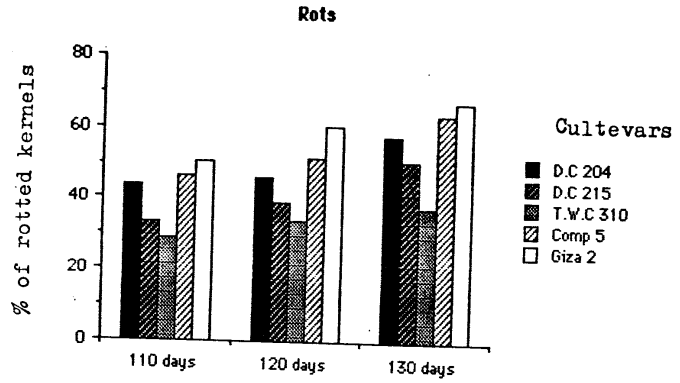


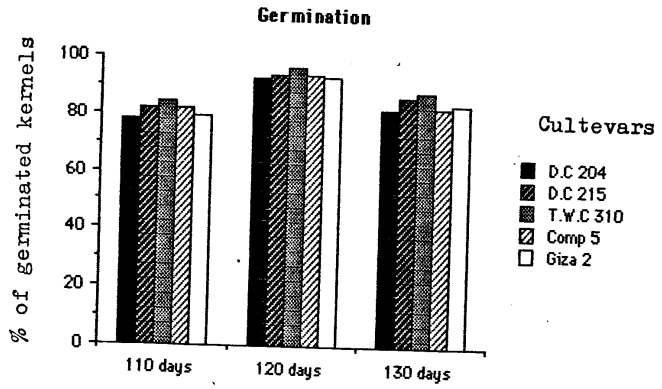
Figure(7): Pathogenic and germinative behaviour of five maize cultivars grown at the second sowing date (20th of June) with different harvesting dates during 1989 season.





Figure(8): Pathogenic and germinative behaviour of five maize cultivars grown at the first sowing date(1st of June) with different harvesting dates during 1990 season .





Figure(9): Pathogenic and germinative behaviour ot five maize cultivars grown at the second sowing date(20th of June) with different harvesting dates during 1990 season .

3- Ear infection :

Data presented in tables 7 and 8 and figures 10 to 20 indicated that Fusarium moniliforme induced the highest degrees of infection with ear rot , followed by B. theobromae , Aspergillus niger, Aspergillus flavus and Penicillium sp.

The inoculation by Fusarium moniliforme in the cultivars TWC 310 and Giza 2 indicated that significant differences were observed between the different inoculation techniques at the three intervals with the exception of both ear tip and husks inoculation techniques on cultivar TWC 310 after 10 days of fertilization in table 7 ,and after 20 and 30 days of fertilization in table 8 .

Regarding the inoculation by Penicillium sp. in the two tested cultivars, the data showed that no significance was observed between silk inoculation technique and control after 20 and 30 days of fertilization,and between silk and ear tip inoculation techniques on the cultivar Giza 2, after 10 days of fertilization,however, the rest of inoculation techniques at different times showed significance , as indicated in tables 7 and 8 and figures 11 and 16 .

As for the inoculation with Aspergillus niger in the two tested cultivars, the data showed that no

significance was observed between silk and ear tip inoculation techniques after 10 days of fertilization , tables 7 and 8 , and between silk inoculation technique and control after 30 days of fertilization , as indicated in table 8 . While, the rest of associations in tables 7 and 8 showed significant differences between the two cultivars at the different intervals.

Concerning the inoculation by Aspergillus flavus in the two cultivars, data presented in tables 7 and 8 indicated that significance was observed between the different inoculation techniques at different times with the exception of silk inoculation technique and control at 30 days after fertilization in both of the tested cultivars .

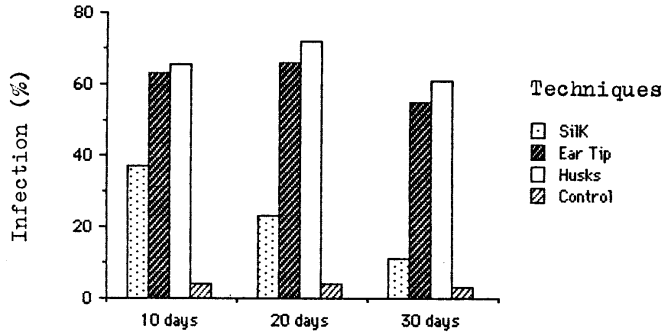
Regarding the inoculation by B. theobromae , the presented data in table 7 showed that no significance was observed between ear tip and husks inoculation techniques at different times after fertilization in cultivar TWC 310; while cultivar Giza 2, data in table 7 indicate no significance between ear tip and husks inoculation techniqus after 30 days of fertilization. Also, presented data in table 8 indicate no significance between silk and ear tip inoculation techniques after 10 days of fertilization in cultivar TWC 310. The rest of combinations in tables 7 and 8 showed significance.

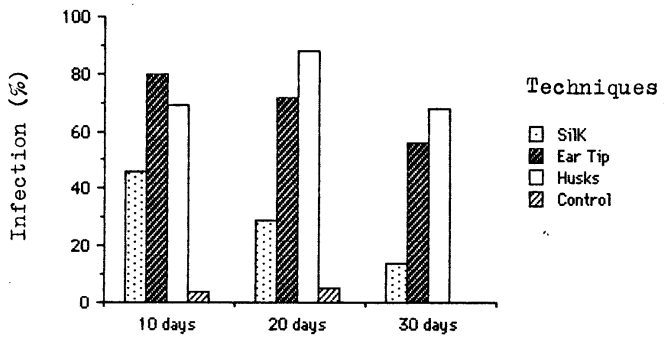
Table(7): The reaction of kernel and ear rot pathogens on two maize cultivars i.e. TWC 310 and Giza 2 using three inoculation techniques at three times after flowering during 1989 season.

Days after fertilization	Methods of inoculation	Fungi inducing kernel and ear rots in maize									
		F.moniliforme		Pemicillium sp.		A. niger		A. flavus		B.theobromae	
		TWC310	Giza 2	TWC310	Giza 2	TWC310	Giza 2	TWC310	Giza 2	TWC310	Giza2
10 days	Silk inoculation	37.00b	46.00c	05.00c	10.00b	10.00b	16.00b	12.00b	17.00b	34.00b	38.00c
	Ear tip inoculation	63.00a	80.00a	12.00b	14.00b	12.00b	12.00b	6.00c	12.00c	38.00ab	54.00b
	Husks inoculation	65.50a	69.00b	18.00a	20.00a	25.00a	33.00a	24.00a	23.00a	43.00a	60.00a
	Control	04.00c	04.00d	00.01d	00.01c	00.01c	00.01c	00.01d	00.01d	00.01c	00.01d
20 days	Silk inoculation	23.00c	29.00c	02.00c	02.00c	03.00c	08.00c	09.00c	13.00c	20.00b	24.00c
	Ear tip inoculation	66.00b	72.00b	51.00b	51.00b	49.00b	41.00b	32.00b	44.00b	34.00a	54.00a
	Husks inoculation	72.00a	88.00a	61.00a	61.00a	63.00a	54.00a	48.00a	70.00a	32.00a	49.00b
	Control	04.00d	05.00d	00.01c	00.01c	03.00d	00.01d	00.01d	03.00d	00.01c	05.00d
30 days	Silk inoculation	11.00c	14.00c	00.01c	00.01c	00.01d	01.00d	02.00c	04.00c	10.00c	13.00b
	Ear tip inoculation	55.00b	56.00b	46.00b	60.00b	52.00b	71.00b	45.00b	61.00b	30.00a	30.00a
	Husks inoculation	61.00a	68.00a	50.00a	72.50a	65.00a	83.00a	53.00a	79.00a	18.00b	30.00a
	Control	03.00d	00.00d	02.00c	01.00c	04.00c	08.00c	03.00c	05.00c	00.01d	01.00c

Table(8) The reaction of kernel and ear rot pathogens on two maize cultivars i.e. TWC 310 and Giza 2 using three inoculation techniques at three thimes after flowering during 1990 season .

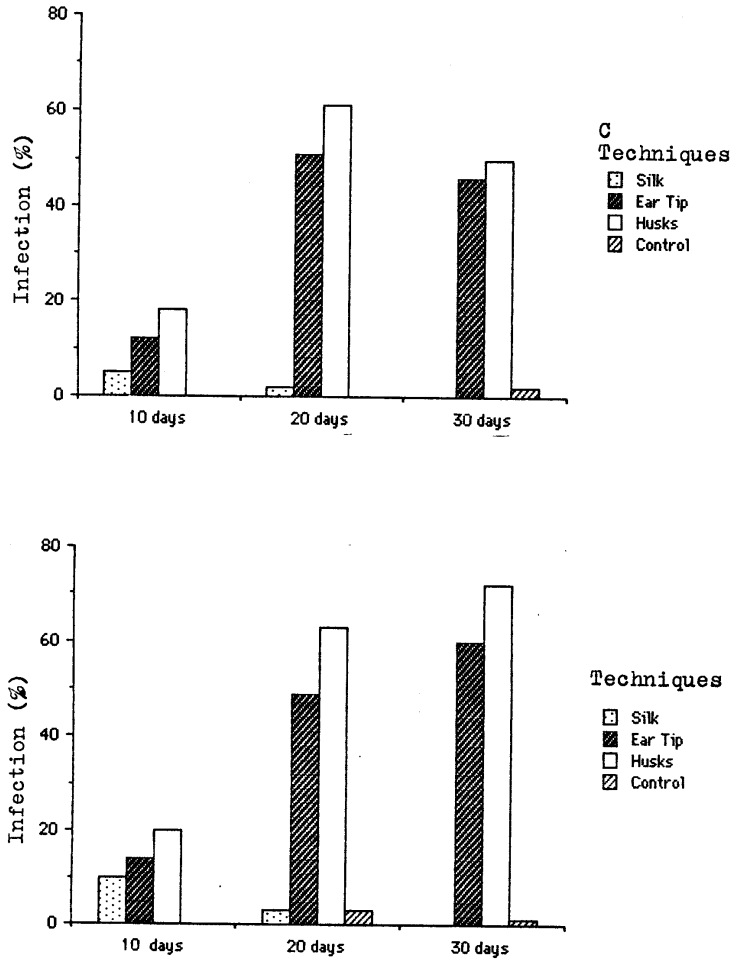
Days after fertilisation	Methods of inoculation	Fungi inducing kernel and ear rots in maize									
		F.moniliforme		Pemicillium sp.		A. niger		A. flavus		B.theobromae	
		TWC310	Giza 2	TWC310	Giza 2	TWC310	Giza 2	TWC310	Giza 2	TWC310	Giza 2
10 days	Silk inoculation	35.00c	45.00c	01.00b	08.00b	12.00b	17.00b	13.00b	18.00b	32.00b	46.00b
	Ear tip inoculation	59.00b	80.00a	15.00a	10.00b	10.00b	14.00b	08.00b	12.00c	36.00b	39.00c
	Husks inoculation	70.00a	67.00b	20.00a	22.00a	32.00a	30.00a	22.00a	25.00a	45.00a	64.00a
	Control	05.00d	06.00d	00.01b	00.01c	01.00c	00.01c	00.01c	00.01d	00.01c	00.01d
20 days	Silk inoculation	18.00b	26.00c	02.00c	04.00c	10.00c	12.00c	06.00c	13.00c	18.00c	29.00c
	Ear tip inoculation	72.00a	70.00b	45.00b	50.00b	40.00b	40.00b	34.00b	46.00b	35.00b	57.00a
	Husks inoculation	73.00a	90.00a	50.00a	61.00a	51.00a	65.00a	48.00a	69.00a	38.00a	51.00b
	Control	01.00c	03.00d	00.01c	02.00c	01.00d	03.00d	00.01d	02.00d	00.01d	00.01d
30 days	Silk inoculation	12.00b	15.00c	04.00c	00.01c	02.00c	01.00c	01.00c	03.00c	10.00c	18.00c
	Ear tip inoculation	56.00a	54.00b	40.00b	62.00b	48.00b	67.00b	50.00b	61.00b	29.00a	32.00a
	Husks inoculation	56.00a	65.00a	61.00a	71.00a	61.00a	82.00a	60.00a	80.00a	23.00b	23.00b
	Control	01.00c	05.00d	02.00c	00.01c	03.00c	03.00c	01.00c	04.00c	04.00d	02.00d





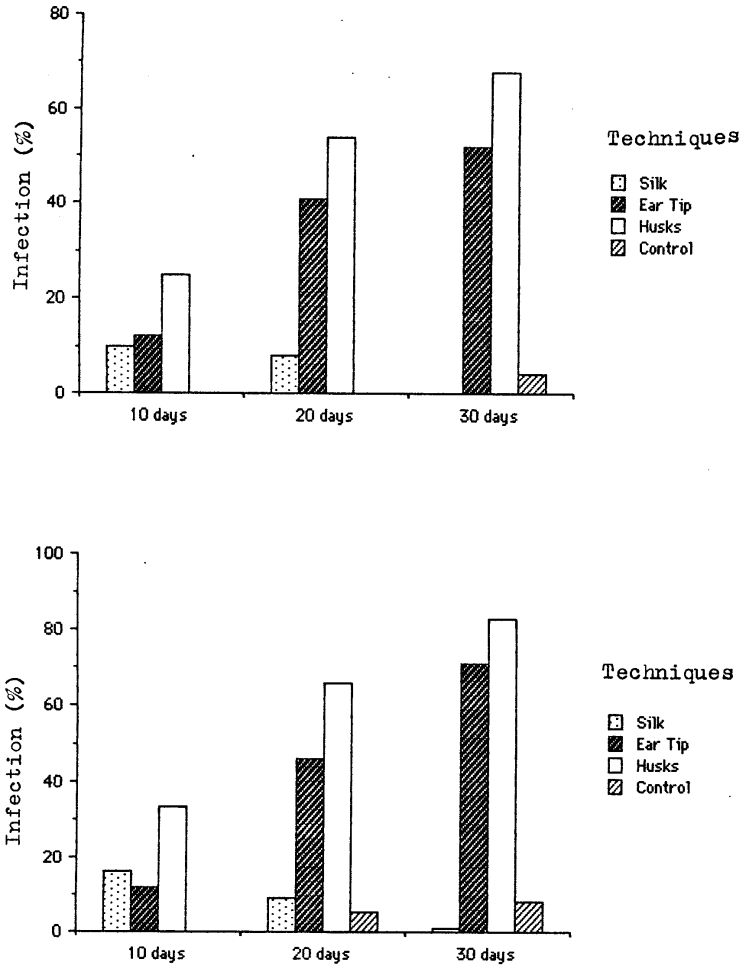
Figure(10): Inoculation by Fusarium moniliforme at different times after fertilization during 1989 season.

Up : In TWC 310 cultivar .
Down: In Giza ∠ cultivar .



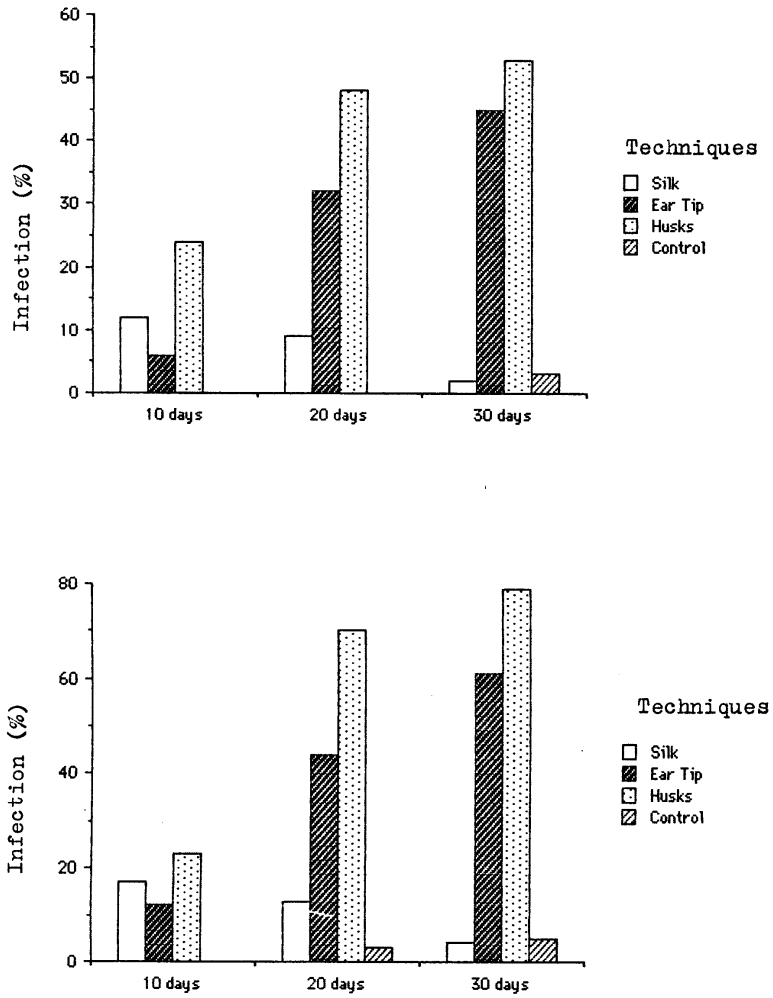
Figure(11): Inoculation by Penicillium sp. at different times after fertilization during 1989 season.

Up : I n TWC 310 cultivar .
Down : I n Giza 2 cultivar .



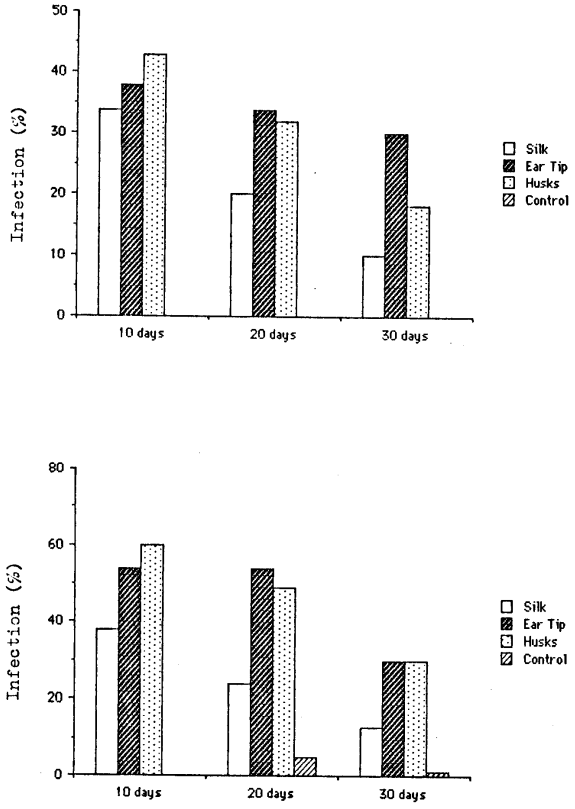
Figure(12): Inoculation by Aspergillus niger at different times after fertilization during 1989 season.

Up : In TWC 310 cultivar .
Down: In Giza 2 cultivar .



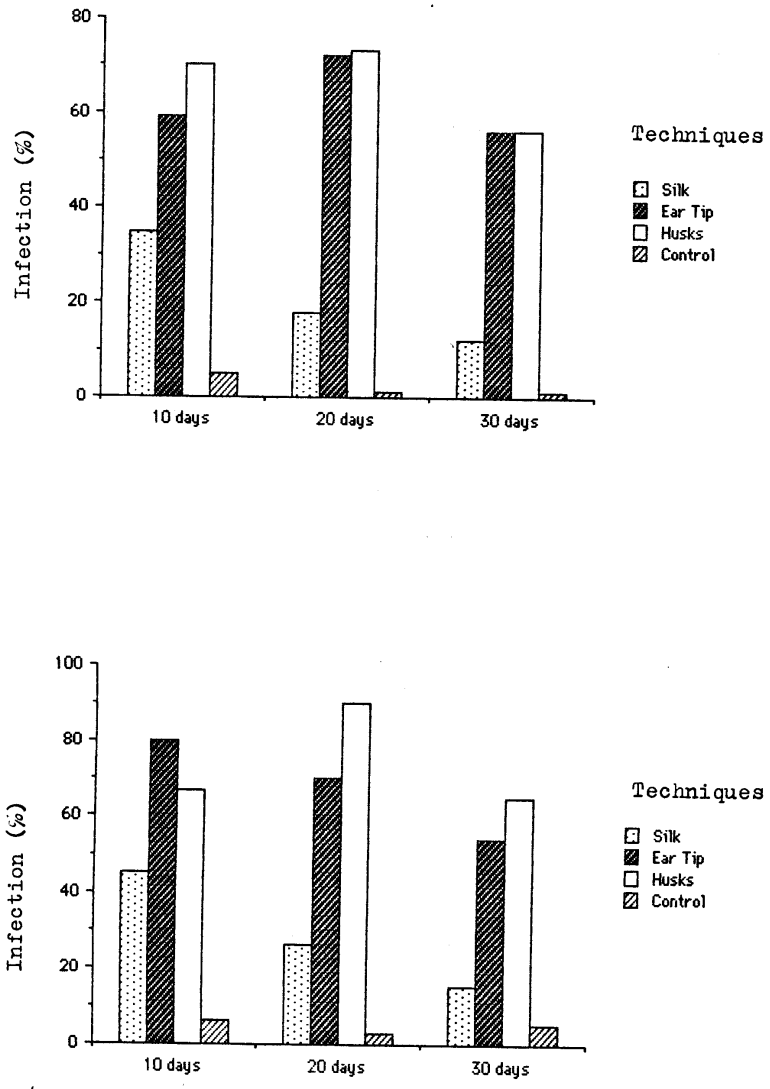
Figure(13): Inoculation by Aspergillus flavus at different times after fertilization during 1989 season .

Up : In TWC 310 cultivar .
Down : In Giza 2 cultivar .



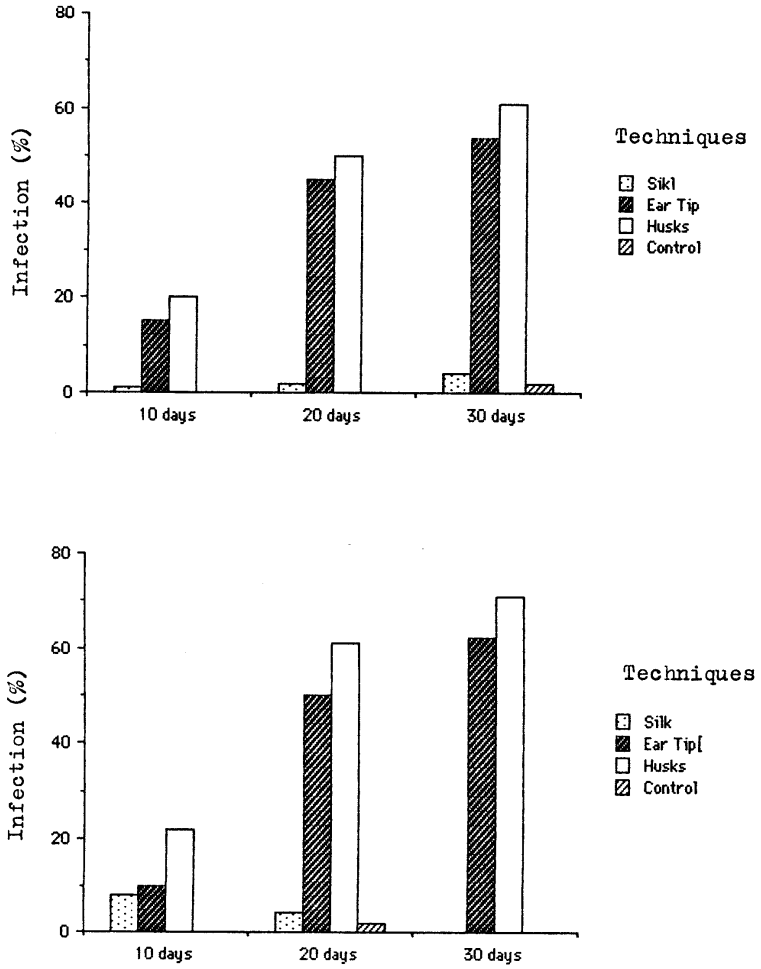
Figure(14): Inoculation by B.theobromae at different days after fertilization during 1989 season.

Up : In TWC 310 cultivar .
Down : In Giza 2 cultivar .



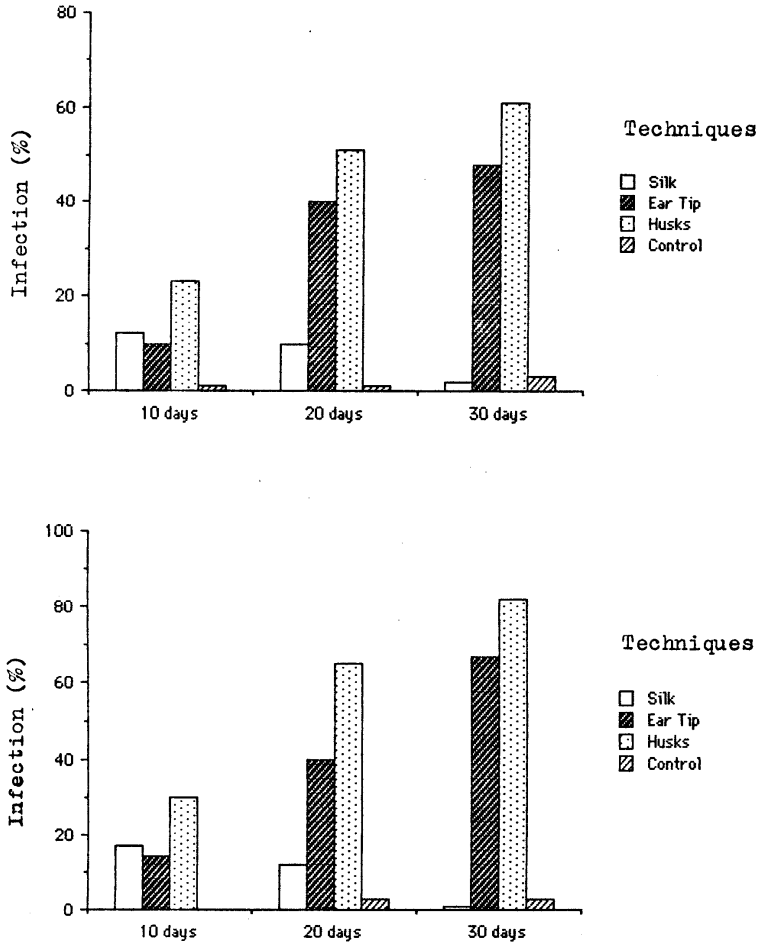
Figure(15): Inoculation by Fusarium moniliforme at different times after fertilization during 1990 season .

Up : In TWC 310 cultivar .
Down : In Giza 2 cultivar .



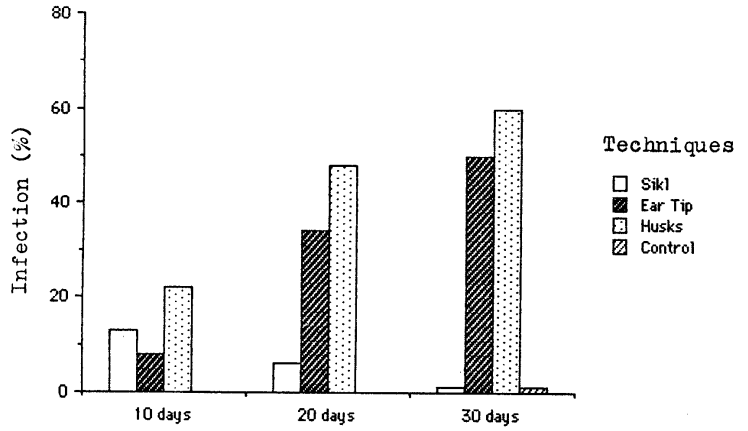
Figure(16): Inoculation by Pencillium sp. at different times after fertilization during 1990 season.

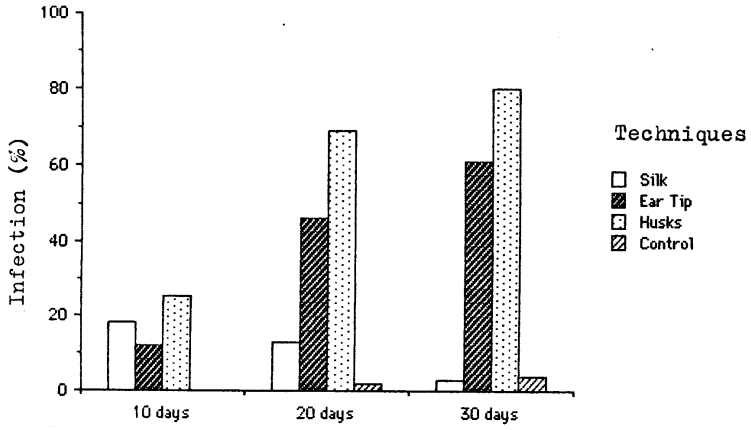
Up : In TWC 310 cultivar .
Down : In Giza 2 cultivar .



Figure(17): Inoculation by Aspergillus niger at different times after fertilization during 1990 season .

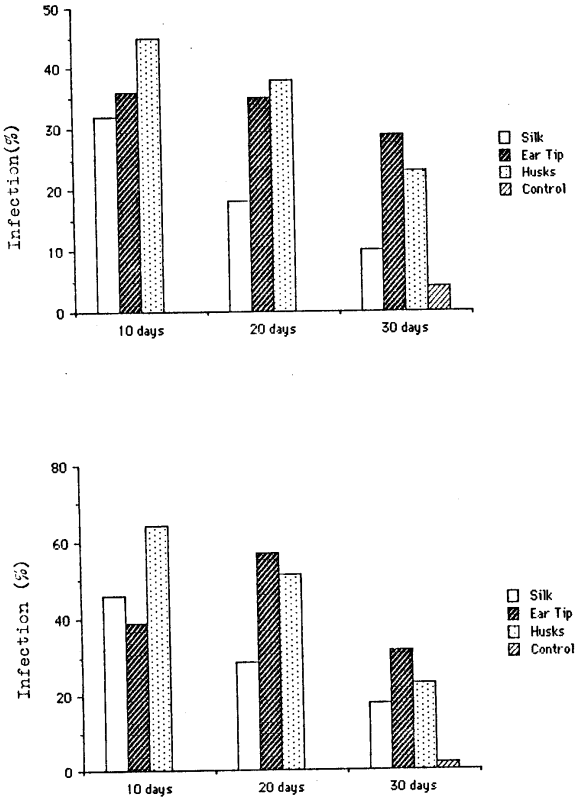
Up : In TWC 310 cultivar .
Down : In Giza 2 cultivar .





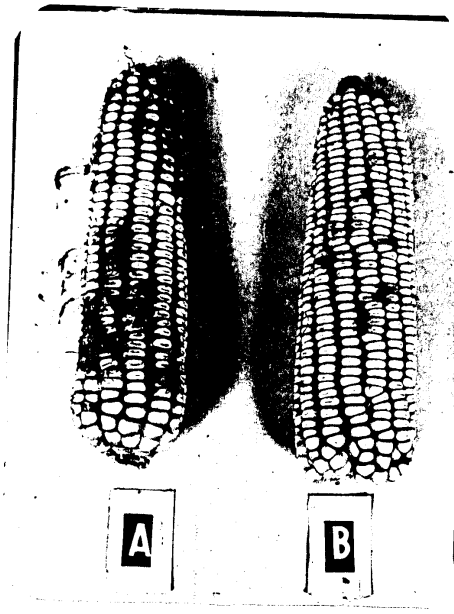
Figure(18): Inoculation by Aspergillus flavus at different times after fertilization during 1990 season .

Up : In TWC 310 cultivar .
Down : In Giza 2 cultivar .

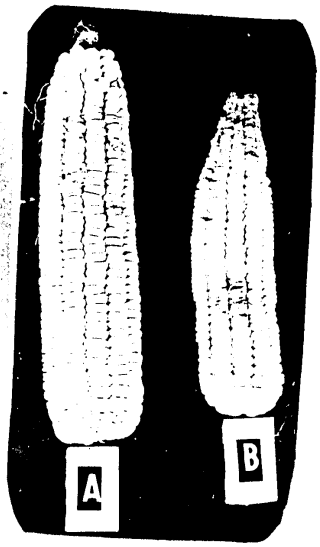


Figure(19): Inoculation by B.theobromae at different days after fertilization during 1990 season.

Up : In TWC 310 cultivar .
Down : In Giza 2 cultivar .



(1)



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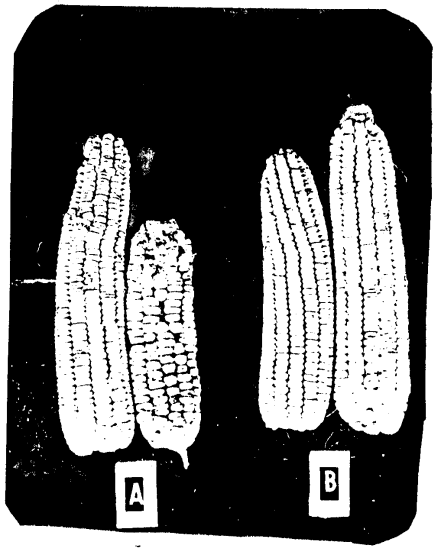


(3)

Figure(20):
(1): Husks injection by A.niger after 30 days of fertilization
(2): Husks injection by A.flavus after 30 days of fertilization .
(3): Husks injection by F.moniliform after 10 days of fertilization :
A: Giza 2 cultivar
B:TWC 310 cultivar

4- Chemical control of ear rot :

Tables 9 and 10 show the effect of benlate 50 % and dithane M_{45} sprayed at different times after flowering of cultivar Giza 2 i.e. 2 and 15 ; 2 , 15 and 25 , and 2 , 15 , 25 and 35 days after flowering.

Data showed significance between times of number of applications, tested fungicides and isolated fungi , also indicated that the highest rate of kernel infection was recorded with Fusarium moniliforme at the 1st , 2nd and 3rd treatments, in case of Dithan-M_{45} application . On the other hand , the least % of mycoflora was recorded with Benlate 50 % against Aspergillus niger at the 3rd spraying treatment . The rest of the fungi in the tables were reduced by various rates between the two ridges according to the tested fungicide and time of applications .

IV- Soil infestation :

Data presented in table 11 and illustrated in figures 21 to 25 indicated that cultivars TWC 310 and Giza 2 showed various response to the tested fungi and their effect on seed germination, percentage and the length, fresh and dry weight of shoot system .

Table(9): Effect of spraying field-grown maize plants cultivar Giza 2 by Benlate 50 % and Dithan M_{45} on rot pathogens and their frequency assaciated with post harvest seeds during 1989 season.

Fungi	Non-sprayed plants mycoflora (%)	Fungicides	Times of applications by fungicides: 2 and 15 days after flowering — kernel mycoflora(%)	2,15 and 25 days after flowering — kernel mycoflora(%)	2,15,25 and 35 days after flowering — kernel mycoflora(%)
Fusarium moniliforme	41.500	Benlate 50 %	35.250	32.000	29.250
		Dithan M_{45}	38.500	35.750	33.250
Penicillium sp.	20.000	Benlate 50 %	17.750	10.000	04.000
		Dithan M_{45}	18.500	12.750	05.500
Aspergillus niger	14.500	Benlate 50 %	12.250	07.000	02.250
		Dithan M_{45}	13.750	09.500	03.500
Aspergillus flavus	13.500	Benlate 50 %	09.500	06.750	02.500
		Dithan M_{45}	12.250	07.500	04.500
Other fungi	14.000	Benlate 50 %	09.250	06.500	03.750
		Dithan M_{45}	13.000	09.250	07.250

		A	B	C	AB	AC	BC	ABC
LSD	5 %	2.619	0.488	0.951	0.845	1.813	1.299	2.411
	1 %	3.966	0.701	1.261	1.215	2.508	1.741	3.290

A = Spraying treatment
B = Fungicides
C = Isolated fungi

Table(10): Effect of spraying field-grown maize plants cultivar Giza 2 by Benlat 50 % and Dithan M_{45} on rot pathogens and their frequency assaciated with post harvest seeds during 1990 season.

Fungi	Non-sprayed plants mycoflora (%)	Fungicides	Times of applications by fungicides: 2 and 15 days after flowering — kernel mycoflora(%)	2,15 and 25 days after flowering — kernel mycoflora(%)	2,15,25 and 35 days after flowering — kernel mycoflora(%)
Fusarium moniliforme	42.000	Benlate 50 %	34.500	30.750	28.250
		Dithan M_{45}	40.250	34.750	34.500
Penicillium sp.	22.500	Benlate 50 %	17.750	09.250	05.250
		Dithan M_{45}	21.750	12.750	07.250
Aspergillus niger	16.000	Benlate 50 %	11.000	06.750	03.000
		Dithan M_{45}	14.250	09.500	05.250
Aspergillus flavus	13.500	Benlate 50 %	09.750	06.250	03.250
		Dithan M_{45}	13.000	08.000	05.000
Other fungi	14.500	Benlate 50 %	10.000	06.750	05.000
		Dithan M_{45}	12.250	09.250	09.000

		A	B	C	AB	AC	BC	ABC
LSD	5 %	0.487	0.541	0.985	0.937	1.652	1.359	2.311
	1 %	0.738	0.778	1.307	1.348	2.149	1.825	3.101

A = Spraying treatment
B = Fungicides
C = Isolated fungi

As for germination % significance was observed between Aspergillus flavus and Fusarium moniliforme , control and the other tested fungi on TWC 310 and Giza 2 cultivars .

Regarding the effect on shoot and root length the data indicated that significance was observed between Aspergillus flavus and Aspergillus niger and the rest of the tested fungi on TWC 310 cultivar. While, significance was observed between Aspergillus flavus, Aspergillus niger and the other tested fungi on Giza 2 cultivar .

Regarding the shoot and root fresh weight, the data showed significance between Aspergillus flavus , Aspergillus niger and Fusarium moniliforme and the other tested fungi in TWC 310 cultivar. While, significance was observed between Aspergillus flavus, Aspergillus niger , Fusarium moniliforme and Penicillium sp. and the other tested fungi in Giza 2 cultivar.

As for shoot dry weight of TWC 310 and Giza 2 cultivars , data indicated that significance was observed between . Aspergillus flavus, Aspergillus niger and Fusarium moniliforme and the othre tested fungi .

As regard to root dry weight of TWC 310 and Giza 2 cultivars , the presented data showed that significance was observed between Aspergillus flavus , Fusarium moniliforme , Penicillium sp. , the other tested fungi and control treatment .

IIV- Laboratory experiments :

1- Effect of seed disinfectant on Fusarium moniliforme rot incidence and seed germination .

Data presented in table 12 and figurs 26 and 27 indicated that TWC 310 and Giza 2 maize cultivars showed various responses with the different treatments regarding their effect on seed germination % , seed and seedling infection percentage by Fusarium moniliforme.

As for germination % the data indicated sifnificant differences between treatments on the two tested cultivars .

Regarding the effect on seed infection % the data indicated that there are significant differences between treatments on the two tested cultivars.

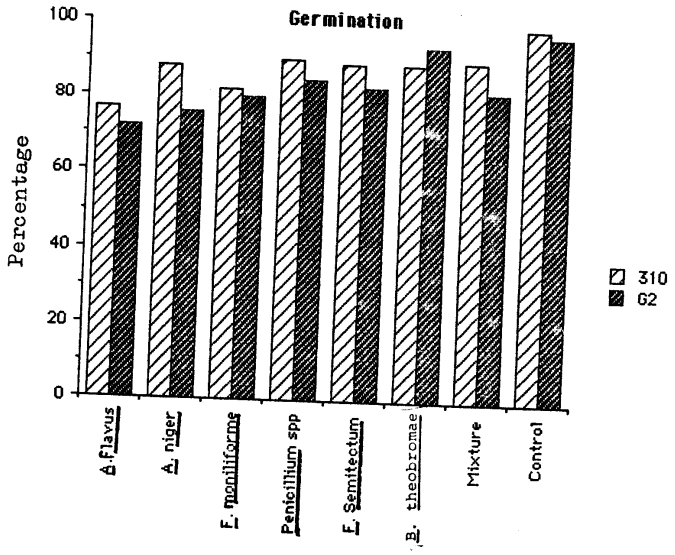
Regarding the effect on seedling infection % the data showed that significant differences was observed between treatments number 1 and No.6 and the other tested treatments,on the two tested cultivars.

Table(11): Effect of ear and kernel rot causal agents on seed germination, shoot and root length, and fresh dry weight of TWC 310 and Giza 2 seedlings.

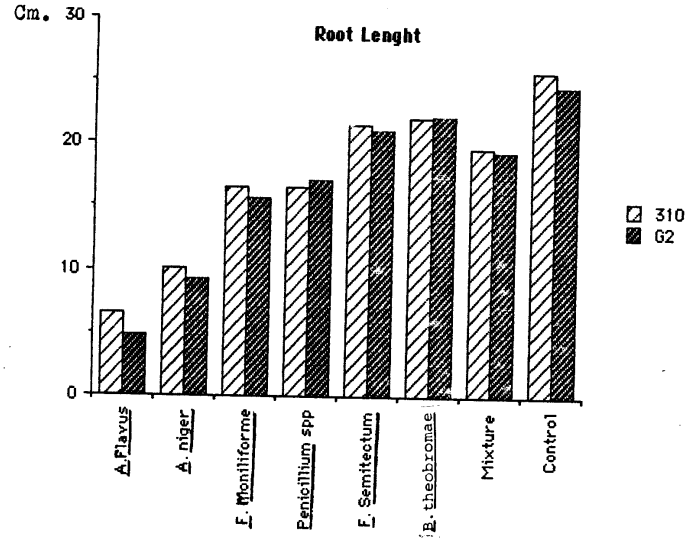
Fungi	TWC 310							Giza 2						
		Shoot			Root				Shoot			Root		
	Germination %	L.* Cm.	F.W.** mg.	D.W.** mg.	L. Cm.	F.W. mg.	D.W. mg.	Germination %	L. Cm.	F.W. mg.	D.W. mg.	L. Cm.	F.W. mg.	D.W. mg.
A. Flavus	77.0c	25.0d	2.25g	0.5c	8.5e	1.23e	0.2e	72.5c	20.2f	2.08e	0.4d	4.8h	1.08e	0.2d
A. niger	88.0b	25.6d	2.60f	0.5c	10.1e	1.55d	0.3d	7o.0bc	22.0e	2.50d	0.4d	9.3g	1.40d	0.3c
F. moniliforme	82.0bc	28.9c	2.65ef	0.5c	16.5d	1.63d	0.4c	80.0bc	29.0c	2.53cd	0.4d	15.7f	1.55c	0.3c
Penicillium sp.	90.0b	31.9b	2.80be	0.6b	16.5d	1.80bc	0.4c	85.0b	31.5b	2.68c	0.5c	17.0e	1.57c	0.3c
F. semitectum	89.0b	31.7b	3.10c	0.6b	21.5b	1.88b	0.5b	83.0b	30.0c	3.05b	0.6b	21.0c	1.70b	0.4b
B. theobromae	90.0b	35.2a	3.80b	0.6b	22.0b	2.00a	0.5b	94.0a	31.3c	3.63a	0.7a	22.0b	1.85a	0.4b
Mixture	90.0b	29.0c	2.95cd	0.6b	19.6c	1.77c	0.5b	82.0b	25.2d	3.00b	0.6b	19.4d	1.63bc	0.4b
Control	99.0a	36.0a	4.05a	0.7a	25.7a	2.05a	0.6a	97.0a	34.1a	3.78a	0.7a	24.6a	1.88a	0.5a

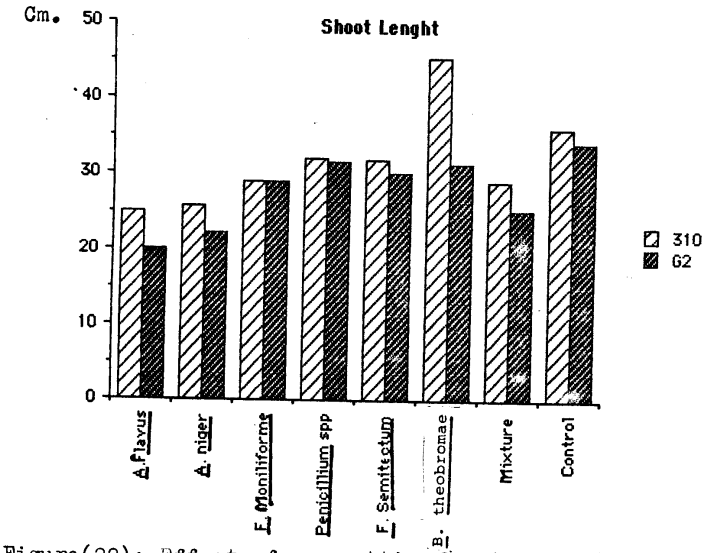
* Length of root or shoot of seedling .

** Average of fresh and dry weight per seedling .

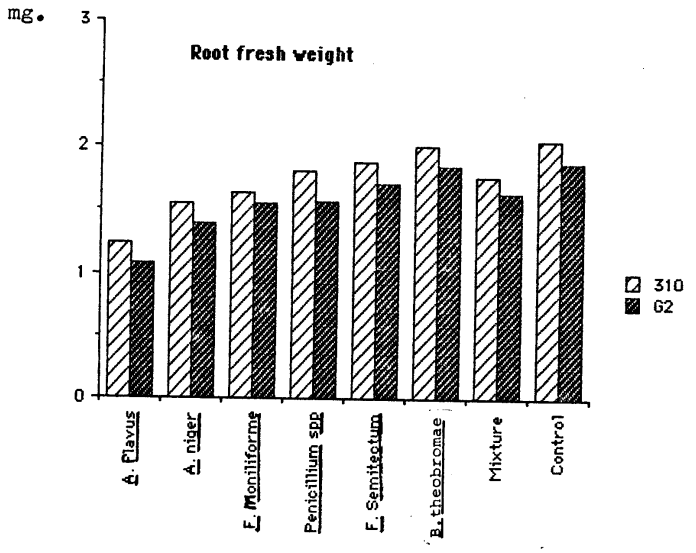


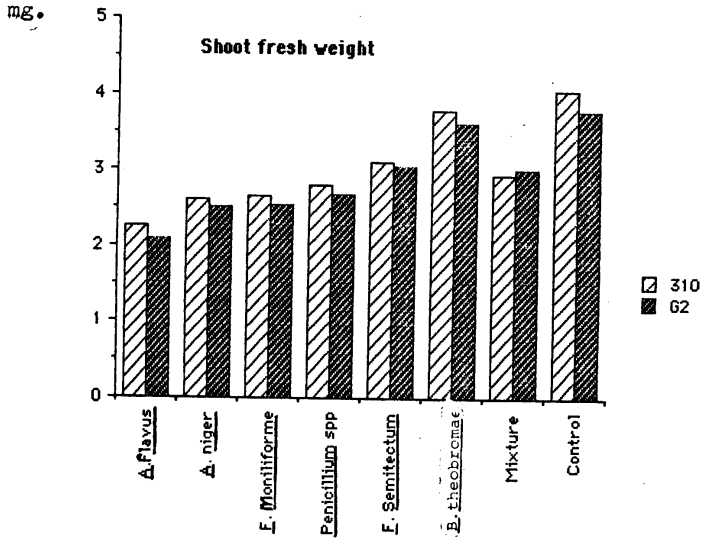
Figure(21): Effect of rotting fungi on seed germination (%) of TWC 310 and Giza 2 maize cultivars .



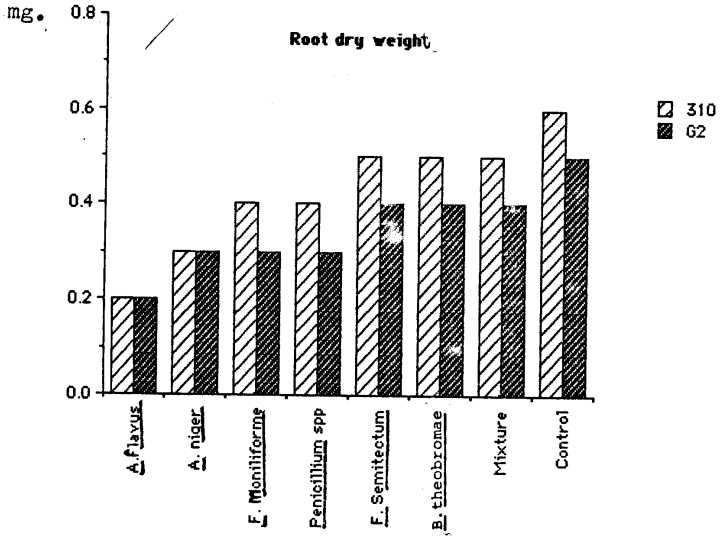


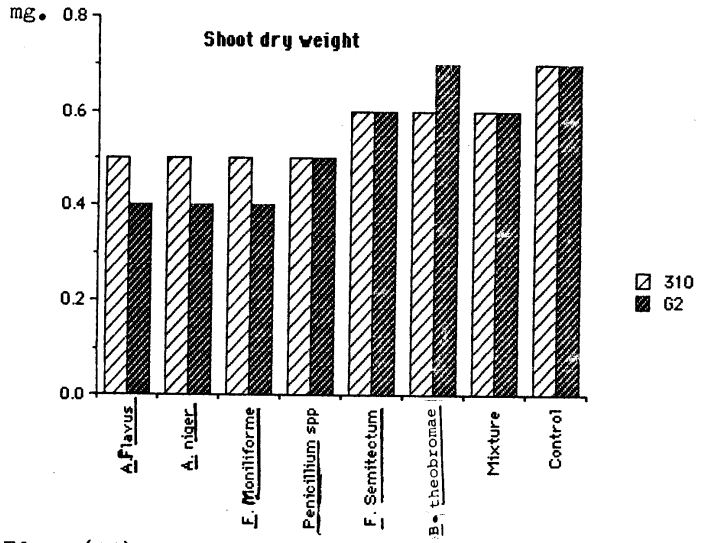
Figure(22): Effect of rotting fungi on root and shoot length of TWC 310 and Giza 2 maize cultivars.



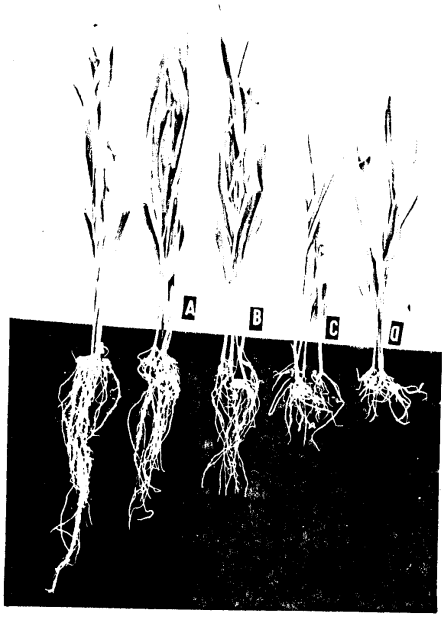


Figure(23): Effect of rooting fungi on root and shoot fresh weight of TWC 310 and Giza 2 maize cultivars.





Figure(24): Effect of **rotting** fungi on root and shoot dry weight of TWC 310 and Giza 2 maize cultivars .



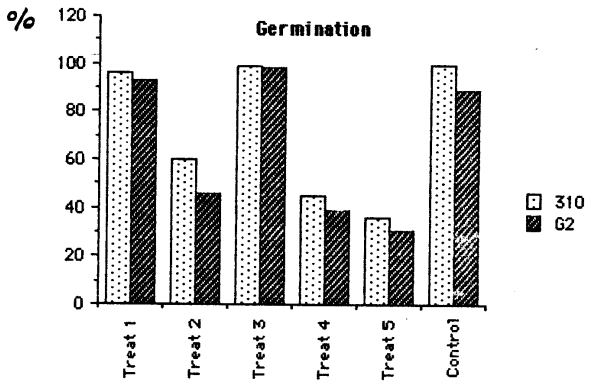
- Control (mon-infested soil).
A Soil infested by mixture of tested fungi .
B Soil infested by Fusarium moniliforme .
C Soil infested by Aspergillus niger .
D Soil infested by Aspergillus flavus.

Figure(25): Effect of infested Soil by tested fungi on maize plants cultivar TWC 310, 30 days old showing length of roots and shoots with compared to healthy ones growing in non-infested soil.

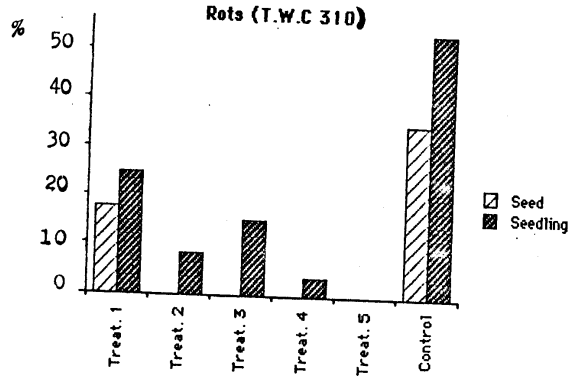
Table(12): Influence of corn seed disinfestation treatments on seed germination and the recovery of Fusarium moniliforme from seed and seedlings soon after harvest.

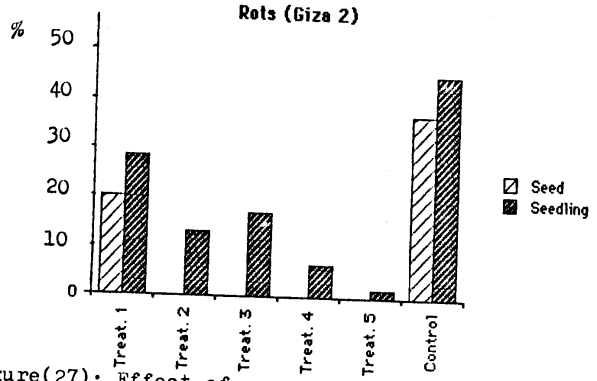
No.	Treatments	TWC 310			Giza 2		
		Germination %	Infection(%)		Germination %	Infection (%)	
			Seed	Seedling		Seed	Seedling
1	0.525 % Na O Cl (10 min soak)	96 a	18 b	25 b	93 a	20 b	28 b
2	Water 20°C (24 hr.),water 55°C (10 min soak)	60 b	00 c	09 cd	46 b	00 c	13 cd
3	Benomyl at 2 ppm in H_2O (24 hr. soak).	99 a	00 c	15 c	98 a	00 c	17 c
4	Benomyl at 6.250 ppm in acetone (24 hr. soak)	45 c	00 c	04 d	39 bc	00 c	07 de
5	Benomyl at 25 ppm in acetone(24 hr. soak)	36 c	00 c	00 d	31 c	00 c	02 e
6	Untreated (control)	100 a	35 a	54 a	98 a	36 a	45 a

Figure(26): Effect of corn seed disinfestation treatments on seed germination percentage for TWC 310 and Giza 2 maize cultivars .



Treat 1 0.525 % Na O Cl (10 min soak)
Treat 2 Water 20°C (24 hr,), water 55°C(10 min.soak)
Treat 3 Benomyl at 2 ppm in H_{20} (24 hr. soak).
Treat 4 Benomyl at 6.250 ppm in acetone(24 hr.soak).
Treat 5 Benomyl at 25 ppm in acetone(24 hr. soak).
Treat 6 Untreated (control) .





Figure(27): Effect of corn seed disinfestation treatments on the recovery of Fusarium moniliforme from seed and seedling for TWC 310 and Giza 2 cultivars.

Treat.1 0.525 % Na O Cl (10 min soak)
Treat.2 Water 20°C(24 hr.),water at 55°C(10 min soak)
Treat.3 Benomyl at 2 ppm in H_2O (24 hr. soak)
Treat.4 Benomyl at 6.250 ppm in acetone(24 hr. soak)
Treat.5 Benomyl at 25.0 ppm in acetone(24 hr. soak).
Treat.6 Untreated (control).

2- The effect of hot water treatment on the development of Fusarium moniliforme in both seeds and seedlings:

Data presented in table 13 and Figures 28 and 29 showed that the TWC 310 and Giza 2 cultivars showed various responses with the diferent treatments and their effects on seed germination % , seed and seedling infection % by Fusarium moniliforme.

As for germination % , the data indicated that significance was observed between treatments with hot water at 65°C , 70°C and the other tested treatments on TWC 310 and Giza 2 cultivars .

Regarding the effect on seed and seedling infection % by the fungus, presented data showed that significance was found between the treatment 45°C, and the other tested treatments, on TWC 310 and Giza 2 cultivars.

3- Location of Fusarium moniliforme in seed parts :

Data presented in table 14 indicated that Fusarium moniliforme was detected in all parts of maize seed with varied degrees. The highest frequency of colonies was recorded on either TWC 310 or Giza 2 cultivars in pedicel and pericarp, i.e. 17 % and 31 %, respectively . Colonies frequency in each of the two cultivars was the same in the embryo (2%), while the figure was quite more with the cultivar Giza 2 than TWC 310 in the endosperm.

Table (13): Effect of hot water treatment on the development of Fusarium moniliforme in seeds and seedlings of TWC 310 and Giza 2 maize cultivars.

Treatments	TWC 310			Giza 2		
	Germination %	Infection (%)		Germination %	Infection (%)	
		Seed	Seedling		Seed	Seedling
45°C (5 min.)	98.0 a	18.0 b	22.0 b	96.0 a	23.0 b	31.0 b
50°C (5 min.)	96.0 a	05.0 c	08.0 c	95.0 a	05.0 c	17.0 c
55°C (5 min.)	94.0 a	02.0 c	04.0 c	91.0 a	03.0 c	09.0 d
60°C (5 min.)	88.0 a	00.0 c	00.0 c	85.0 a	00.0 c	00.0 e
65°C (5 min.)	28.0 b	00.0 c	00.0 c	28.5 b	00.0 c	00.0 e
70°C (5 min.)	00.0 c	00.0 c	00.0 c	00.0 c	00.0 c	00.0 e
Control	99.0 a	30.0 a	45.0 a	98.0 a	40.0 a	53.0 a

Table(14): The percentage of Fusarium moniliform colonies originated from different parts of maize seed of TWC 310 and Giza 2 cultivars grown on PDA medium.

Seed parts	Fusarium moniliforme calonies (%)	
	On TWC 310 maize cultivar	On Giza 2 maiz cultivar
Pedicel and pericarp	17	31
Embryo	2	2
Endosperm	3	4

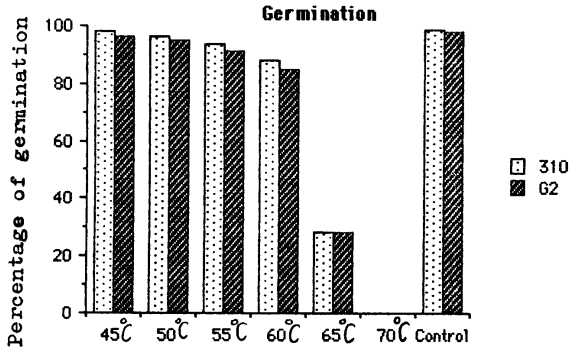
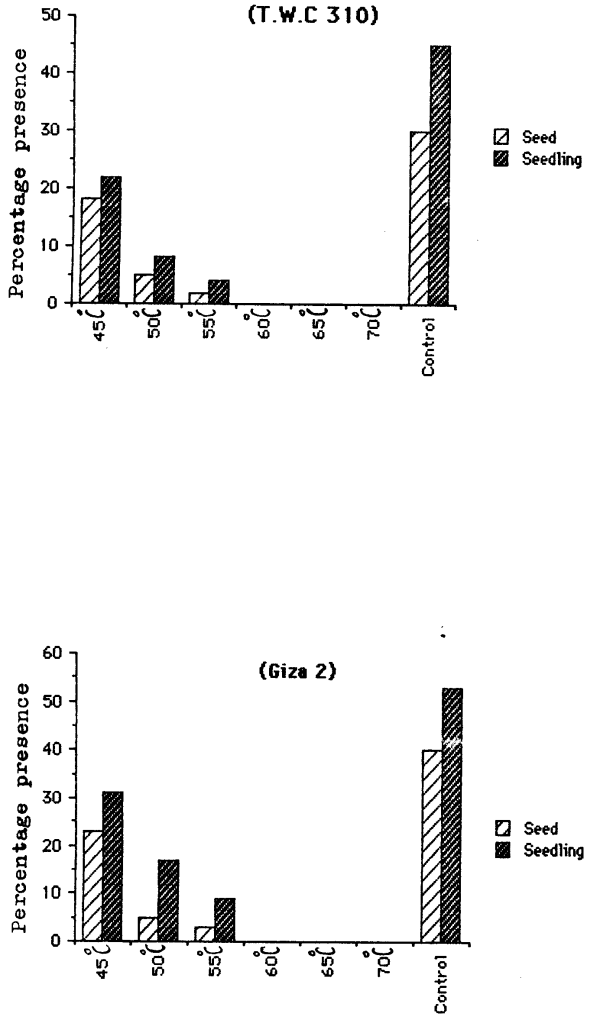


Figure (28): Effect of hot water treatments on seed germination (%) for TWC 31 0 and Giza 2 maize cultivars.



Figure(29): Effect of hot water treatments on the development of Fusarium moniliforme in both seed, and seedling on TWC 310 and Giza 2 cultivar.

4- Effect of certain systemic fungicides and storage for different intervals on grain rot development:

Table 15 and figures 30 to 33 show the effect of certain systemic fungicides at three rates of application 1 , 2 and 3g / kg seeds at the different intervals of storage on seed germination percentage and the disease development for TWC 310 and Giza 2 maize cultivars .

In regard to seed germination % the data showed significance between previcur N and the other tested fungicides,while no significance was observed between benlate 50 % and vitavax 200 at the three rates of application through the different intervals of storage on the two tested cultivars . Benlate 50 % followed by vitavax 200 proved their effectivness by the prolonging periods of storage and at the 2nd and 3rd rate of application on the two tested cultivars . On the other hand,previcur N showed retarding effect on seed germination % , specially at high level of application 3 ml / kg and prolonging periods of storage .

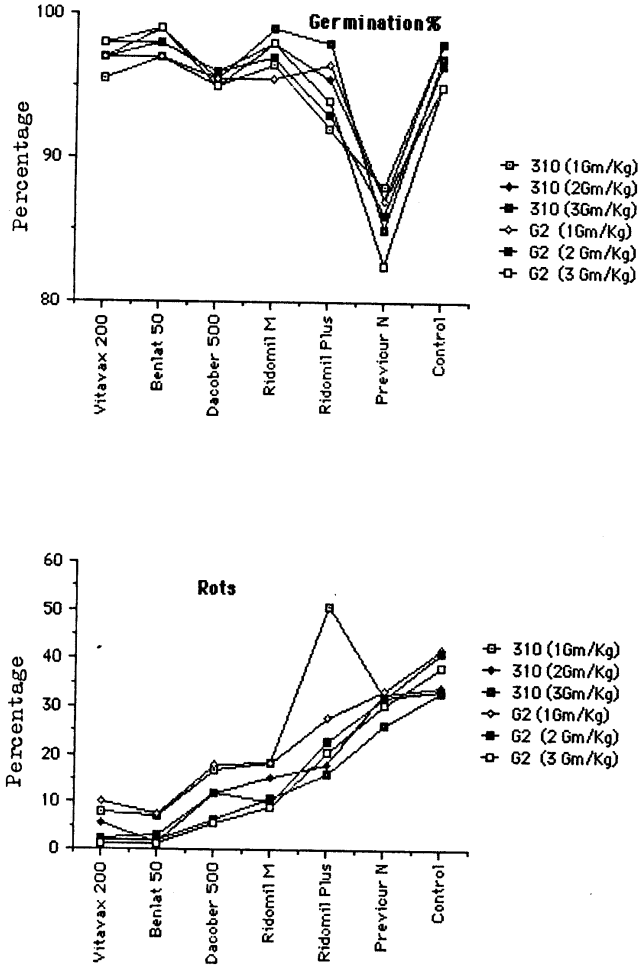
Regarding the rot percentage,data showed that no significance was observed between Benlate 50 % and vitavax 200 in reducing percentage of grain rot,while significance was found between Previcur N and the other

tested fungicides at the three rates of application , through the different intervales of storage , on the two tested cultivars , Benlate 50 % and vitavax-200 were more effective in reducing percents of grain-rot, specially at the 2nd and 3rd rate of application,while dacober 500 and redomil Mz exhibited a moderate effect. On the other hand , previcur N was the least effective one in this regard , since it was nearly similar to the control treatment .

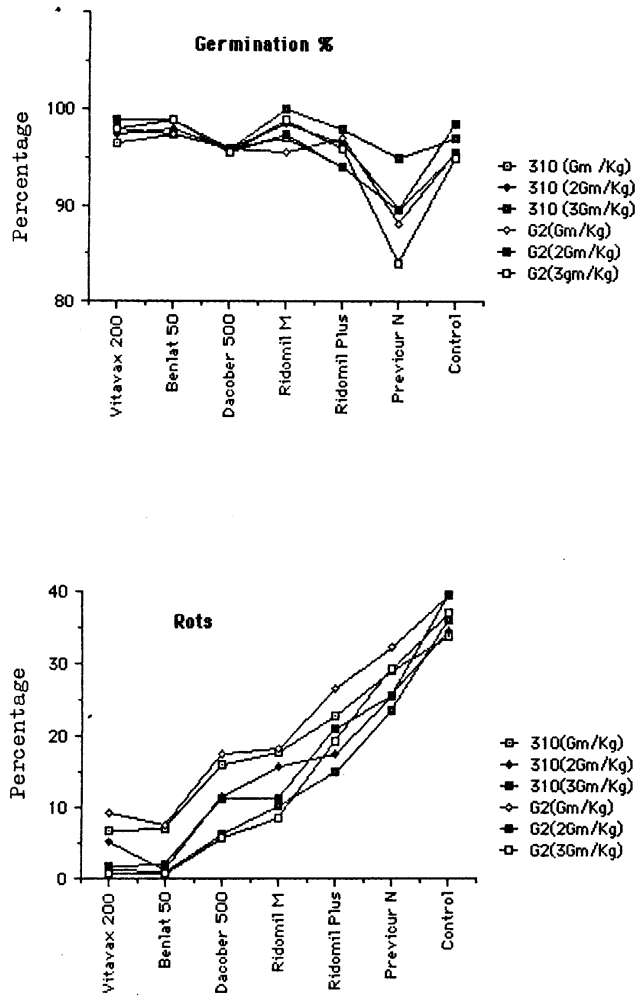
Table(15): The effect of 6 systemic fungicides applied as seed dressers at 1,2 and 3g/kg seed against maize ear and kernel rots on TWC 310 and Giza 2 cultivars at 4 times of storage in terms of rot (%) and germination (%) during 1989 .

The rate	Time of storage / cultivars	do*				30 days				60 days				90 days			
		TWC 310		Giza 2		TWC 310		Giza 2		TWC 310		Giza 2		TWC 310		Giza 2	
	Fungicides	R**	G***	R	G	R	G	R	G	R	G	R	G	R	G	R	G
1g./kg.	Vitavax 200	07.8	95.5	10.0	97.0	06.8	096.5	09.3	98.0	06.8	097.5	06.3	098.0	06.3	94.0	09.0	96.5
	Benlate 50%	07.0	97.0	07.5	97.0	07.0	097.5	07.5	97.5	06.8	097.5	07.5	098.5	05.8	96.0	06.8	96.0
	Dacober 500	17.0	95.0	18.0	95.5	16.0	096.0	17.5	96.0	14.5	097.0	16.5	095.0	15.5	93.0	15.5	94.0
	Redomil Mz	18.5	96.0	18.5	95.5	17.0	097.0	18.3	95.5	16.3	098.0	17.0	097.5	19.0	96.0	20.8	94.5
	Redomil plus	20.8	92.0	27.8	96.5	22.8	094.0	26.5	97.0	23.0	095.5	25.5	096.5	23.0	92.0	25.3	95.0
	Previcur N	32.0	88.0	33.3	87.0	29.0	089.5	32.3	88.0	28.8	088.0	30.8	086.5	26.3	86.0	29.0	83.0
	Control	33.3	98.0	42.0	95.0	33.8	098.5	39.5	95.5	35.8	095.5	38.8	094.5	39.5	95.0	45.8	95.0
2g./kg.	Vitavax 200	05.5	97.0	02.3	98.0	05.3	097.5	01.8	99.5	02.3	099.0	01.8	099.5	03.3	98.0	01.5	97.5
	Benlate 50%	01.5	98.0	03.0	98.0	01.3	098.0	02.0	99.0	01.0	099.5	01.5	098.5	02.0	96.0	03.0	96.5
	Dacober 500	12.0	96.0	12.0	96.0	11.5	096.0	11.3	95.5	15.5	097.0	10.8	095.0	11.3	94.0	10.5	95.0
	Redomil Mz	15.5	98.0	10.0	97.0	15.8	093.5	11.3	97.5	14.5	099.0	11.0	098.5	15.0	95.5	09.5	95.0
	Redomil plus	18.0	95.5	23.0	93.0	17.5	096.5	21.0	94.0	18.0	095.0	20.5	095.5	16.3	93.0	21.3	93.0
	Previcur N	32.5	87.0	32.0	89.0	25.5	089.5	25.5	89.5	26.8	087.5	26.0	086.5	25.3	85.0	26.0	85.5
	Control	34.3	98.0	41.3	96.5	43.5	098.5	39.5	95.5	36.5	097.5	38.8	096.0	38.0	95.0	43.5	94.0
3g./kg.	Vitavax 200	01.8	97.0	01.3	98.0	01.3	098.0	00.8	98.0	00.8	099.5	00.5	098.5	01.0	95.0	01.0	96.0
	Benlate 50%	01.8	99.0	01.3	99.0	01.0	099.0	00.8	99.0	00.3	100.0	00.0	100.0	01.3	96.5	01.0	97.0
	Dacober 500	06.8	95.5	05.8	95.0	06.3	096.0	05.8	95.5	05.8	095.5	05.3	094.0	06.0	94.0	07.8	93.5
	Redomil Mz	11.0	99.0	09.0	98.0	10.3	100.0	08.5	99.5	10.3	100.0	08.0	100.0	10.8	97.0	07.8	96.0
	Redomil plus	16.0	98.0	20.5	94.0	15.0	098.0	19.3	97.0	13.5	097.0	18.8	097.0	11.0	97.0	19.3	93.0
	Previcur N	26.3	85.0	30.3	82.5	23.5	085.0	29.3	84.5	22.0	085.0	27.0	082.5	24.0	83.0	29.0	80.0
	Control	33.5	97.0	38.3	95.0	36.0	097.0	37.0	96.0	34.8	098.0	34.8	095.5	37.3	96.0	41.0	93.5
LSD	5%	2.1	1.8	2.1	1.8	2.2	2.02	2.2	2.02	12.9	1.9	12.9	1.9	2.7	2.4	2.7	2.4
	1%	2.7	2.3	2.7	2.3	2.9	2.77	2.9	2.67	17.2	2.6	17.2	2.6	3.6	3.1	3.6	3.1

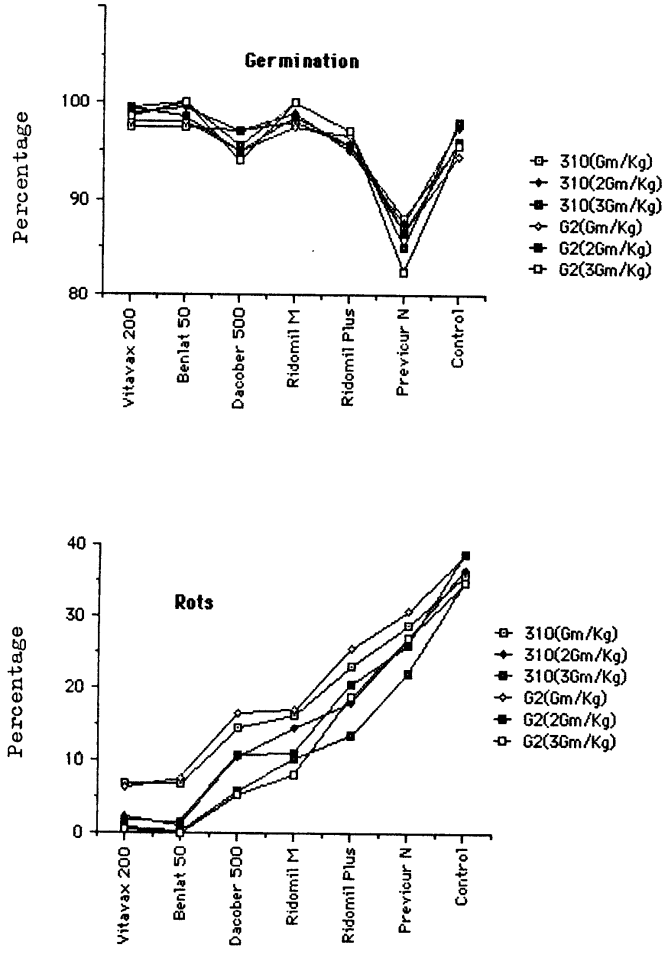
* Soon after treatment
** Rots (%)
*** Germination (%)



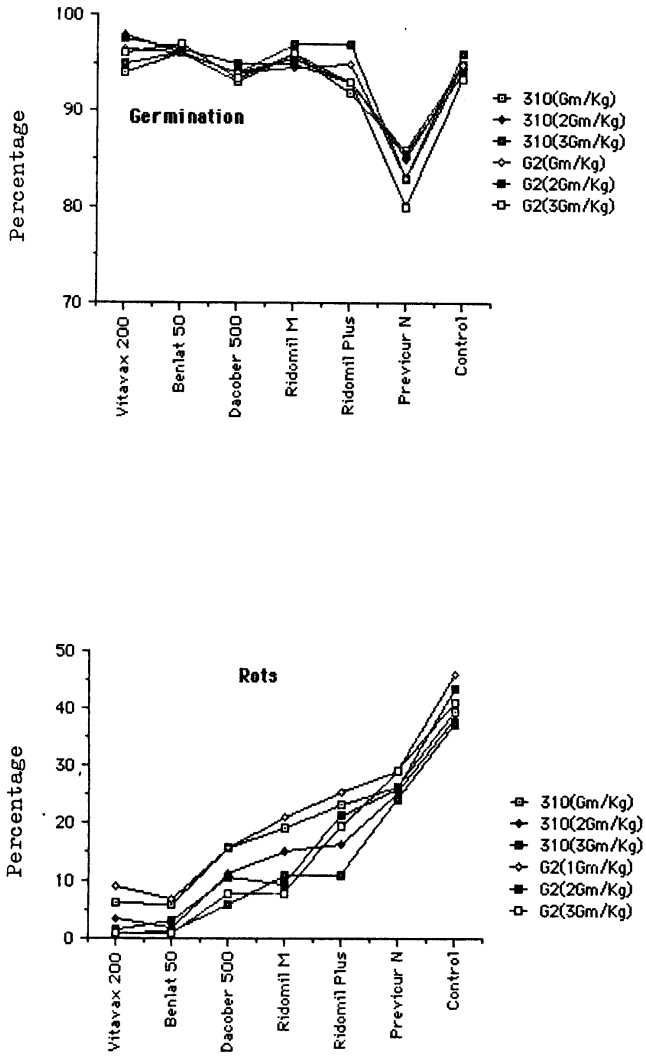
Figure(30): Effect of certain systemic fungicides soon after treatment using three rates of application on seed germination and rot (%) in TWC 310 and Giza 2 cultivars .



Figure(31): Effect of certain systemic fungicides and storage for one monthusing three rates of application on seed germination and rot (%) in TWC 310 and Giza 2 cultivars.



Figure(32): Effect of certain systemic fungicides and storage for two months using three rates of application on seed germination and rot (%) in TWC 310 and Giza 2 cultivars .



Figure(33): Effect of certain systemic fungicides and storage for three months using three rates of application on seed germination and rot(%) in TWC 310 and Giza 2 cultivars .

DISCUSSION

This study offers some contributions in the range of integrated process of controlling maize kernel and ear rots in Egypt. The obtained results showed that the freshly-harvested seeds of maize (Giza 2, DC 215 and TWC 310 cultivars) were externally and internally colonized by several species of the causal fungi.Four fungal genera notably Fusarium moniliforme, Penicillium sp., Aspergillus niger and Aspergillus flavus were associated with seeds of all tested cultivars at different localities, while other fungi , i.e. Negrospora oryzae , B. theobromae and Fusarium semitectum were associated with seeds of some tested cultivars and localities. This result was supported by the findings of Ibrahim and Farag (1965), Mislivec and Tuit (1970), Gamal El-Din et al.(1987)and Wichlow(1988). Kinds and frequency of presence of fungi depend upon host cultivar and environmental conditions , Limonard (1968). The survey also indicated that rate of infection by ear rot disease in maize cultivar Giza 2 was generally higher in Kafr El-Sheikh govermorate,than in DC 215 and TWC 310 maiz cultivars. The highest percentage of diseas incidence in 1989 & 1990 seasons,was found at Motobas and Kafr El-Sheikh localities. The present results could be explained on the same basis , i.e. host cultivar and environmental conditions in addition to the harvest date, soil infestation by stalk borers and finally the genetic constitution of the host .

Regarding the side action of stem borers on the development of ear and kernel rot of maize, the obtained results showed that the insect damaged samples of maize demonstrated higher percentage of kernel rots and loss of grain germination than the insect-free samples. Reducing insect damage in corn plants through the application of insecticides resulted in less kernel rots and lower non-germinated grains as compared to untreated plants. These findings were similar to that reported by Sinha and Ranjan(1989). On the other hand, Payne et al. (1988)observed that sporulation of the fungus(Aspergillus flavus)in the field is most often associated with injured kernels due to stem borers.

It is evident from the present study that both early sowing and sampling dates resulted in high rates of seed germination and low rates of infection especially with Penicillium sp., Aspergillus niger and Aspergillus flavus. However , the late sowing and sampling dates resulted in low rates of seed germination and high rates of infection by the previously mentioned fungi . These findings are considered to be reasonable and logic concerning the rates of germination since they related to seed maturity. On the other hand,the high frequency of the previously mentioned fungi at the late sampling date could be explained by the fact that these fungi i.e. saprophytic fungi are related to the senecence stage ,

John and Sons (1958) . Similar results were obtained by Fathi (1966) and Diab et al. (1989). Regarding the varietal resistance , under the stress of natural inoculation the present study revealed that TWC 310 . DC 215 and DC 204 hybrides , were less susceptible to infection rather than composite 5 and Giza 2 cultivars, at all sowing dates. Similar results were obtained by King and Scott (1981), Cantone et al.,(1983) and Scott and King (1984), who found that susceptibility to ear rot disease differed significantly between corn inbreds and hybrids. Since maize hybrids were generally more resistant than inbreds . The present results revealed that Fusarium moniliforme predominated on / in the grains. Its frequency percentage tended to be high in all cultivars grown at all sowing dates and it infected the kernels before any other agents of kernel or ear rot$. Such results agree with the reports of Caldwell et al. (1981) and King (1981) .

Regarding the different responses of the host against the different types of inoculations,the obtained results revealed that husks inoculation was superior for inducing disease symptoms followed by ear tip and silk inoculation procedures . These results were supproted by those reported by King and Scott(1982),Diab et al.,(1984)and Styer and Cantliff(1984). Regarding the varietal resistance, under the stress of artificial

inoculation , the obtained results showed that TWC 310 was more resistant comparing with Giza 2 cultivar through either of inoculation dates. Similar results were obtained by King and Scott (1981), Cantone et al., (1983) and Chambers (1988) .

Numerous investigations were carried out in different locations with different maize cultivars against ear rot using the application of various fungicides as seed dressers. However, less reports were available on the effect of field applications with fungicides on the growing plants on the fungal association with seeds. The present work indicated that either benlate 50 % or dithane-M_{45} significantly reduced the disease incidence compared with the untreated controls . Three times of application were more effective than two and one . Such results coresponded well with the finding of Fahim et al. (1986) who found that the pre-harvest spraying with different fungicides could protect seeds against fungal invasion. Benlate 50 % was more effective than dithan-M_{45} in this regard. Similar results were reported also by Fahim et al., (1986) .

Soil infestation by each of Aspergillus flavus , Aspergillus niger and Fusarium moniliforme had greatly reduced seed germination and seedling growth of each of the tested cultivars . Although, Limonard (1968)

noted that these fungi were probably useful for their host seeds as they provided a natural protection against seed and soil-borne pathogens. The obtained results are in agreement with those reported by workers who confirmed their pathogenic potential and ability to cause economic losses . For instance, Styer and Contliff (1984) pointed out that maize seeds infected with Fusarium moniliforme increased the number of abnormal seedlings and reduced seedling growth of germinated seeds. Jayaweera et al., (1988)reported that several species of Fusarium are known to invade the coat,endosperm and the embryo resulting in failure of germination, other species of Fusarium are known to produce phytotoxins which probably interfere with germination.Prasad et al., (1988) reported that maximum percent loss of total nitrogen, starch, total free sugar, total free amino acids and seed germination was due to infection by Aspergillus flavus . Sinha and Ranjan (1989) found that increasing concentration of aflatoxin B_1 produced by Aspergillus flavus, significantly inhibited protein, nucleic acids and chlorophyll synthesis of the germinating maize grains. The obtained results revealed also that in case of soil infestation using a mixture of the tested fungi, the response of the host was intermediate. This behaviour could be explained on the basis of the antagonistic effect between them. Similar results were obtained by Dawood (1982) .

As regard to the effect of seed soaking using certain chemicals on the development of Fusarium moniliforme in maize seeds and seedlings, the present results gave evidence that the application by either sodium hypochlorite or benomyl 50 % induced complete protection against the pathogen without any significant decrease in seed germination . These results were in the same line with those reported by Daniels (1983) and Foley (1962) .

The hot water treatment proved it's efficacy against Fusarium moniliforme in both infected seeds and seedlings as obtained from the present results and supported by the findings of Foley (1962), Salama and Mishricky (1973), El-Meleigi et al., (1980), and Daniels (1983) .

The present result focussed a spot light on the seed parts in which Fusarium moniliforme was restricted as a mycelium. It is evident that pedicels and pericarps are considered to be common parts of fungal existance . Low frequencies of fungal incidence could be detected in both embryos and endosperm layers . The maize seeds of hybride TWC 310 were less sensetive than those of the commercial open pollenated cultivar Giza 2 and consequently their contents of the mycelium of the pathogen was lower . Qasem and Christensen (1960) reported that if the pericarp of the kernel remained unbroken , fungal penetration may be induced through the

pedicel in common and was rare in any other way . Our results could be explained on the light of this observation and was supported by the findings of Donald (1968), and Singh et al. (1988) .

Concerning the effect of certain systemic fungicides with the storage at different intervals on the disease development, the obtained results revealed that benlate 50 % followed by vitavax 200 were effective in controlling the disease through the different intervals of storage. While, dacober 500 and redomil Mz exhibited a moderate effect. On the other hand, previcur N was the least effective one in this regard . Similar results were reported by Singh et al .(1971), El-Khadem et al. (1979), El-Sawah et al. (1984) and Fahim et al. (1986) .

The foregoing systemic fungicides also exhibited a synergetic effect on seed germination as clarified from the obtained results. For instance benlate 50 % followed by vitavax 200 and redomil-Mz proved their effectiveness by the prolonging periods of storage . On the other hand , previcur-N showed retarding effect on seed germination than control treatment, specially at high level of application . Similar results were obtained by El-Sawah et al. (1984) and Diab et al. (1989) .

SUMMARY

STUDIES ON SOME ROT DISEASES OF ZEA MAYS IN EGYPT

1- The obtained results indicated the existence of the following fungi on maize during 1989 and 1990 growing seasons :

- Fusarium moniliforme Sheld.
- Penicillium sp.
- Aspergillus niger Van Tieghem
- Aspergillus flavus Link
- Nigrospora oryzae Petch
- Botryodiplodia theobromae Pat.
- Fusarium semitectum Berk. & Rav.

Fusarium moniliforme has proved to be the most prevalent fungus which incited the disease followed by Penicillium sp. and Aspergillus spp. On the other hand Nigrospora oryzea , B. theobromae and Fusarium semitectum were the least frequently distributed fungi.

2- The commercial varieties Giza 2 and composite 5 were the more susceptible comparing with hybrids DC 215 and TWC 310.

3- Disease was present in Motobas and Kafr El-Sheikh countiesand with less degree in Dussouk, El-Reyad and Beialla. The least records of the disease were found in Sedi-Salem and Qualine.

4- Field experiments indicated that husks injection was the best procedure for inducing the disease, since significant differences were observed between that method and ear tip and silk spray methods. The optimum time of artificial inoculation was accompalished at 10 days after pollination for the two pathogens Fusarium moniliforme and Botryodiplodia theobromae. However, the best time of inoculation was 30 days after pollination for other tested fungi.

5- The systemic fungicide Benlate 50 % was effective than Dithan M-45 in reducing the disease. The least degree of disease incidence was obtained with the treatment which sprayed 3 times at 15, 25 and 35 days after flowering comparing with the two and one sprayed ones.

6- Significant differences were observed between treated and untreated plots by chemicals for controlling maize stem borers and increasing germination percentage.

7- Results indicated that the late sowing date (i.e.20 June) and the late sampling date (i.e.130 days after sowing) caused high rates of rot and reduced seed germination

8- The laboratory experiments indicated that Aspergillus flavus, Aspergillus niger and Fusarium moniliforme decreased seed germination (%), dry and fresh weight and length of either root and shoot.

9- Seed dressers indicated that Benlate 50 % and Vitavax 200 exhibited a profound effect in reducing the disease at 2 and 3 g/Kg seed. While seed soaking in Benlate 50 % at 2.000 ppm for 24 hr or in sodium hypochlorit at 0.525 % for 10 min. are reducing the existence of Fusarium moniliforme in each of infected seeds or seedlings.

10- Hot water treatment at 55-60 °C for 5 min. reduced Fusarium moniliforme in both infected seed and seedlings, whithout any significant effect on seed germination (%).

11- The results also revealed that mycelial colonies of F. moniliforme were concentrated in pedicel and pericarp, and in low concentration at endosperm and embryo.

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" بسم الله الرحمن الرحيم "

" الملخص العربى "

" دراسات على بعض أمراض عفن الذرة الشامية فى مصر "

١ - بينت النتائج المتحصل عليها خلال موسمى ١٩٨٩ ، ١٩٩٠ على وجود الفطريات الآتية على حبوب الذرة الشامية :-

* فيوزاريوم مونيليفورم — Fusarium moniliforme
* نوع من البنسليوم — Penicillium sp.
* اسبرجلس نيجر — Aspergillus niger
* اسبرجلس فلافس — Aspergillus flavus
* نيجروسبورا اوريزا — Nigrospora oryzae
* بتريود يبلود يا ثيوبروما — Botryodiplodia theobromae
* فيوزاريوم سيميتيكتم — Fusarium semitectum

حيث كان فطر فيوزاريوم مونيليفورم أكثر الفطريات انتشارا يليه فطر البنسليوم والاسبرجلس ، بينما كان الفطر نيجروسبورا أوريزا والفطر ديبلوديا مايدس والفطر فيوزاريوم سيميتيكتم أقل الفطريات المختبرة انتشارا ٠

٢ - كانت الأصناف التجارية جيزة ٢ ، تركيبى ٥ أكثر حساسية للاصابة بالمقارنة بالهجين الزوجى ٢١٥ والهجين الثلاثى ٣١٠ ٠

٣ - أعلى اصابة بالمرض سجلت فى مركزى مطوبس وكفر الشيخ ويليها بدرجة أقل فى مراكز دسوق والرياض وبيلا ، بينما أقل اصابة كانت فى مركزى سيدى سالم وقلين ٠

٤ - بينت التجارب الحقلية أن حقن الاغلفة الخارجية للكوز كانت أحسن الطرق فى أحداث العدوى بالمرض حيث ظهرت فروق معنوية بين هذه الطريقة وطريقة رش طرف الكوز ورش الحريرة بالمعلق الجرثومى للفطريات ٠ وكان أحسن ميعاد للعدوى هو الميعاد المبكر (١٠ أيام من التلقيح) بالنسبة للفطرين فيوزاريوم مونيليفورم وبتريود يبلود يا ، أما بقية الفطريات المختبرة فكان أحسن ميعاد للعدوى بها هو الميعاد المتأخر (بعد ٣٠ يوم من التلقيح)٠

٥ - أوضحت الدراسة أن مبيد البنليت ٥٠ ٪ كان أكثر فعالية من المبيد دياثين م ٤٥ فى الاقلال من المرض عند استعمالهم رشا بالحقل. وكانت أقل درجة لظهور المرض عند الرش ثلاث مرات (بعد ١٥ ، ٢٥ ، ٣٥ يوم من التزهير) وذلك بالمقارنة بالرش مرتين أو مرة واحدة.

٦ - ظهرت فروق معنوية بين القطع التجريبية المعاملة بالمبيدات ضد ثاقبات ساق الذرة وبين القطع الغير معاملة وازدادت نسبة الانبات فى القطع المعاملة بالمقارنة بالقطع غير المعاملة .

٧ - أوضحت النتائج أيضا أن الميعاد المتأخر للزراعة (٢٠ يونيو) وكذلك ميعاد آخذ العينات المتأخر (١٣٠ يوم من الزراعة) أدى الى ارتفاع معدل الاصابة بالعفن وكذلك قلل نسبة الانبات فى الحبوب الناتجة .

٨ - بينت التجارب المعملية أن الفطر اسبرجلس فلافس والفطر اسبرجلس نيجر والفطر فيوزاريوم موفيليفورم على التوالى أدوا الى الاقلال من نسبة الانبات ومن الوزن الجاف والطازج وطول البادرات الناتجة وذلك عند عدوى التربة بهذه الفطريات .

٩ - معاملة الحبوب بالبنليت ٥٠ ٪ والفيتافاكس ٢٠٠ عملت على الاقلال من المرض عند استعمالهم بمعدل ٢ أو ٣ جرام/كيلو جرام من الحبوب، بينما نقع الحبوب فى محلول البنليت ٥٠ ٪ بتركيز ٢ جزء فى المليون لمدة ٢٤ ساعة أو فى هيبوكلوريد الصوديوم بتركيز ٥٢٥ر ٪ لمدة ١٠ دقائق أدى ذلك الى الاقلال من وجود فطر فيوزاريوم مونيليفورم فى كل من الحبوب أو البادرات الناتجة.

١٠ - معاملة الحبوب بالماء الساخن على درجة حرارة ٥٥ - ٦٥ مم لمدة ٥ دقائق أدت الى الابادة التامة لفطر فيوزاريوم مونيليفورم فى كل من الحبوب والبادرات دون تأثير للمعاملة على النسبة المئوية للانبات للحبوب المعاملة .

١١ - دلت النتائج المتحصل عليها على أن الفطر فيوزاريوم مونيليفورم يكون أكثر تركيزا فى منطقتى اتصال الحبة بالقولحة ومنطقة البشرة الخارجية للحبة ويكون أقل تركيزا فى كل من الجنين والاندوسبرم.

دراسات على بعض أمراض الذرة الشامية فى مصر

رسالة مقدمة من

صبحى عبد العزيز السيد طليه

بكالوريوس العلوم الزراعية (أمراض نبات) ١٩٨٠

كلية الزراعة بكفر الشيخ ـ جامعة طنطا

للحصول على درجة الماجستير

فى العلوم الزراعية

أمراض النبات

قسم النبات الزراعى

كلية الزراعة ـ كفر الشيخ

جامعة طنطا

١٩٩١م