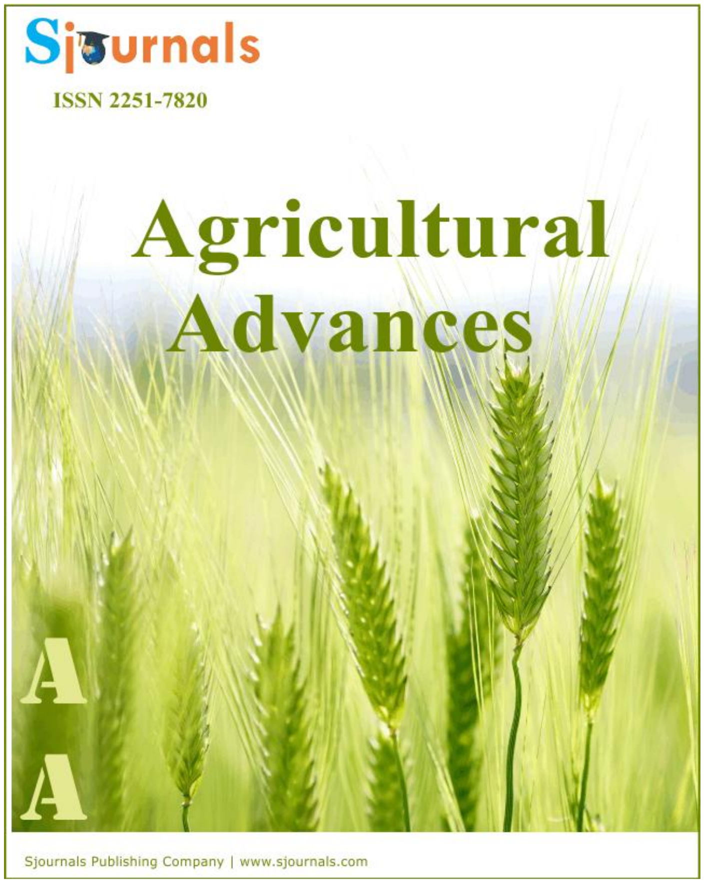
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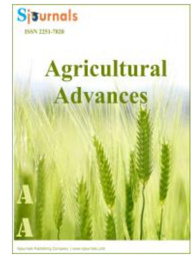

Original article

Evaluation on reaction of early maturing maize lines and hybrids to fusarium ear rot

M. Mohseni[a,*], M.H. Haddadi[a], M. Zamani[b]

[a]Scientific member of Agronomy and Horticulture Crops research Department, Mazandran Agricultural and Natural Resources research Center, AREEO, Sari, Iran.
[b]Scientific member of Seed and Plant Iprovemet Insttitute, Agricultural research Education and Extension Organization (AREEO), Karaj, Iran.

*Corresponding author; Scientific member of Agronomy and Horticulture Crops research Department , Mazandran Agricultural and Natural Resources research Center, AREEO,Sari, Iran.

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A B S T R A C T

In order to investigate the amount of resistance in and early maturity lines and hybrids to ear rot fusarium disease, an experiment was caried out with 56 lines and 34 hybrids which were extracted from material corn and forage crop department were planted in Gharakhil agricultural research station in 2010-2011. Inter row space was 75 centimeters, row legth was 2/5 m and pland distance in row was 25 centimrters. By using artifical inoculation, all of gonotyps were inoculated by using scale rating, the rate of resistance was indentfied (Diseas severity) and the result in2010 showed that three lines were very suseptible, 11 lins were susceptible and others were tolorant. Two hybrids were susceptibl and others tolorant. Results in 2011 showed that five lines were susceptibleand12 lines were very tolorant. Hybrid, KE77007/14 × KE1264/5-1 was resistant, 31 hybrids were tolorant and one hybrid was susceptibl.

1. Introduction

Maize is infected by Fusaria at different developmental stages, leading to root rot, seedling blight stem and ear rot, which are considered the most important maize diseases worldwide (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 maize and its derived products (Marin et al., 2004). Effective 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 demonstrated as the most important pathway for *F. verticillioides* infection (Munkvold and Desjardins, 1997., Desjardins et al., 2002). *Fusarium verticillioides* contamination levels during vegetative growth till the pre-silking stage indicated that the fungus endophytically colonizes plants and, according to recent studies, protects the host against more devastating pathogens (Knop et al., 2007; Lee and May, 2009). *F. verticillioides* is often considered 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 reduced kernel emergence obtained from silk inoculated sweet corn ears.

Research into the potential for using microbes antagonistic to *Fusarium* spp. is being conducted with rice plants susceptible to *F. moniliforme* (Marin et al., 2004). Preliminary results indicate that 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) demonstrated 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. Still 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). Wet-milling of contaminated corn produces a starch fraction with very little or no fumonisins while the steep water, gluten, germ and fiber fractions contain most of the toxin (Munkvold, 2003).

Fusarium verticillioides (Sacc.) Nirenberg is a common pathogen of maize causing root, stalk, and ear rots worldwide (Munkvold and Desjardins, 1997) and is more widespread in tropical and subtropical regions. Stalk rot reduces grain yield due to premature senescence and indirectly because of stalk breakage (Kozic et al., 2002).

2. Materials and methods

The studies were performed during two growing seasons (2010-2011) in an experimental field of the agricultural research station at Qaemshahr (Qarakheil) in Iran. The trials were set up in a randomized compelet block design with three replications. 56 lines and 34 hybrids of maize varieties (40 varieties in 2010 and 50 varieties in 2011) were applied in this study. To create ear rot infection spore suspension with concentration of 1× 106 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 cultivars, 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 and statistical analysis, MSTAT-C software was used.

3. Results

After harvest, disease severity was determiend, The result in 2010 showed that from 22 lines in 2010, three lines (KE84013/311, KE84019/131 and KE78011/61231) were very suseptible, 11 lines were susceptible and eight lines were tolorant. In 22 hybrids, Two hybrids (KE77003/8XK1264/5-1 and KE77009/2XK1264/5-1) were susceptibl and others were tolorant (Tabl 1). Results in 2011 showed that five lines (KE81012/3-1-1, KE8102/5-1-2, KE81014/5-1-1-2, KE8106/4-1-1-1 and KE81018/4-1-1) were susceptibleand ,12 lines were very tolorant. Hybrid of KE77007/14 × KE1264/5-1 was resistant, 31 hybrids were tolorant and one hybrid (KE76009/171Xk1263/1) was susceptibl (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).

Table 1
Fusarium ear rot severity for some selected early maturing maize varieties infected by Fusarium verticillioides, in 2010.

No	Varieties	Fusarium ear rot severity %	Reaction
1	KE77003/5XK1263/1	16.33	MR*
2	KE77002/1XK1264/5-1	14	MR
3	KE77003/1XK1264/5-1	13.66	MR
4	KE77003/5X1XK1264/5-1	14.33	MR
5	KE77003/6X1XK1264/5-1	14.33	MR
6	KE77003/8XK1264/5-1	35.66	S
7	KE77008/2XK1264/5-1	15	MR
8	KE77010/3XK1264/5-1	21.66	MR
9	KE77009/2XK1264/5-1	30	S
10	KE77009/1XK1264/5-1	14.33	MR
11	KE77008/1XK1264/5-1	16.33	MR
12	KE77010/3XK1263/1	14.66	MR
13	KE77007/1XK1264/5-1	12.66	MR
14	KE77009/2XK1263/1	14.33	MR
15	KE77010/2XK1264/5-1	23	MR
16	KE77006/5XK1264/5-1	22.66	MR
17	KE77006/3XK1264/5-1	17	MR
18	KE77006/3XK1263/1	16.66	MR
19	KE84001/111	43	S
20	KE84004/512	30	S
21	KE84004/911	17.33	MR
22	KE84006/821	24.66	MR
23	KE84008/411	33.3	S
24	KE84008/421	27.66	S
25	KE84008/511	21	MR
26	KE84009/511	42.33	S
27	KE84009/522	18	MR
28	KE84009/611	17	MR
29	KE84011/411	35.66	S
30	KE84012/411	42.33	S
31	KE84013/311	71.33	HS
32	KE84014/421	41	S
33	KE84016/421	32.3	S
34	KE84017/111	32.3	S
35	KE84018/211	22	MR

36	KE84019/131	74.33	HS
37	KE77004/1	29.33	S
38	KE78011/61231	51.33	HS
39	KE84019/4112	12.33	MR
40	KE84006/321	24.33	MR

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

Table 2
Fusarium ear rot severity for some selected early maturing maize varieties infected by Fusarium verticillioides, in 2011.

No	Varieties	Fusarium ear rot severity %	Reaction
1	KE77003/11XK1214/5-1	11	MR*
2	KE77004/1XK1214/5-1	13.66	MR
3	KE77005/1XK1214/5-1	14	MR
4	KE77006/1XK1214/5-1	13	MR
5	KE77006/2XK1214/5-1	12	MR
6	KE77003/11XK1263/5-1	14.33	MR
7	KE77003/12XK1263/1	15	MR
8	KE77003/13XK1263/1	16.66	MR
9	KE77004/1XK1263/1	18	MR
10	KE77004/2XK1263/1	22.66	MR
11	KE77005/2XK1263/1	21	MR
12	KE77005/3XK1263/1	21	MR
13	KE77006/1XK1263/1	17.33	MR
14	KE77006/412XK1264/5-1	20.66	MR
15	KE75015/1-2-1-11XK1264/5-1	17.66	MR
16	KE75016/321XK1264/5-1	10.33	MR
17	KE59XK1264/5-1	18.66	MR
18	KE77006/3XK12631/1	16.66	MR
19	KE77006/3Xk1264/5-	19.33	MR
20	KE77003/1Xk1264/5-1	19.33	MR
21	KE76009/141Xk1264/5-1	17.33	MR
22	KE76009/114Xk1264/5-1	21	MR
23	KE76009/172Xk1264/5-1	16.66	MR
24	KE76009/173Xk1264/5-1	13	MR
25	KE76009/171Xk1263/1	27.33	S
26	KE76010/121Xk1264/5-1	17	MR
27	KE76009/232Xk1264/5-1	16.66	MR
28	KE76009/112Xk1264/5-1	17.33	MR
29	KE76009/112Xk1264/5-1	16.33	MR
30	KE77002/1Xk1264/5-1	20.33	MR
31	KE77003/8Xk1264/5-1	15	MR
32	KE77007/14Xk1264/5-1	8.33	R
33	KE77010/3Xk1263/1	11.33	MR
34	KE81012/3-1-1	33	S
35	KE8102/5-1-2	41.33	S
36	KE81014/5-1-1-2	25.1	S
37	KE8106/4-1-1-1	29.33	S
38	KE781017/3-3-1	15.33	MR
39	KE81017/4-2-1	13	MR
40	KE81017/5-1-1	13	MR

41	KE81017/5-3-1	11.33	MR
42	KE81018/3-1-1	14	MR
43	KE81018/3-2-1	21.33	MR
44	KE81018/3-2-3	18.66	MR
45	KE81018/4-1-1	35	S
46	KE81018/5-1-1	23	MR
47	KE810127/4-3-2	16.33	MR
48	KE81027/4-4-1	15	MR
49	KE81027/4-4-3	16.33	MR
50	KE781027/5-3-1	17.66	MR

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

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