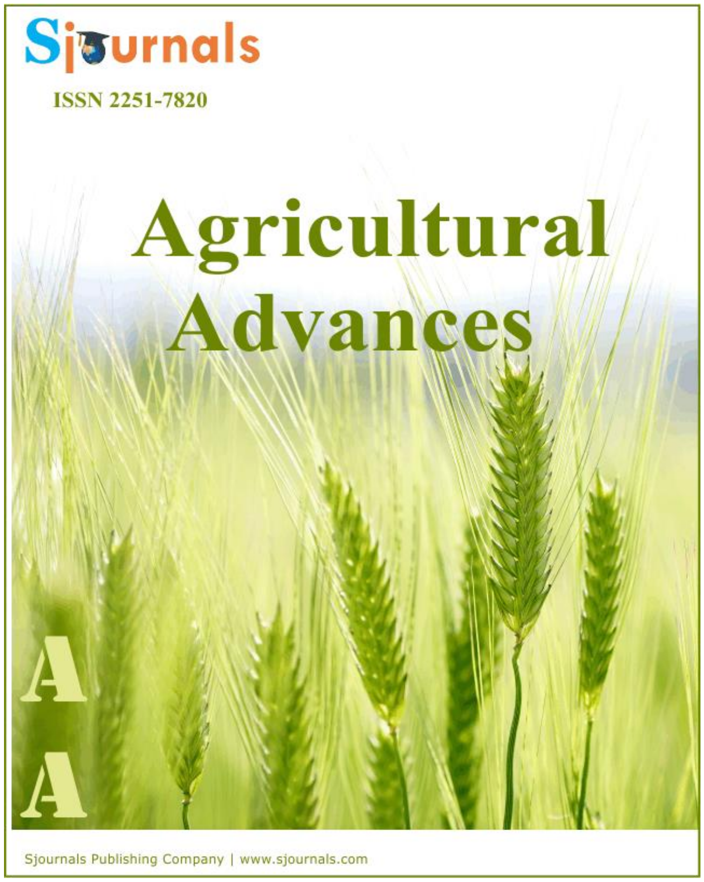
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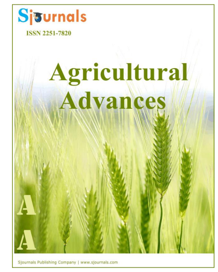

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Original article

Study of lately maturing maize genotypes to fusarium ear rot

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In order to recognition of resistance in lately maize genotypes to ear rot fusarium disease, this study was conducted with 37 hybrids and 30 lines which were produced at corn and forage crop department. These genotypes were used at Qharakheil agricultural research station in 2017-2018. Distance of row spacing was 75 centimeters, row length was 2/5 m and plans distance in row was 25 centimeters. By handle inoculation, all of genotypes were inoculated, and the amount of genotypes resistant were recognized (Disease severity). The results in 2017 showed that five lines had susceptible, eight lines had tolorant and two lines had resistant. Two hybrids had susceptible and one resistant, 17 hybrids had tolorant. Results in 2018 showed that three lines had susceptible, two lines had very susceptible and two lines tolorant.

1. Introduction

One of the most important corn diseases, especially at intropical and subtropical regions, is Fusarium ear rot. This disease has been reported from the cultivation regions of maize in Iran (Rahjou et al., 2009). Fusarium spp are known as common fungal pathogens of maize, causing ear, stalk, and root rots (Munkvold and Desjardins, 1997). When infection develops into Fusarium ear rot, the disease becomes of particular concern to corn producers, not only because it reduces grain quality (Afolabi et al., 2007) but also because F. verticillioides produces toxic secondary metabolites in corn kernels, called umonisins (Marasas, 2001; Marasas et al., 1981).

Fusaria is infected at different developmental stages of maize, leading to ear rot, which are recognized the most important maize diseases (White, 1999). Although the etiology of this diseases is complex, the principal causative factors are members of the *Discolor* and *Liseola* section of the *Fusarium* genus (Munkvold, 2003). Occurrence of *Fusarium* species in particular cropping seasons is variable, changes from year to year, and is strongly influenced by weather conditions (Stewart et al., 2002). High temperature and limited precipitation favor especially *F. verticillioides* incidence (Afolabi et al., 2007).

Fusarium pink ear rot usually occurs on individual or groups of kernels that are often covered with white or light pink mycelium (Moretti et al., 2002). Among the *Fusarium* species able to produce fumonisins, only those belonging to the *G. fujikuroi* clade, and especially *F. verticillioides* and *F. proliferatum*, have been associated with fumonisin contamination of agricultural commodities like corn and its derived products (Marin et al., 2004).

Management of fumonisin contamination in maize relies on the control of the fungal infection and requires a better understanding of *F. verticillioides* biology and epidemiology (Rossi et al., 2009). Infection through silks was recognized as the most important pathway for *F. verticillioides* infection (Desjardins et al., 2002). *Fusarium verticillioides* contamination levels during vegetative growth till the pre-silking stage indicated that the fungus endophytically colonizes plants and protects the host against more damages by pathogens (Knop et al., 2007; Lee and May, 2009). *F. verticillioides* is often studied as a fungus of low pathogenic properties towards cereals compared to other *Fusarium* species affecting this crop (Wit et al., 2010). Headrick (Headrick and Pataky, 1989) reported that kernel emergence reduced from silk inoculated sweet corn ears.

Study into the potential for using microbes antagonistic to *Fusarium* spp. is being conducted with rice plants susceptible to *F. moniliforme* (Marin et al., 2004). Some species may suppress growth of toxigenic fungi. Since these toxins are heat-stable, ordinary cooking and procedures for heat processing do not substantially reduce toxin levels. However, other processing steps may decrease toxin levels. Recent data from Kansas (Rumbeiha and Oehme, 1997) and the U.K. (Patel et al., 1997) determined that certain corn products contain relatively high levels of fumonisins: corn meal (up to 349 ng/g), polenta (up to 2124 ng/g), and corn flour (up to 167.7 ng/g). Other corn-based foods generally had low mycotoxin levels but some individual samples contained significantly higher levels. Other products, including corn oils, corn syrups, tortilla shells, and canned corn had little or no detectable fumonisins. Some of these differences in toxin levels in different products result from some physical or mechanical steps during processing. Since fumonisins are present at higher concentrations in rice husks and in corn screenings from infected plants, polishing of rice and removal of small particles from corn processing can significantly reduce toxin levels. Aqueous extraction of fumonisin-contaminated material also removes significant amounts of this water-soluble toxin and thereby reduces toxicity of the material (Voss et al., 1996).

Stalk rot reduces grain yield due to premature senescence and indirectly because of stalk breakage (Kozic et al., 2002).

2. Materials and methods

The research was conducted during two growing seasons (2017-2018) in the agricultural research station at Qaemshahr (Qarakheil) in Iran. The treatments were arrangement in a randomized complete block design with three replications. 30 lines and37 hybrids of maize genotypes (32 genotypes in 2017 and 35 genotypes in 2018) were applied in this study. To ear rot infection spore, suspension with concentration of 1× 10^6 for each milliliter prepared and 7-10 days after pollination in the middle of ear (Mid ear) by injection method (Nail Punch), plants were inoculated. At harvest time, disease severity by using Jeffers et al. (1994) method in CIMMYT International Research Center with 1-6 scale for scoring calculated and genotypes responses were determined: ŸWith no infection, 100% of ears are safe and infection percent is 0.ŸInfection is limited to a few seeds around the inoculation site and less than or equal to 10%. At harvest time, disease severity was calculated.

3. Results

The result in 2017 showed that from 14 lines, four lines (KLM77002/10-1-1-1-1-3-2, K74/1, K19 and MO17) were very susceptible, Two lines (KLM77021/4-1-2-1-2-4-1 and K18)were resistant and others were tolorant. In 14 hybrids, One hybrid (K3651/2X K19(FS)) was susceptible, two hybrids (KLM76002/3-1-1-1-1-1-1-3XK18 and KSC703) were resistant and others were tolorant (Table 1).

Table 1
Fusarium ear rot severity for some selected lately maturing maize varieties infected by Fusarium verticillioides, in 2017.

No	Genotypes	Fusarium ear rot severity %	Reaction
1	KLM77002/10-1-1-1-1-3-2 XMO17	20	MR*
2	KLM77002/10-1-1-1-1-3-2 XK18	12	MR
3	KLM76002/3-1-1-1-1-1-1-3XK18	10	R
4	KLM83002/90/2-1XK19	14	MR
5	KLM75003/2-1-1-1-3-1-1-1XK47/3	14.3	MR
6	KLM78018/6-1-1-1-3-2XK19	15.3	MR
7	KLM77021/4-1-2-1-2-4-1XK47/3	11	MR
8	SC715B	11	MR
9	SC670	21.3	MR
10	KLM77002/3-1-1-1-1-1-1-3/XB73	18	MR
11	KLM81027XB73	13.3	MR
12	KLM77002/3-1-1-1-1-1-1-3XK18	13	MR
13	KLM77029/8-1-1-1-2-2-2XK18	11	MR
14	KLM81027XK18	12.6	MR
15	KSC703	10	R
16	KSC647	12.6	MR
17	KSC704	19.6	MR
18	K3651/2X K19(FS)	36	S
19	KLM75003/2-1-1-1-3-1-1-1	21	MR
20	KLM76002/3-1-1-1-1-1-1-3	19.3	MR
21	KLM7604/3-5-1-2-21-1-1	14.6	MR
22	KLM77002/10-1-1-1-1-3-2	28	S
23	KLM77012/4-1-1-5-1-2-1	17.3	MR
24	KLM77021/4-1-2-1-2-4-1	9	R
25	KLM78018/6-1-1-1-3-2	12.6	MR
26	KLM76021/1-3-1-1-1-2-1-1	15.6	MR
27	KLM77002/10-1-1-1-1-3-2	19.3	MR
28	KLM78012/6-1-1-1-1-2	12.3	MR
29	K74/1	41.6	S
30	K19	25.3	S
31	MO17	28	S
32	K18	8	R

*R = Resistant, S = Susceptible, HS = High Susceptible, MR = Moderately Resistant.

Table 2
Fusarium ear rot severity for some selected laterly maturing maize varieties infected by Fusarium verticillioides, in 2018.

No	Genotypes	Fusarium ear rot severity %	Reaction
1	KLM77002/10-1-1-1-1-3-2 XMO17	14.3	MR*
2	KLM77002/10-1-1-1-1-3-2 XK18	13.3	MR
3	KLM76002/3-1-1-1-1-1-1-3XK18	12	MR
4	KLM83002/90/2-1XK19	10.7	MR
5	Ksc701	12.3	MR
6	KLM78018/6-1-1-1-3-2XK19	16	MR
7	KLM77021/4-1-2-1-2-4-1XK47/3	13.3	MR
8	SC715B	17.7	MR
9	SC670	14.6	MR

10	KLM77002/3-1-1-1-1-1-1-3/XB73	14.3	MR
11	KLM81027XB73	16.3	MR
12	KLM77002/3-1-1-1-1-1-1-3XK18	14	MR
13	KLM77029/8-1-1-1-2-2-2XK18	15.3	MR
14	KLM81027XK18	12	MR
15	KSC703	14.3	MR
16	KSC647	13.3	MR
17	KSC704	20.3	MR
18	K3651/2X K19(FS)	25.7	S
19	Ksc713	12	MR
20	Ksc716	14.7	MR
21	KLM75003/2-1-1-1-3-1-1-1	15.7	MR
22	KLM76002/3-1-1-1-1-1-1-3	16.7	MR
23	KLM7604/3-5-1-2-2−1-1-1	23	S
24	KLM77002/10-1-1-1-1-3-2	13.3	MR
25	KLM77012/4-1-1-5-1-2-1	13.7	MR
26	KLM77021/4-1-2-1-2-4-1	12.3	MR
27	KLM78018/6-1-1-1-3-2	12.3	MR
28	KLM76021/1-3-1-1-1-2-1-1	20.7	S
29	KLM77002/10-1-1-1-1-3-2	17.3	MR
30	KLM78012/6-1-1-1-1-2	14	MR
31	K74/1	55	HS
32	K19	40	S
33	MO17	30.3	S
34	K18	8	R
35	K47/2-2-1-4-1-1-1	9.7	R

* R = Resistant, S = Susceptible, HS = High Susceptible, MR = Moderately Resistant.

Results in 2018 showed that four lines (KLM7604/3-5-1-2-2−1-1-1, KLM76021/1-3-1-1-1-2-1-1, K19 and MO17) were susceptible and line of K74/1 was very susceptible, 8 lines were tolorant. 19 hybrids were tolorant and one hybrid (K3651/2X K19(FS)) was susceptible (Table 2).

Ear rot is a major economic concern to maize (*Zea mays* L.) producers and the processing industry due to the losses in grain yield and quality. Generally, Fusarium ear rot is favored by warm and dry conditions (Ochor et al., 1987; Vigier et al., 1997).

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