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Stalk rots complex diseases related to kind of animal manure and insecticide and its effect on the quality of maize grains

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ABSTRACT

Maize genotypes' reactions against stalk rot causal organisms showed that the lowest disease incidence was recorded in cases fertilized by decomposing animal manure (7-8 weeks old) and insect control, compared with those fertilized by fresh animal manure and no insect control. The highest percent of insect infection as well as the highest lodging percent were recorded in soil treated with fresh manure with no insect control. The weight of 100 kernels decreased as well as the yield per two rows with plots treated with fresh animal manure and no insect control. Maize hybrids single cross 10 (SC10) had a suitable level of resistance to tested diseases and recorded a lower infection percent of tested diseases, higher values of weight of 100 kernels, and higher yield per tested row than those recorded with the tested open-pollinated variety (Balady). Fresh animal manure resulted in increasing disease severity for each tested disease, indicating the danger of farmers fertilizing their farms with fresh animal manure before storing it for a few weeks. The obtained results also illustrated high germination percent and high grain component percent, i.e., protein, oil, ash, fiber, carbohydrates, and phenols, in all grains collected from plots that were fertilized by stored animal manure (7-8 weeks old) and sprayed against insects, as compared with the control treatment. Overall, this study never recommended the use of fresh farmyard animal manure before storing it for at least 7-8 weeks for fertilization of the soil. All in all, true disease control, the lowest kernel rot diseases, and high quantitative and qualitative yields per 2 rows were obtained from the plots sprayed with insecticide and fertilized by stored animal manure (decomposing animal manure). In short, the study found that using decomposing animal manure (7-8 weeks old) and insect control is the best way to prevent stalk rot diseases in maize. Fresh animal manure should not be used, as it can increase the severity of the diseases.

Keywords: Maize, animal manure, stalk rots complex diseases, seed quality

INTRODUCTION

Corn stalk rot is highly damaged by fungal soil-borne diseases, and it reduces the yield and quality of maize. The infection of corn stalk rot reaches 30–50% in some areas (He *et al.,* 2019). The use of organic matter in the soil to stimulate microbial activity in maize fields could be a suitable strategy to reduce the initial inoculum of stalk rot disease in maize (Bastida *et al.,* 2008). Many researches on soil organic matter mechanisms have been done with the items of controlling plant diseases in a considerable and sustainable direction (Bonamoni *et al.,* 2010). Organic matter has been used as a strategy for controlling some soil plant pathogens based on its ability to suppress some soil-borne pathogens (Lazarovitz *et al.,* 2009). Bonanomi *et al.* (2007) found that using organic matter in manure was suppressive of about 45 percent of some diseases studied. Thus, the use of organic matter may be an alternative way to control many diseases; however, further research is needed to enhance this effect. Alakonya *et al.* (2003) suggest that, in general, organic manure reduced the infection of maize plants by *Macrophomina phaseolina* and *F. moniliforme* compared to controls. The use of organic manure might be important in the management of *F. moniliforme* in areas where the pathogen is prevalent (AICRP, 2014). Organic animal manure fixed into the soil supplies macro- and micronutrients, alters the soil pH and electrical values, enhances microbial biomass and the activities of some enzyme systems (Reddy *et al.,* 2013), and could also increase the amount and diversity of enzymes released into the soil by the microbial community (Heck *et al.*, 2019). Post-flowering stalk rot is an important stage, and a complex of a number of fungi in nature (like *Fusarium verticillioides*, which causes

Fusarium stalk rot, *Macrophomina phaseolina*, which causes charcoal rot, and *Harpophora maydis*, which causes late wilt) are involved in the diseases (Subedi *et al.,* 2016). Bonanomi *et al.* (2007) added that stored organic manure can be an effective way for field soils to reduce the infection percentages caused by root diseases in the balance of natural and field microorganisms. Disease suppression from stored manure resulted in heat and activity of oxidative enzymes, which affected and may have damaged the growth of fungal and oomycota pathogens. In the same item, Vargas-Garcia *et al.* (2010) predicted that stored manure containing importance dynamic as a C source would suppress early blight disease and more other soil-borne pathogens than manure with fresh are poor C sources. Mweshi *et al.* (2010) found that *Fusarium spp.*, especially *Fusarium verticillioides*, was the dominant fungus causing ear and kernel rot diseases in maize. Neher *et al.* (2013) reported that stored farmyard manure has contrasting biochemical structure and resistance to decay. Decomposing farmyard manure had a higher C:N ratio and higher lignin and cellulose values than fresh manure. Masibonge *et al.* (2015) showed that maize ear rot disease resulted in significantly reduced qualitative and quantitative yields. Moreover, ear or kernel rots of maize can be caused by a number of fungi, especially *Fusarium* species, *Aspergillus* species, and *Aspergillus* spp. Hafiza *et al.,* (2016) showed that stored organic manure stimulates antagonistic activities of microorganisms against soil-borne diseases. The fertilization of soil by stored organic matter also results in the accumulation of specific compounds that may be antifungal or other pathogens. Pan *et al.* (2019) indicated that chicken manure-based organic fertilizer has a potential effect in disease control programs to avoid the use of conventional fungicides. They added that fresh animal manures increased the development of root rot diseases and, eventually, plant death. Sifolo *et al.* (2019) found that the application of manure had a positive effect on maize growth, yield, and yield components production. However, the storage of these manures for a suitable time before application can be recommended to increase maize productivity and quality. The manure could be stored for at least one month to kill pathogens, parasites, insect eggs, and weed seeds because the temperature must be at least 131 degrees Fahrenheit for 15 days (Athena 2019). In the same respect, Bradley (2019) showed that the temperature in the storage process of manure should reach between 120 and 160 5F as well as kill pathogens, parasites, insect eggs, and weed seeds; therefore, the temperature during animal manure storage needs to be at least 131 5F for 15 days. Handrid *et al.* (2020) showed that the animal organic manure combined with some biological agents is able to suppress the severity of white leaf spot disease and Maydis leaf blight by about 47.36% and increase yield production. Essam *et al.* (2020) found that application of organic manure resulted in maximum grain weight as well as grain yield and protein content (%) in the grain of maize varieties. On the other hand, Gatch and Munkvold (2001) showed that the European corn borer (ECB) (*Ostrinianubilalis*) has a considerable role in stalk rot development by making entry wounds and by acting as a vector for some stalk rot pathogens, especially *Fusarium verticillioides*. In the same item, Freije and Wise (2016) illustrated that stalk rot symptoms do not develop until late in the field. Many of the pathogens that cause stalk rots are already weak because of imbalances of nutrients or water in the soil. Therefore, foliar diseases and insect damage play an important role in predisposing a plant to infection by stalk rot disease. Overall, planting hybrids with insect-resistance traits may reduce the effects of stalk rots. Byamukama and Yabwalo (2019), Mekonnen Gebeyaw (2020), and Monajjem *et al.,* (2016) found that stalk rots caused a complex reduction in seed weight as well as yield production, especially if the plants wilted before grain fill. Stalk rots also significantly reduce yield production, especially when infected plants lodge and are not harvested by a combine in the final. Lodged stalks may also result in ear rot developing when the ears touch the soil, which contains high levels of moisture. Samar *et al.* (2023) illustrated that the tested maize cultivars, i.e., SC10 and SC176, were resistant to the tested disease, i.e., *turcicum* leaf blight in maize, as compared with the open-pollinated variety, i.e., the Balady cultivar. The highest values of yield production, weight of 100 kernels, percent germination, and grain components (oil, carbohydrates, fiber, silica, phenols, protein) were found in plots fertilized with aged animal manure storage for about 5-6 weeks, when compared to the control treatment. On the other hand, using fresh animal manure in fertilization was unsuitable and led to the lowest values of all tested characters, as explained above, with the exception of ash% and EC. This paper aimed to study stalk rot, a complex disease related to animal manure and insecticides, and its effect on the quality of maize grains. This paper aimed to study Stalk rots complex diseases related with kind of animal manure and insecticide and its effect on quality of maize grains.

MATERIALS AND METHODS

Making of organic animals' manure:

The animals' organic manure was obtained daily from the farm animal barn, then moved and stored in the farmyard until it was used in fertilization of the field. In this study, two types of organic manures from animals were used: The first was named "fresh animals' organic manure" (5–6 days old), and the second was named "stored animals' organic manure" (7-8 weeks old before using).

Re-infestation of late wilt disease nursery:

Many different isolates of *Cephalosporium maydis* were used to re-infest the Sakha field disease nursery to increase the efficiency of selection in the field. The inoculum of these isolates was raised on sterilized grain sorghum seeds moistened with water in milk bottles. After sufficient fungal growth had been obtained, the inocula of different isolates were thoroughly mixed and used to infest fresh Nile silt at the rate of 10 g/kg silt. The infested soil was then distributed into 25-cm-diameter pots in the greenhouse and sown with susceptible hybrid maize during March–April to promote fungal growth in the soil. In May 2020 and 2021, the pots were emptied, and the infested soil was thoroughly mixed and distributed into the disease nursery at the rate of 200 kg per feddan as uniformly as possible before sowing the maize materials, as was adopted by El-Shafey *et al.* (1988).

Field experiment:

The experiment was performed at Sakha Agricultural Research Station in a field late wilt disease nursery and the seed technology laboratory within the 2020 and 2021 growing seasons. A split plot design with three replicates was used in this experiment; the main plots contained two maize genotypes, i.e., SC10 and Balady cvs. The subplots contained six treatments, as follows: T1 = soil treated by fresh animal manure at a rate of 5 kg/plot and insects control; T2 = soil treated by fresh animal manure at a rate of 5 kg/plot and no insects control; T3 = soil fertilized by decomposing manure (7-8 week old) at a rate of 5 kg/plot and insects control; T4 = soil fertilized by decomposing manure (7-8 week old) at a rate of 5 kg/plot and no insects control; T5 = soil untreated by any animal manure and sprayed to control insects; and T6 = soil untreated by any animal manure and not sprayed against insects. Each plot consists of twelve rows, each 5 m long and 80 cm apart (a total of 48 m2). The plants were approached one at a time, leaving approximately 25 cm between hills. All agricultural practices were done in due time and as recommended. The insect control was done using the insecticide Lannate 90% SP as a spray after 20 days from sowing and repeated after a 10-day interval (after 30 days from sowing) at the rate of 1.5 g/l of water. At harvest (after 120 days from sowing), the yield was recorded as kg/two rows, and the weight of 100 kernels was also recorded. Finally, 500 g of kernels were taken from each treatment in each replicate for further analysis.

Isolation of kernel rots causal pathogens:

After harvest, samples from two tested maize cultivars (SC10 and Balady cv) were randomly collected from each tested treatment and each replicate and kept at laboratory temperature until the beginning of the investigation. To isolate fungal pathogens causing kernel rots of maize, one hundred kernels of each maize cultivar at each tested treatment and each replicate formerly mentioned were surface sterilized in 1% sodium hypochlorite for about 3 minutes and washed several times in distilled sterilized water. They were then blotted between two sterilized filter papers and plated in Petri plates containing 10 ml of potato dextrose agar medium (PAD). Plates were incubated at 27° C for 7–10 days, microscopically examined, and purified using the hyphal tip technique. Obtained fungi were recorded as percentages of infected kernels in each maize cultivar tested at each treatment and in each replicate according to their frequency of developing on isolation plates (ISTA, 1985). The obtained fungi were identified in the department of mycology, the Plant Pathology Institute, and the ARC in Giza, Egypt.

Germination test (%):

Seeds was estimated by the standard laboratory germination test, according to the Rules of International Seed Testing Association (ISTA., 1993).

Electrical conductivity test (EC) ($\mu S.cm^{-1}\ g^{-1}$):

Four samples each of 50 seeds were weighted and placed in 500 ml conical flask containing 250 ml distilled water. Then flasks were completely covered and incubated at 25 centigrade for 24 hours. Conductive measures were recorded at the end of test period using a calibrated conductivity meter (AOAC, 1990).

Chemical composition of grains:

Grains samples were taken randomly from each plot and ground to a fine powder, which was then passed through a 2 mm mesh for chemical analysis. Crude fiber, crude protein, carbohydrate percent, ash percent, and oil content by the Soxhlet extraction method were determined according to AOAC (1990) and expressed as a percent of the dry weight of the sample. Total phenols were estimated using the folin-Denis reagent according to the method of Tolba (1996).

Statistical analysis:

All collected data were presented for analysis of variance according to Gomez and Gomez (1984). Treatments means by which Duncan's multiple range test were compared (Duncan, 1955). All statistical analysis was performed using variance technique using "MSTAT" software package.

RESULTS

Results in table 1 for 2020 and figure 1 illustrated that the mean severity of *F. verticillioides* (%), *C. maydis* (%), and *Sclerotium bataticola* (%) were high at 11.778, 9.583, and 11.667 percent in Balady CV, compared with 8.611, 7.500, and 9.583 in SC-10, respectively. On the other hand, the highest infection percentages were obtained with treatment no. 2 (T2 = fresh manure and no insect control); they were 14.167, 10.833, 14.167, 11.667, and 50.833% in *F. verticillioides%, C. maydis%, Sclerotium bataticola*%, other fungi%, and stalk rot complex% in SC10, respectively. while it was 16.667, 15.833, 16.667, 17.500, and 66.667 in Balady cv, respectively. On the reversal, the lowest infection percentages by stalk rot causal organisms were obtained with treatment no. 3 (T3 = stored manure and insect control); it recorded 2.500, 3.333, 5.833, 4.167, and 15.833 in SC10, respectively, while it was 6.500, 4.167, 6.667, 6.667, and 23.167% in Balady cv, the other hand, the results obtained in table 2 during 2021 were in the same trend with which obtained during 2020 in table 1.

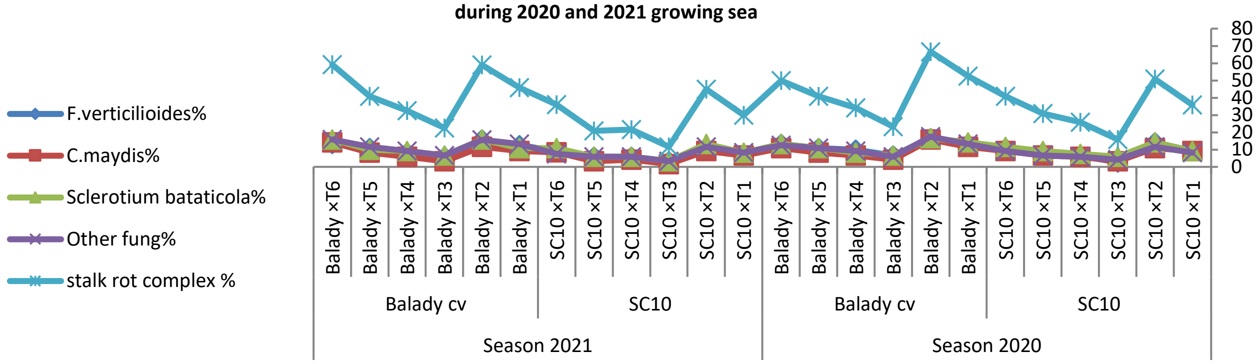
Table 1. Severity of infection % by stalk rots causal agents of two maize cultivars (SC10 and Balady) were sowed in *C. maydis* late wilt nursery field under different animal manures fertilization and insects' control during 2020 growing season.

	Treatments	***F.verticilioides%***	***C.maydis%***	***Sclerotium batatic0la%***	**Other fungi%**	**stalk rot complex %**
Cultivars (A)	SC10	8.611b	7.500b	9.583b	7.639b	33.333b
	Balady	11.778a	9.583a	11.667a	11.528a	44.556a
F.test		**	**	**	*	**
Treats (B)	T1	11.250b	10.417bc	11.667b	10.833b	44.167b
	T2	15.417a	13.333a	15.417a	14.583a	58.750a
	T3	4.500d	3.750d	6.250d	5.000d	19.500e
	T4	8.333c	6.250d	7.917c	7.500c	30.000d
	T5	9.583c	7.500c	10.000c	8.750c	35.833c
	T6	12.083b	10.000b	12.500b	10.833b	45.410b
F.test		**	**	**	**	**
A×B	SC10 ×T1	9.167d	9.167bc	9.167cd	8.333c	35.833d
	SC10 ×T2	14.167b	10.833b	14.167b	11.667b	50.833b
	SC10 ×T3	2.500f	3.333e	5.833f	4.167e	15.833g
	SC10 ×T4	6.667e	5.833d	7.500e	5.833d	25.833f
	SC10 ×T5	8.333de	6.667cd	9.167cd	6.667d	30.833e
	SC10 ×T6	10.833d	9.167bc	11.667bc	9.167c	40.833c
	Balady ×T1	13.333c	11.667b	14.167b	13.333b	52.500b
	Balady ×T2	16.667a	15.833a	16.667a	17.500a	66.667a
	Balady ×T3	6.500e	4.167de	6.667de	5.833d	23.167f
	Balady ×T4	10.000d	6.667cd	8.333d	9.167c	34.16de
	Balady ×T5	10.833d	8.333c	10.833c	10.833bc	40.830c
	Balady ×T6	13.333c	10.833b	13.333b	12.500b	50.000b
F.test		**	**	**	**	**

T1= Fresh manure and insect control, T2= Fresh manure and no insect control, T3= Stored manure and insect control, T4= Stored manure and no insect control, T5= No manure and insect control and T6= No manure and no insect control.

* and ** indicated P< 0.05, 0.01 and not significant, respectively.

Figure 1:Severity of infection % by stalk rots causal organisms of two maize cultivars (SC10 and Balady) which were planted in C. maydis field disease nursly under different animal manures fertilization and insects control during 2020 and 2021 growing sea



T1=Fresh manure and insect control, T2= Fresh manure and no insect control, T3= Stored manure and insect control, T4= Stored manure and no insect control, T5= No manure and insect control ,and T6= No manure and no insect control

Table 2. Severity of infection % by stalk rots causal agents of two maize cultivars (SC10 and Balady) were sowed in *C. maydis* field disease nursing under different animal manures fertilization and insects control during 2021 growing season.

	Treatments	*F.verticilioides%*	*C.maydis%*	Sclerotium%	Other fungi%	stalk rot complex %
Cultivars (A)	SC10	6.944b	5.583b	7.917b	7.083b	27.528b
	Balady	11.111a	8.750a	11.389a	12.056a	43.306a
F.test		**	**	*	**	*
Treats (B)	T1	9.583c	7.917b	9.583b	10.833b	37.917c
	T2	13.333a	10.417a	14.583a	13.667a	52a
	T3	4.583e	2.5d	5.000d	5.000d	17.083f
	T4	7.083d	5.000c	7.500c	7.500c	27.083e
	T5	8.333cd	5.83bc	7.917bc	8.75c	30.833d
	T6	11.25b	11.33a	13.330a	11.667a	47.583b
F.test		**	**	**	**	**
A×B	SC10 ×T1	6.667e	6.667d	8.333d	8.333d	30.000e
	SC10 ×T2	10.833b	9.167c	13.333b	11.667c	45.000b
	SC10 ×T3	3.333f	1.667f	3.333f	3.333f	11.667g
	SC10 ×T4	5.833e	4.167de	5.833e	5.833e	21.667f
	SC10 ×T5	5.833e	3.333e	5.833e	5.833e	20.833f
	SC10 ×T6	9.167bc	8.500cd	10.833c	7.500d	36.000d
	Balady ×T1	12.500b	9.167c	10.833c	13.333b	45.833b
	Balady ×T2	15.833a	11.667b	15.833a	15.667a	59.000a
	Balady ×T3	5.833e	3.333e	6.667e	6.667e	22.500f
	Balady ×T4	8.333bc	5.833d	9.167cd	9.167d	32.500de
	Balady ×T5	10.833b	8.333cd	10.000c	11.667c	40.833c
	Balady ×T6	13.333b	14.167a	15.833a	15.833a	59.167a
F.test		**	**	**	**	**

- and ** indicated P< 0.05, 0.01 and not significant, respectively.

In terms of the effect of soil treatments with different animal manures and insect control on lodging percentage, weight of 100 grain values, and yield per treatment, the data obtained during 2020 in Table 3 showed that the infection by insect percentage and lodging percentage were low in SC10, at 5.833 and 5.583%, respectively, while they were high in Balady cv., at 11.528 and 11.944%, respectively. The 100 grain weight as well as yield per each treatment were high in SC10 (38.389 g and 11.751 kg, respectively), while they were low in balady CV (35.250 g and 7.461 kg, respectively). On the other hand, the highest infection by insects as well as the highest lodging (10.00 and 10.00% in SC10 and 16.00 and 16.00% in Balady cv, respectively) were recorded in treatment no. 2 (soil treatment by fresh animal manure and no insect control); therefore, the lowest 100 grain weight as well as the lowest yield per treatment (35.66g and 11.217kg in SC10 and 32.66g and 6.983kg in Balady cv, respectively) were obtained under the same treatment (T2) mentioned above. In the reversal, the lowest infection by insects% as well as the lowest lodging % (1.667 and 0.833 % in SC10, and 5.833 and 6.667% in Balady cv, respectively) and the highest weight of 100 kernels as well as the highest yield per 2 rows (43.33 g and 12.5 kg in SC10, and 38.33 g and 7.917 kg in Balady cv, respectively) all were obtained under T3 treatment no 3 (soil treatment by decomposing animal manure and insect control) (soil treatment by decomposing animal manure and weed control (in On the other hand, the results obtained during the 2021 growing season (table 4) showed the same direction as those obtained during the 2020 growing season (table 3).

Table 3. Severity of infection % by stalk rot complex %, infection by insects%, lodging%, weight of 100 kernel (g) and yield per two rows (kg) of two maize cultivars (SC10 and Balady) were sowed in *C. maydis* field disease nursey under different animal manures fertilization and insects' control during 2020 growing season.

	Treatments	**stalk rot complex %**	**Infection by Insects %**	**Lodging %**	**Weight of 100 kernel (g)**	**Yield per two rows (kg)**
Cultivar (A)	SC10	33.333b	5.833b	5.583b	38.389a	11.751a
	Balady	44.556a	11.528a	11.944a	35.250b	7.461b
F.test		**	**	**	**	**
Treats (B)	T1	44.167b	9.580b	10.917c	36.833c	9.577c
	T2	58.750a	13.330a	13.333a	34.167e	9.100e
	T3	19.500e	3.750d	3.750d	40.833a	10.208a
	T4	30.000d	6.660c	7.083c	38.583b	9.898b
	T5	35.833c	8.750bc	7.917c	35.833d	9.458d
	T6	45.410b	10.000b	9.583b	34.667e	9.392d
F.test		**	**	**	**	**
A×B	SC10 ×T1	35.833d	5.833de	8.500cd	38cd	11.737c
	SC10 ×T2	50.833b	10.000c	10.000c	35.66e	11.217e
	SC10 ×T3	15.833g	1.667f	0.833f	43.33a	12.5a
	SC10 ×T4	25.833f	4.167e	3.333e	40.33b	12.017b
	SC10 ×T5	30.833e	6.667d	5.000d	37.33cd	11.517d
	SC10 ×T6	40.833c	6.667d	5.833d	35.66e	11.517d
	Balady ×T1	52.500b	13.333b	13.333b	35.66e	7.417g
	Balady ×T2	66.667a	16.667a	16.667a	32.66g	6.983h
	Balady ×T3	23.167f	5.833de	6.667d	38.33c	7.917f
	Balady ×T4	34.16de	9.167c	10.833c	36.83de	7.78f
	Balady ×T5	40.830c	10.833bc	10.833c	34.33f	7.4g
	Balady ×T6	50.000b	13.333b	13.333b	33.667fg	7.267g
F.test		**	**	**	*	**

*and ** indicated P< 0.05, 0.01 and not significant, respectively.

Table 4. Severity of infection % by stalk rot complex %, infection by insects%, lodging%, weight of 100 kernel (g) and yield per two rows (kg) of two maize cultivars (SC10 and Balady) were sowed in *C. maydis* field disease nursey under different animal manures fertilization and insects control during 2021 growing season.

	Treatments	**stalk rot complex %**	**Infection by Insects %**	**Lodging %**	**Weight of 100 kernel (g)**	**Yield per two rows (kg)**
A	SC10	27.528b	6.944b	7.639b	37.172a	11.788a
	Balady	43.306a	11.111a	10.306a	35.356b	7.415b
F.test		*	**	**	**	**
B	T1	37.917c	10b	9.667bc	36c	9.528c
	T2	52.000a	15a	15.417a	33.73e	9.075e
	T3	17.083f	4.58e	3.33e	40.85a	10.325a
	T4	27.083e	6.25d	5d	38.28b	9.933b
	T5	30.833d	7.91c	9.167c	34.78d	9.433cd
	T6	47.583b	10.41b	11.25b	33.93e	9.315d
F.test		**	**	**	**	**
A×B	SC10 ×T1	30.000e	8.333cd	8.333e	36.06cd	11.707c
	SC10 ×T2	45.000b	11.667b	14.16b	34.06fg	11.183e
	SC10 ×T3	11.667g	2.5000f	0.833g	43.06a	12.71a
	SC10 ×T4	21.667f	4.167e	2.5g	39.73b	12.15b
	SC10 ×T5	20.833f	5.833de	9.167de	35.5de	11.55cd
	SC10 ×T6	36.000d	9.167c	10.83cd	34.6ef	11.43d
	Balady ×T1	45.833b	11.667b	11cd	35.93cd	7.35h
	Balady ×T2	59.000a	18.333a	16.667a	33.4fg	6.967i
	Balady ×T3	22.500f	6.667d	5.833f	38.63b	7.94f
	Balady ×T4	32.500de	8.333cd	7.5ef	36.83c	7.717g
	Balady ×T5	40.833c	10.000bc	9.167de	34.06fg	7.317h
	Balady ×T6	59.167a	11.667b	11.667c	33.267g	7.2h
F.test		**	**	*	**	**

* and ** indicated P< 0.05, 0.01 and not significant, respectively.

Results in table 5 during 2020 and figure 2 cleared that, the mean severity of *F.verticilioides%* , *F. semetictum%*, *A.flavus%*, *A.niger*% and *Pencillium sp. %* were high 16.267, 13.561, 12.25, 13.394 and 12.139 % in Balady cv comparing with 12.183, 10.139, 9.439, 10.217 and 8.978 in SC10, respectively . on the other hand, the highest infection percentage were obtained with treatment no 2 (T2= soil treatment with Fresh manure and no insect control) it was 15.967, 12.733, 9.833, 13.733 and 12.067 % in SC10 respectively. While, it was very high in Balady cv i.e 20.833, 17.400, 13.400, 18.167 and 17.067 %, respectively. On the revers. The lowest infection percentages by kernels rots causal organisms were obtained with treatment no 3 (T3= Stored manure and insect control), it recorded 8.733, 5.733, 4.167, 6.633 and 5.067 % in SC10, respectively, while it was 13.167, 12.167, 6.067, 9.167 and 6.967 % in Balady cv respectively. On the other hand, the results obtained in table 6 during 2021 were in the same trend with which obtained during 2020 in table 5.

Table 5. Severity of infection % by stalk rot complex % and infection% by kernel rots diseases causal organisms of two maize cultivars (SC10 and Balady) were sowed in *C. maydis* field disease nursey under different animal manures fertilization and insects control during 2020 growing season.

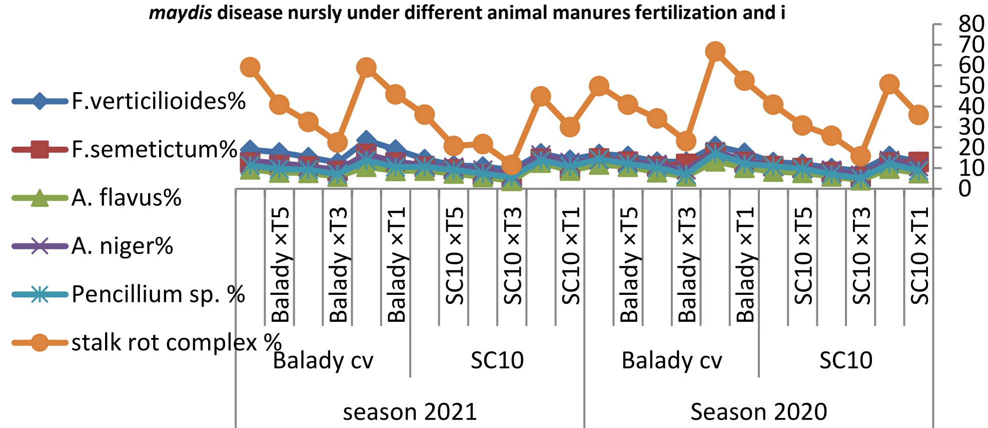
	Treatments	stalk rot complex %	*F. vertecilioides %*	*F. semetictum %*	*A.flavus%*	*A.niger%*	*Pencillium sp. %*
Cultivar (A)	SC10	33.333b	12.183b	10.139b	9.439b	10.217b	8.978b
	Balady	44.556a	16.267a	13.561a	12.25a	13.394a	12.139a
F.test		**	**	**	*	**	**
Treat (B)	T1	44.167b	15.35b	13.067ab	11.233b	12.233b	10.467c
	T2	58.750a	18.4a	15.067a	15.75a	15.95a	14.567a
	T3	19.500e	10.95d	8.95d	7.067e	7.9d	6.017e
	T4	30.000d	11.617c	9.5cd	8.783d	10.517c	8.617d
	T5	35.833c	14.067c	11.617bc	10.5c	11.617b	10.95c
	T6	45.410b	14.967c	12.9ab	11.733b	12.617b	12.733b
F.test		**	**	**	**	**	**
A×B	SC10 ×T1	35.833d	13.200d	13.067b	7.633c	10.733cd	8.867de
	SC10 ×T2	50.833b	15.967c	12.733bc	9.833bc	13.733b	12.067c
	SC10 ×T3	15.833g	8.733f	5.733e	4.167e	6.633e	5.067f
	SC10 ×T4	25.833f	10.067e	8.167d	6.067d	9.067d	7.067e
	SC10 ×T5	30.833e	12.167de	10.067c	7.733c	10.067cd	9.733d
	SC10 ×T6	40.833c	12.967de	11.067c	8.400c	11.067c	11.067cd
	Balady ×T1	52.500b	17.500b	13.067b	10.167b	13.733b	12.067c
	Balady ×T2	66.667a	20.833a	17.400a	13.400a	18.167a	17.067a
	Balady ×T3	23.167f	13.167d	12.167bc	6.067d	9.167d	6.967ef
	Balady ×T4	34.16de	13.167d	10.833c	8.067c	11.967c	10.167d
	Balady ×T5	40.830c	15.967c	13.167b	10.633b	13.167b	12.167c
	Balady ×T6	50.000b	16.967b	14.733b	11.833b	14.167b	14.400b
F.test		**	*	*	**	*	**

*and ** indicated P< 0.05, 0.01 and not significant, respectively.

Table 6. Severity of infection % by stalk rot complex % and infection% by kernel rots diseases causal organisms of two maize cultivars (SC10 and Balady) were sowed in *C. maydis* field disease nursey under different animal manures fertilization and insects control during 2021 growing season.

	Treatments	**stalk rot complex %**	***F. vertecilioides%***	***F. semitictum%***	***A.flavus %***	***A.niger %***	***Pencillium sp. %***
Cultivar (A)	SC10	27.528b	12.861b	9.439b	7.894	11.228b	8.561
	Balady	43.306a	17.906a	12.25a	8.394	12.65a	10.267
F.test		*	**	*	NS	**	*
Treat (B)	T1	37.917c	16.567b	11.233b	8.783b	13b	10.667b
	T2	52.000a	20.45a	15.75a	11.733a	16.567a	13.783a
	T3	17.083f	10.917e	7.067e	4.833e	8.117e	6.333e
	T4	27.083e	13.117d	8.783d	6.733d	10d	8.333d
	T5	30.833d	14.567c	10.5c	7.667c	11.45c	9.35c
	T6	47.583b	16.683b	11.733b	9.117b	12.5b	11.017b
F.test		**	**	**	**	**	**
A×B	SC10 ×T1	30.000e	14.067e	9.733ef	8.83cd	12.833b	10.833b
	SC10 ×T2	45.000b	17.3c	14.533b	12.73a	16.400a	13.833a
	SC10 ×T3	11.667g	9.067h	5.4h	3.83g	7.067d	5.500d
	SC10 ×T4	21.667f	10.833g	6.733g	5.733f	9.067c	7.400c
	SC10 ×T5	20.833f	11.4g	9.5f	7.4e	10.500c	9.067b
	SC10 ×T6	36.000d	14.5de	10.73de	8.83cd	11.500bc	10.733b
	Balady ×T1	45.833b	19.067b	12.733c	8.73cde	13.167b	10.500b
	Balady ×T2	59.000a	23.6a	16.967a	10.733b	16.733a	13.733a
	Balady ×T3	22.500f	12.767f	8.733f	5.83f	9.167c	7.167c
	Balady ×T4	32.500de	15.4d	10.833d	7.733de	10.933	9.267b
	Balady ×T5	40.833c	17.733c	11.5d	7.933de	12.400b	9.633b
	Balady ×T6	59.167a	18.867b	12.733c	9.4c	13.500b	11.300b
F.test		**	**	*	**	*	**

Figure 2: Severity of infection % by stalk rot complex % and in fection % by kernel rots diseases causal organisms of two maize cultivars (SC10 and Balady cv) were planted in *C. maydis* disease nursly under different animal manures fertilization and i



T1= Fresh manure and insects control, T2= Fresh manure and no insects control, T3= Stored manure and insects control , T4= Stored manure and no insects control, T5= No manure and insects control, and T6= No manure and no insects control

Data presented in table 7 showed that, in SC10, the germination, protein, oil and ash % were high 93.05 & 92.66, 8.727 & 9.016 , 7.107 & 6.87 % and 1.598&1.649% during 2020 &2021 seasons, respectively, comparing with 91.61 & 90.83%, 7.767 & 8.166%, 6.434 & 6.23% and 1.127 &1.298% in balady cultivar during 2020 &2021 seasons, respectively. The results in table 7 also showed that, the highest germination %, protein, oil % and ash % were obtained with fertilized by decomposing manure T3 and T4, it was recorded 95.83 & 95.5%, 8.99 & 9.55 %, 7.365 & 6.89 % and 1.682 & 1.78 % in T3 during 2020 & 2021 seasons, respectively, while it recorded 95.5 & 93.5%, 8,85 & 8.97, 7.143 & 6.73 % and 1.677&1.69 % in T4 during 2020 & 2021 seasons, respectively. The same trend was observed in table 7 with the interactions between treatments and tested maize cultivars (SC10 and balady maize cultivars) during 2020 and 2021 growing seasons.

Data presented in table 8 found that, in SC10, the fiber%, Carbohydrate% and phenols Mg\100g, were high 2.695 &2.713% , 77.49 & 76.35% and 1.36 &1.55 during 2020 &2021 seasons, respectively, comparing with 2.382 & 2.551%, 76.758 & 75.21and 1.305 & 1.41 in balady cultivar during 2020 &2021 seasons, respectively. Results in table 8 also showed that, the highest fiber %, Carbohydrate% and phenols were obtained with fertilized by decomposing manure T3 and T4, it was recorded 2.665 & 2.78 % , 79.814 & 78.41 % and 2.004 & 2.101 in T3 during 2020 & 2021 seasons, respectively, while it recorded 2.537 & 2.69 %, 78.41& 76.81 and 2.068 & 2.123 in T4 during 2020 & 2021 seasons, respectively. The same trend was observed in table 8 with the interactions between treatments and tested maize cultivars (SC10 and balady maize cultivars) during 2020 and 2021 growing seasons.

Table 7. Germination %, Protein %, Oil % and Ash % content in grains were affected by two kinds of animal manure treatment and insects infection in two maize genotypes during 2020 and 2021 growing seasons.

		Germination %		**Protein %**		**Oil %**		**Ash %**	
Season		2020	2021	2020	2021	2020	2021	2020	2021
	SC 10	93.05a	92.66a	8.727a	9.016a	7.107a	6.87a	1.598a	1.649a
A	baldy	91.61b	90.83b	7.676b	8.166tb	6.434b	6.23b	1.127b	1.298b
F test		*	*	**	**	**	**	**	**
	T1	94ab	91.5bc	7.4c	7.64c	6.867	6.11	1.462c	1.56c
	T2	90.17c	88.5cd	7.32c	6.97d	6.962	5.91	1.471c	1.36d
	T3	95.83a	95.5a	8.99a	9.558a	7.365	6.89	1.682a	1.78a
	T4	95.5a	93.5ab	8.85a	8.97b	7.143	6.73	1.677a	1.69a
	T5	94ab	91.5bc	7.46c	7.89c	6.667	6.54	1.595b	1.49c
B	T6	90.5b	87d	7.787b	7.55c	6.82	6.39	1.489c	1.65b

F test		*	**	**	**	NS	NS	**	**
A×B	SC10 ×T1	94bc	92c	7.82ef	8.01ef	6.85e	6.52bcd	1.481cd	1.24d
	SC10 ×T2	90d	89de	6.59g	7.0g	6.71e	6.49bcd	1.56bcd	1.12e
	SC10 ×T3	97a	96a	11.65a	12.01a	8.21a	8.0a	1.827a	1.72a
	SC10 ×T4	95b	94b	9.33bc	9.56bc	7.77b	7.61ab	1.754a	1.67a
	SC10 ×T5	94bc	92c	8.87cd	8.97cd	6.52f	6.23cd	1.489cd	1.30cd
	SC10 ×T6	92cd	90d	8.1de	8.23de	6.58f	6.34cd	1.467d	1.43bc
	Balady ×T1	91d	90d	6.98fg	7.78fg	6.88e	6.66bcd	1.444d	1.32c
	Balady ×T2	88.33e	87e	6.82g	6.97g	6.153g	6.01d	1.6bc	1.40bc
	Balady ×T3	95.67ab	94b	9.77b	9.98b	7.58c	7.45ab	1.501cd	1.54b
	Balady ×T4	93c	90d	8.05de	8.12de	7.06d	6.98bc	1.627b	1.55b
	Balady ×T5	90d	90d	6.71g	6.88g	6.82e	6.65bcd	1.454d	1.23d
	Balady ×T6	90d	88e	7.76ef	7.98ef	6.52f	6.31cd	1.54bcd	1.39c
F test		*	*	**	**	**	**	**	**

* and** indicated P< 0.05, 0.01 and not significant, respectively.

Table8: Fiber %, carbohydrate %, and phenols content in grains were affected by two kinds of animal manure treatment and insects' infection in two maize genotypes during 2020 and 2021 growing seasons.

		Fiber %		**Carbohydrate %**		**Phenols Mg\100g**	
Season		2020	2021	2020	2021	2020	2021
A	SC10	2.695a	2.713a	77.49a	76.35a	1.36a	1.55a
	Balady	2.382b	2.551b	76.758b	75.21b	1.305b	1.41b
F test		**	**	**	**	*	*
B	T1	2.29cd	2.35cd	73.52c	73.12c	0.916c	0.926c
	T2	2.19d	2.22d	74.449c	73.35c	0.895c	0.996c
	T3	2.665a	2.78a	79.814a	78.41a	2.004a	2.101a
	T4	2.537b	2.69b	78.41a	76.81ab	2.068a	2.123a
	T5	2.379c	2.41c	78.12ab	77.81ab	1.025b	1.112b
	T6	2.27cd	2.39cd	76.475b	75.56b	1.084b	1.125b
F test		**	**	**	**	**	**
A×B	SC10 ×T1	2.56abc	2.45ab	75.444b	73.61b	0.898b	0.987b
	SC10 ×T2	2.37def	2.18de	74.011b	73.98b	0.862b	0.895b
	SC10 ×T3	2.701a	2.67a	79.96a	76.56a	1.975a	2.012a
	SC10 ×T4	2.698a	2.61a	78.16a	76.99a	2.043a	2.115a
	SC10 ×T5	2.243efg	2.13efg	77.926a	74.87b	0.988b	0.998b
	SC10 ×T6	2.394cde	2.29cde	75.042b	74.09b	1.066b	1.112b
	Balady×T1	2.515bcd	2.45bcd	75.586b	74.34b	0.933b	0.959b
	Balady×T2	2.206fg	2.19fg	74.888b	73.93b	0.928b	0.968b
	Balady×T3	2.63ab	2.54ab	79.665a	76.77a	2.032a	2.121a
	Balady×T4	2.592b	2.55b	78.052a	77.09a	2.094a	2.215a
	Balady×T5	2.138g	2.09g	78.885a	74.01b	1.061b	1.065b
	Balady×T6	2.364def	2.25def	75.909b	74.54b	1.102b	1.034b
F test		**	**	*	*	*	*

DISCUSSION

The stored organic manure may be a suitable alternative for reducing the severity of many diseases. Previous studies assessed the importance of using the stored manure as soil fertilizer. Therefore, Bonanomi *et al.* (2007) found that using organic manure in fertilization led to inhibition for about 45 percent of the many diseases studied. Alakonya *et al.* (2003) suggest that organic animal manure is generally suppressive of the activity and infection of maize plants by *F. moniliforme* compared to untreated manure. The survival of *F. moniliforme* decreased gradually with time after planting. The use of organic manure might be a suitable option in the management of *F. moniliforme* in areas where the pathogen is dominant. Moreover, Hafiza *et al.* (2016) showed that old animal manure (storage manure) can stimulate antagonistic activities of microorganisms toward soil-borne pathogens as well as decrease the incidence of diseases. The storage of organic manure in farmyards also leads to the accumulation of some specific compounds that may be used to manage fungi and other soil-borne pathogens. Pan *et al.,* (2019) showed also that organic fertilizer has a potential effect in a disease control program that would minimize the use of conventional fungicides. They added that using fresh animal manures in fertilization resulted in increased development of root rot diseases as well as dieback and plant death. In general, the treatment of soil by decomposing animal manure and insect control led to the lowest infection by stalk rots causal organisms as well as the lowest infection percent by stalk rots complex as compared with fertilizing soil by fresh animal farmyard manure and no control of insects. On the other hand, several studies have attributed the effect of animal manure and infection by insects on the severity of infection by stalk rot pathogens, lodging percentage, weight of 100 kernels, and yield per plot. Therefore, Gatch and Munkvold (2001) showed that the Ostrinianubilalis, also known as the European corn borer, can contribute to stalk rot development by either creating entry wounds or by serving as a vector for some stalk rot pathogens, particularly *Fusarium verticillioides*. In the same direction, Freije and Wise (2016) found that stalk rot destroys stalks and symptoms do not appear until the late stages of maize plants. Many of the organisms explained that stalk rot pathogens infect plants, which become weaker because of decreasing nutrient or water imbalances, insect damage, and foliar disease damage. Insect damage plays an effective role in predisposing a maize plant to infection; therefore, planting hybrids with insect-resistance traits may reduce the effects of stalk rot diseases. Moreover, Byamukama and Yabwalo (2019) found that stalk rots are quite common corn diseases. Yield losses resulting from disease ranged from 5 to 20%, according to the susceptibility rate of the hybrid. Stalk rots cause yield loss through reduced seed size if the plants wilt before grain fill. Stalk rots also reduce yield production when infected plants lodge and their ears touch the watered soil, as well as when they are not picked by the combines during harvest. Lodged stalks may also lead to ear rots developing because the ears touch the soil or are exposed to high soil moisture content on the soil surface. Stress on maize plants caused by leaf diseases, low soil fertility, high planting population, and insect damage may all increase the severity of stalk rot. Overall, Essam *et al.* (2020) added that using composted manure in fertilization resulted in the maximum 100-grain weight and grain yield of maize varieties. Samar *et al.* (2023) concluded that high yield (kg/2 rows) and high weight of 100 grains were obtained from plots treated with storage animal manure (old manure) compared with untreated and control treatments, while treatment with fresh animal manure resulted in bad values for all tested characters. In general, the obtained results indicated that treatment of soil by decomposing animal manure and insect control led to the lowest infection by stalk rot causal organisms as well as the lowest infection percent by kernel rot diseases compared with fertilization of soil by fresh animal manure and no control of insects. These results agree with those illustrated by Mweshi *et al.,* (2010), who found that the dominant ear rots were caused by *Fusarium spp.*, especially *Fusarium verticillioides*. The mean rank of fungal species, from highest to lowest, was *F. verticillioides*, *Aspergillus* niger, *Fusarium* graminearum, *A. flavus*, and *Aspergillus* spp. Neher *et al.,* (2013) added that using storage farmyard manure led to a contrast in biochemical structure and stable resistance to destruction. decomposing animal manure typically had higher C and N values and also higher lignin and cellulose levels than those obtained from fresh manure, making them more resistant to decay and extending the longevity of the suppressive effect. In the same item, Masibonge *et al.* (2015) showed that maize ear and kernel rot diseases are global phenomena that lead to significant yield loss in quantitative and qualitative terms. Moreover, ear and kernel rot damage to corn can be caused by a number of fungi, especially *Fusarium* species, *Aspergillus* species, and Penicillium species. The organic manure increases the activity of suppressiveness-related enzymes and nutrient contents. Overall, two types of animal manure treatment and insect infection affected grain germination, protein, oil, fiber, carbohydrates, ash, and phenol content. The obtained results indicated the grains' contents were enhanced with stored animal manure and insect control. These results were in agreement with findings by Essam *et al.* (2020), which observed that application of composted manure increased the protein concentration (%) of maize varieties. Moreover, Samar *et al.,* (2023) added that the highest germination percentage and the highest values of grain components (oil %, carbohydrates %, fiber %, phenols Mg100 g, protein %) were observed in plots that were fertilized by decomposing animal manure (5–6 weeks old) compared with the control treatment, while plots fertilized by fresh animal manure gave the lowest values of all the tested characters mentioned above. These results were in line with findings by Freije and Wise (2016) and Samar *et al.* (2023). They illustrated that high percent of grain components (carbohydrates, oil, fiber, phenols, and protein) were observed in maize hybrids (SC176 and SC10), which had a good level of resistance to tested diseases compared with an open-pollinated variety (Balady). The desirable results of decomposing manure in seed composition may be because it contains many valuable soil nutrients. Some of these nutrients are the same as those found in commercial fertilizers: ammonium, nitrogen, soluble phosphate, and potassium salts.

CONCLUSION:

Collectively, this study recommended the importance of storing farmyard animal manure for some time (at least 7-8 weeks) to identify alternative methods as control methods that have high efficiency, low costs, and positive impacts on human health, food safety, and environmental contaminations, as well as being highly suitable for corn stalk rot control because using fresh animal manure in fertilization leads to increased infection by stalk rot complex pathogens and disease severity development, as well as increased ear and kernel rot disease, indicating the considerable danger when fertilized by tested fresh animal manure. Moreover, the highest germination percent and the highest percent of grain components, i.e., protein percent, oil percent, ash percent, fiber percent, carbohydrates percent, and phenols percent, as well as the lowest lodging percent, were obtained also from treatments that fertilized with storage animal manure (old manure) and sprayed

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أمراض أعفان الساق المركب وارتباطها بتنوع السماد البلدي والمقاومة الحشرية وتأثيرها علي جودة حبوب الذرة الشامية

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أظهرت النتائج المتحصل عليها من استجابة بعض الطرز الوراثية في الذرة الشامية للإصابة بمسببات أعفان الساق (سيفالوسيوريوم مايدس، فيوزاريوم فيرتيسيليودس , اسكليلوشيم باتاتيكولا ، وفطريات اخري مثل الماكروفومينا فاسيولينا وانواع أخري من الفيوزاريوم والريزوكتونيا) أن أعلي إصابة بهذه الفطريات كانت في حالة تسميد التربة بالسماد العضوي الطازج وبدون رش النباتات ضد الثاقبات ، وذلك مقارنة بالمعاملات المسمدة بالسماد العضوي المخزون لمدة من ٧- ٨ أسابيع والتي تم رش النباتات فيها ضد الثاقبات. وكانت المعاملات المسمدة بالسماد العضوي المخزون وبدون رش للثاقبات أقل في فعاليتها في تقليل نسبة الإصابة بالمسببات المرضية المختبرة مقارنة بالمعاملات المسمدة بالسماد العضوي المخزون والمرشوشة ضد الثاقبات. بينما كان العكس صحيح وكانت نسبة الإصابة بالمسببات المختبرة هي الأعلى والاشد مع المعاملات التي تم تسميدها بالسماد العضوي الطازج ولم يتم رشها ضد الثاقبات, وهذا يوضح الأهمية القصوى في استخدام السماد العضوي بعد تخزينه لفترة من الزمن كي يتحلل إلي مكونات صالحة للنبات وترتفع درجة حرارته لقتل بذور الحشائش وبيض الحشرات وميسليوم وجراثيم الفطريات والامتناع مطلقا عن التسميد بالسماد العضوي الطازج للتربة المصرية. إضافة الي ما سبق فان أعلي نسبه للإصابة بالثاقبات وبالتالي أعلي نسبة رقاد للنباتات تم تسجيلها في المعاملات المسمدة بالسماد العضوي الطازج والتي لم يتم رشها ضد الثاقبات، وعلي العكس كانت أقل نسبه للإصابة بالثاقبات وأقل نسبة رقاد للنباتات تم تسجيلها في المعاملات المسمدة بالسماد العضوي المخزون والمرشوشة ضد الثاقبات. وعلي الجانب الاخر فان أقل وزن للمائة حبة وبالتالي أقل محصول لكل خطين تم تسجيلهما في المعاملات المسمدة بالسماد العضوي الطازج والغير مرشوشة ضد الحشرات وكان العكس صحيح في حالة المعاملات المسمدة بالسماد العضوي المخزون والمرشوشة ضد الثاقبات. أوضحت النتائج أيضا أن الهجين الفردي ١٠يحتوي علي نسبة مقاومة مناسبة للإصابة بمسببات أعفان الساق ومسببات أعفان الحبوب والكيزان وأعطي قيم مرتفعة لوزن المائة حبة والمحصول للخطين مقارنة بالصنف المفتوح التلقيح (الصنف البلدي). وبينت النتائج المتحصل عليها من عزل مسببات أعفان الحبوب والكيزان أن الفطر فيوزاريوم فيرتيسيليودس هو المسبب الرئيسي والسائد والذي سجل أعلي نسبة إصابة في الحبوب المختبرة وتحت كل المعاملات السمادية والحشرية المختبرة، ثم جاء بعده الفطر اسبرجلس نيجر والبنسيليوم وكان أقلهم إصابه هي الفطريات اسبرجلس فلافس وفيوزاريزم سيميتيكتم وذلك تحت كل المعاملات السماديه والحشرية المختبرة. وفي نفس السياق بينت النتائج المتحصل عليها أن مسببات أعفان الحبوب سجلت أعلي نسبة اصابة للحبوب في المعاملات المسمدة بالسماد العضوي الطازج والغير معاملة ضد الثاقبات, بينما سجلت أقل نسبة اصابة بهذه المسببات في حالة التسميد بالسماد العضوي المخزون والمرشوشة ضد الثاقبات. وبناءا علي ما سبق فان التسميد بالسماد العضوي الطازج أدي الي زيادة نسبة الإصابة بكل المسببات المرضية المختبرة (مسببات عفن الساق ومسببات عفن الحبوب والكيزان), وهذا يوضح لنا خطورة استخدام المزارع للسماد العضوي الطازج في تسميد الحقل قبل تخزينه لبضع أسابيع. بينت النتائج المتحصل عليها من التحليل الكيمائي لبعض مكونات الحبة أن أعلي نسبة انبات وكذلك أعلي نسبة لمكونات الحبة من البروتين والزيت والرماد والألياف والكربوهيدرات والفينولات تم تسجيلها في الحبوب المأخوذة من البلوطات المسمدة بالسماد العضوي المخزون (٧- ٨أسابيع) والمرشوشة ضد الحشرات مقارنة بالمأخوذة من البلوطات التي لم يتم تسميدها ولم يتم رشها ضد الثاقبات (معاملة المقارنة). بينما كان العكس صحيح في المعاملات المسمدة بالسماد العضوي الطازج والغير مرشوشه ضد الثاقبات. وفي النهاية فان هذه الدراسة توصي بعدم استخدام السماد العضوي الطازج مطلقا في حقول المزارعين, وذلك لتثبيط بعض الامراض وللحصول على أعلي محصول في الكم والجودة يجب استخدام السماد العضوي بعد تخزينه لمده من ٧- ٨ أسابيع الأقل.

الكلمات المفتاحية : الذرة ، السماد البلدي ، أمراض عفن الساق المركب ، جودة البذور.