EFFECTS OF REDUCING INTERPLANT COMPETITION FOR LIGHT AND WATER ON STALK ROT OF CORN

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Abstract

Stalk rot in resistant and susceptible corn (*Zea mays*) hybrids was studied under conditions of reduced interplant competition for light and water or for water only. A reduction in competition for both light and water decreased stalk rot by 63% and 20% in resistant and susceptible hybrids respectively, when compared with plants for which stress conditions were not altered. Susceptible hybrids, especially in very dry periods, responded very little to reduced competition for water, and this appeared to limit their response to reduced competition for light. Resistant hybrids were more resilient than susceptible ones in that, when stress was decreased, they showed greater reductions in stalk rot. Susceptible plants tended to maintain yield at the expense of stalk deterioiation and susceptibility to stalk rot.

Introduction

Fungi invade the crowns and stalk bases of corn plants (*Zea mays* L.) as the ears mature and the plants become senescent. The fungus most often involved in southwestern Ontario is Gibberella zeae (Schw.) Petch (imperfect state Fusarium graminearum Schwabe). Factors which impose stress on the plants during ear development, such as competition for light and water, accentuate stem deterioration and rotting by fungi. However the stalks of resistant cultivars remain in good condition during and after maturation of the ear.

Experiments in which stands were thinned at various times to reduce interplant competition indicated that adverse effects on the stalk, due in part to interplant competition, become irreversible during the 4 weeks preceding physiological maturity of the ear (1).

The adverse effects of competition for water and light were studied further to determine their importance in stalk rot development in resistant and susceptible hybrids.

Methods

Experiments were carried out in sandy loam field plots at the Research Station, Harrow. Plants were spaced at 19.8 cm in rows 102 cm apart, giving 49,420 plants/ha. Hybrids used are given in the tables for each experiment. Plots consisted of six 5.1-m rows, with data taken from 4.1 m of the center four rows. Sets of such plots constituted main plots which, in experiments with irrigation, either were not irrigated or received water from hoses on the ground between the rows to supplement rainfall to 2.5 cm/week.

In each plot, alternate plants were cut at ground level on the dates indicated for each experiment. Cut plants were either removed, thus reducing competition for .Light and water, or staked in place, thus retaining light competition but reducing water competition.

Stalk rot was assessed 3 weeks after physiological maturity (35% grain moisture) either by determining the percentage of infected plants or by splitting lenqthwise the stems of 20 plants and recordinq the number of totally or partially decayed internodes.

Results and discussion

Good responses to reduction in stress were not obtained later than 4 weeks after mid-silk in 1966 or later than 2 weeks after mid-silk in 1967 (Table 1).

In 1966, 11.2 cm of rain in August and 7.9 cm in September gave adequate moisture, and no response was obtained with the susceptible hybrid to reduced water competition (alternate plants cut and staked in place); however when light competition was also reduced by removing alternate plants 4 weeks after mid-silk, stalk rot was decreased by nearly half.

In 1967, rain in August and September totalled only 8.8 cm, half of which fell on 2 days at the end of September. The resistant hybrid developed much less stalk rot when competition for water was reduced 2 weeks after mid-silk and still less when

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Table 1. Effects of reducing water and light stress on stalk rot in susceptible and resistant corn hybrids in 1966 and 1967, expressed as % diseased plants 3 weeks after physiological maturity

	Date of treatment[a]					
	1966		1967			
	Susceptible hybrid[b]		Susceptible hybrid[b]		Resistant hybrid[c]	
Treatment	Aug. 23	Sept. 6	Aug. 9	Aug. 23	Aug. 9	Aug. 23
Control, 49,420 plants/ha	53.7		83.1		70.6	
Reduced competition for water[d]	47.6	53.7	74.2	81.1	49.3	74.0
Reduced competition for water and light[e]	28.3	47.3	74.3	79.8	37.4	52.2

[a] Treatment dates were 4 and 6 weeks after mid-silk in 1966; 2 and 4 weeks after mid-silk in 1967. Later treatments were without effect.

[b] Pioneer 371.

[c] B14 x CH9.

[d] Alternate plants cut at ground level and staked in place.

[e] Alternate plants cut at ground level and removed.

competition for light was also reduced (Table 1). When competition was reduced 4 weeks after mid-silk, there was no response to reduction in water stress and moderate response in the resistant hybrid to reduction in competition for water and light. The susceptible variety was severely affected by drought and showed severe stalk rot despite reduced interplant competition. However irrigation of susceptible hybrids did reduce stalk rot and halved it when the population was also reduced (Table 2). Again the resistant hybrids were more resilient, and irrigation almost eliminated stalk rot in them.

Table 2. Effects of irrigation on stalk rot in susceptible and resistant hybrids, 1967

Hybrid and no. plants/ha	No. of rotted internodes per plant	
	Not irrigated	Irrigated[a]
Resistant, 49,420		
B14 x CH9	2.1	0.1
592.46 x 591.23	1.9	0.2
Resistant, 24,710[b]		
B14 x CH9	1.5	0.0
592.46 x 591.23	1.6	<0.1
Susceptible, 49,420		
Pioneer 371	2.3	2.0
Pioneer 3775	2.4	2.0
Susceptible, 24,710[b]		
Pioneer 371	2.0	1.0
Pioneer 3775	1.9	0.7

[a] Irrigation started August 11 (2 weeks after mid-silk) to total, with rain, 2.54 cm/week.

[b] Rows thinned by removing alternate plants 4 weeks after mid-silk (August 22).

In 1968-1970 (Table 3), the resistant hybrids were usually more responsive to decreased stress than the susceptible ones. There was no response by resistant varieties to reduced water competition in 1969, when rainfall in August-September was average (total 12.4 cm), or on nonirrigated plots in the very dry autumn of 1970 (August-September rain 6.8 cm). However reduced competition for water in 1968, and in 1970 on irrigated plots, reduced stalk rot in resistant hybrids by approximately one-half and one-quarter respectively. In all four comparisons, resistant varieties responded well to reduced light competition. The behaviour of susceptible varieties followed a similar pattern, but with smaller responses.

Resistant hybrids throughout the experiments were more resilient than susceptible hybrids in that where stress conditions were ameliorated resistant plants were better able to take advantage of the improved conditions and showed greater reduction in stalk rot. Reduction in stalk rot in populations of resistant hybrids when interplant competition for both light and water was reduced, or when water was supplied by irrigation to reduced populations, averaged 63% of that in populations growing under unaltered stress conditions (Table 4). The corresponding figure for susceptible hybrids was 20%. When the effects of reduced

Table 3. Effects of stress reduction and irrigation on stalk rot, expressed as avg no. rotted internodes per plant, in susceptible and resistant hybrids, 1968–1970

					1970			
					Susceptible		Resistant	
	1968		1969					
Treatment	Susceptible	Resistant	Susceptible	Resistant	Not irrigated	Irrigated[a]	Not irrigated	Irrigated[a]
Control, 49,420 plants/ha	0.6	0.3	2.1	0.2	1.0	1.2	1.0	0.8
Reduced competition for water[b]	0.6	0.1	1.8	0.2	1.0	1.3	0.9	0.6
Reduced competition for water and light[c]	0.4	<0.1	1.6	0.1	1.0	1.1	0.6	0.2

[a] Irrigated for 2 weeks after mid-silk to total, with rain, 2.54 cm/wk.

[b] Alternate plants cut at ground level and staked in place 3 weeks after mid-silk each year.

[c] Alternate plants cut at ground level and removed 3 weeks after mid-silk each year.

Table 4. Effects of reducing stress after pollination on stalk rot in susceptible and resistant hybrids; reduction in stalk rot as % of the stalk rot in untreated control

Hybrid, year, and treatment*	Reduced competition for water (A)	Irrigated (C)	Calculated effect of reduced light competition (B–A) or (D–C)	Reduced competition for light and water (B)	Reduced light competition and irrigation (D)
Susceptible hybrids?					
1966 (a)	11		36	47	
1967 (a)	11		nil	11	
1967 (b)		16	48	16	64
1968 (a)	10		20	30	
1969 (a)	14		11	25	
1970 (a)	nil		nil	nil	
1970 (b)		–22	15		- 7
Mean 1967–70	5		16	20	
Resistant hybrids††					
1967 (a)	30		17	47	
1967 (b)		93		23	99
1968 (a)	46		50	96	
1969 (a)	nil		58	58	
1970 (a)	12		28	40	
1970 (b)		17	62		79
Mean 1967–70	33		43	63	

* Treatment (a): experiments in which stress was reduced by cutting alternate plants at ground level and either staking the tops in place (reduced competition for water) or removing them (reduced competition for light and water), 2 or 4 weeks after mid-silk; treatment (b): plots irrigated weekly from 2 weeks after mid-silk to supplement rainfall to 2.54 cm/wk.

† Susceptible hybrid Pioneer 371 in 1966–1970, plus Pioneer 3775 in 1967.

†† Resistant hybrid B14 x CH9 in 1966–1970, plus 592.46 x 591.23 in 1967.

competition for water and light are assessed separately, susceptible varieties, especially in very dry periods, show little response to a reduction in interplant competition for water. Possibly so little water was available in dry periods that reducing interplant competition was not significant in changing drought effects. Water shortage also appears to limit their response to reduced light competition (Table 4). Presumably the roots of susceptible hybrids deteriorate considerably under stress conditions very soon after pollination. Even the resistant hybrids were not able to withstand full stress conditions in very dry seasons and showed severe stalk rot in 1967 and 1970.

In yield, resistant and susceptible varieties responded very similarly to reduced interplant competition for light and water (resistant, + 19%; susceptible, + 16%) and to irrigation (resistant, + 23%; susceptible, + 26%). Under conditions of least stress the yields of susceptible hybrids were 87–102% of those of resistant hybrids; under conditions of greatest stress they yielded 84–96% of the resistant hybrids. Susceptible plants thus tend to maintain their yield at the expense of stalk deterioration and susceptibility to stalk rot.

Literature cited

1. Mortimore, C. G., and L. F. Gates. 1969. Effects of reducing interplant competition at different stages of growth on stalk rot and yield components of corn. Can. J. Plant Sci. 49:723–729.