Evaluation of Captan as a Seed Treatment for Corn

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ABSTRACT

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A 10.2% increase in plant stand and a 9.9% increase in grain yield were observed for plots planted with captan-treated corn (*Zea mays*) seed over plots planted with talc-treated seed tested at 37 locations with 15 hybrids in 1981. At only five locations, the differences between captan and talc seed treatments were not significant ($P = 0.05$) for either plant stand or grain yield. Planting dates, planting densities, hybrids, and seed treatments were significant ($P = 0.01$) for plant stand and grain yield at Urbana and Dekalb in 1981 and 1982. The planting data × seed treatment interaction was highly significant at Dekalb in 1981 and at Urbana in 1982. In both years, captan seed treatment increased plant stands and grain yields for the early planting date but not for the later planting date. This increase appeared to be related to soil temperature for the 10 days after planting.

Additional key word: RPAR

Captan was introduced in 1953 (3) as a foliar fungicide for fruit crops and as a seed treatment for corn (*Zea mays* L.). About 304,000 kg a.i. of captan is used annually in the United States as a seed treatment for corn (4,5). This is one of the largest uses of captan, and most corn seed in the United States is treated with captan.

With the trend toward earlier planting dates and the increased use of minimum-tillage systems (2), soil temperatures are often near 10 C at planting. Many plant-pathogenic fungi, especially *Pythium* spp., have optimal pathogenicity at 7–12 C, and captan is very effective in controlling these pathogens (6,10).

On 18 August 1980, the Environmental Protection Agency (EPA) issued a Rebuttable Presumption Against Registration (RPAR) stating that if data on human health and/or environmental risks are not successfully rebutted or if risks appear to outweigh benefits, the EPA may announce intent to cancel the registration on captan (1).

Previous researchers have demonstrated the effectiveness of captan in preventing plant stand reductions in cool, wet soils (7,8); however, no data exist for the evaluation of captan over a large geographical area with modern hybrids. Therefore, the objectives of this study were to evaluate captan as a seed treatment for corn at many locations throughout the corn belt and to evaluate possible interactions of planting dates, planting densities, and corn hybrids with captan seed treatment.

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MATERIALS AND METHODS

Experiment 1. Seed lots of 15 corn hybrids (A632 × LH38, B73 × LH38, B73 × Mo17, B73 × MS71, B73 × Pa91, FR19 × Mo17, LH38 × CM105, Mo17 × A634, Mo17 × A641, Mo17 × B73, Mo17 × H100, Northrup King PX87, PX72, PX69, and Dekalb/Pfizer XL55A) were obtained from six seed companies (germination >90%) and treated with captan (132 g a.i./100 kg of seed) or a control formulation (132 g/100 kg of seed) with U.S.P. talc (Mallinckrodt Chemical Works, St. Louis, MO) added instead of captan. The captan and talc treatments were provided by Chevron Chemical Company, Ortho Agricultural Chemical Division, San Francisco, CA; Gustafson Incorporated, Dallas, TX; and Stauffer Chemical Company, Westport, CT. All seed lots were treated with a slurry-type seed treater. Thirty-seven locations were selected throughout the U.S. corn belt, and the best-adapted hybrids were tested at each location. The same seed lot for each hybrid tested was used at all locations in this experiment. A split-plot design with three replicates was used with whole plots (hybrids) arranged in randomized complete blocks. Subplots (seed treatments) were 1.5 m wide (two rows) and ranged from 5.2 to 9.1 m long. Planting densities ranged from 55,000 to 65,000 seeds per hectare. Both row length and planting density varied between

Table 1. Effect of captan seed treatment on plant stands and grain yields compared with talc seed treatments for 15 corn hybrids at 37 locations in the U.S. corn belt

Hybrid	Number of locations tested	Plant stands		Grain yields	
		Number of locations[a]	Percent increase[b]	Number of locations	Percent increase
A632 × LH38	34	4	20.3	4	17.1
B73 × LH38	26	14	19.7	10	21.6
B73 × Mo17	28	16	22.2	11	20.5
B73 × MS71	29	15	25.3	13	22.7
B73 × Pa91	25	5	26.7	4	19.5
FR19 × Mo17	38	3	18.5	3	18.2
LH39 × CM105	26	8	19.9	6	18.4
Mo17 × A634	31	11	20.3	10	19.8
Mo17 × A641	30	5	25.5	4	20.8
Mo17 × B73	27	16	23.9	14	18.7
Mo17 × H100	28	7	22.1	7	19.1
PX87	28	11	25.4	6	23.6
PX72	32	3	20.7	3	17.3
PX69	28	7	23.4	5	19.5
XL55A	27	8	22.3	5	17.2
Mean	29.1	8.9	22.4	7.0	19.6

[a] Number of locations with significant increases ($P = 0.05$) in plant stand or grain yield from captan seed treatment based on Student's paired t test.
[b] Percent increase = plant stand or grain yield from captan treatment minus plant stand or grain yield from talc treatment divided by plant stand or grain yield from talc treatment × 100.

Table 2. Effect of captan seed treatment on plant stands and grain yields of 15 corn hybrids tested across the U.S. corn belt in 1981

Location (state and nearest city)	Number of hybrids tested	Plant stands		Grain yields	
		Number of hybrids[a]	Percent increase[b]	Number of hybrids[a]	Percent increase[b]
Delaware					
Middletown	12	2	18.1	2	17.3
Iowa					
Ackley	14	2	15.2	2	14.7
Dayton	12	4	16.2	4	17.7
Iowa City	15	6	25.3	5	23.5
Johnston	12	2	23.9	2	21.4
Johnston	12	4	19.4	0	0.0
Kellogg	12	2	23.6	3	19.3
Story City	15	3	16.3	3	15.7
Illinois					
Champaign	15	9	29.0	7	24.8
Dekalb	12	8	23.8	6	24.0
Effingham	15	7	36.6	...[c]	...
Macomb	15	2	18.7	2	16.1
Mason City	12	4	17.2	0	0.0
Mt. Vernon	15	0	0.0	2	14.6
Princeton	12	0	0.0	1	14.0
Shelbyville	12	1	14.9	3	17.2
St. Joseph	15	0	0.0	1	16.5
Thomasboro	12	0	0.0	1	17.4
Towanda	15	4	19.1	1	19.2
Indiana					
Atlanta	15	11	20.7	7	19.9
Kokomo	15	1	13.2	1	14.3
Tipton	12	5	22.6	4	21.5
Tipton	15	0	0.0	1	14.3
Minnesota					
Cokato	5	0	0.0	0	0.0
Dassel	6	1	15.6	1	14.1
Rosemount	5	3	17.2	3	16.5
Waseca	5	3	26.8	3	23.9
Nebraska					
Hooper	14	7	17.2	5	16.3
Ohio					
Arcanum	15	15	66.7	15	59.2
Marion	12	4	19.3	0	0.0
McGuffey	15	11	42.5	9	39.0
South Dakota					
Elk Point	14	2	16.1	1	15.7
Wisconsin					
Janesville	6	0	0.0	1	12.6
Livingston	5	1	15.5	0	0.0
Madison	7	3	17.8	1	17.3
Madison	6	1	14.6	2	19.9
Randolph	5	3	17.7	3	16.4
Mean[d]	11.7	3.5	22.0	2.8	19.8

[a] Number of hybrids with significant ($P = 0.05$) increases from captan seed treatment based on Student's paired t test.
[b] Percent increase = plant stand or grain yield from captan treatment minus plant stand or grain yield from talc treatment divided by plant stand or grain yield from talc treatment × 100.
[c] Missing.
[d] Mean percent increase for plant stand and grain yield included locations with significant increases.

locations because of the planting equipment available at each location but were constant at a single location. Plant stands were determined about 6 wk after planting. Grain yields were obtained by machine or hand harvesting each subplot, and grain weights were adjusted to 15.5% moisture. Because of the lack of uniformity for the number of hybrids tested, plot size, and planting rate between locations, the captan and the talc seed treatments were compared for each hybrid at each location and tested for significant differences by Student's paired t test. Data are summarized for hybrids, locations, and those locations and hybrids with significant ($P = 0.05$) increases in plant stand or grain yield.

Experiment 2. From 10 corn hybrids selected from the 15 hybrids used in experiment 1, six were planted at either the Agronomy-Plant Pathology South Farm, Urbana, IL (B73 × Mo17, B73 × Pa91, Mo17 × A634, Mo17 × B73, Mo17 × H100, and PX87), or the Northern Illinois Agronomy Research Center, Dekalb, IL (A632 × LH38, B73 × Mo17, B73 × MS71, FR19 × Mo17, Mo17 × A634, and XL55A). In addition to the two locations and six hybrids, two planting dates, three planting densities, and two seed treatments (captan and talc) were evaluated. The planting dates at Urbana were 27 April and 22 May in 1981 and 26 April and 14 May in 1982. The planting dates at Dekalb were 8 May and 19 May in 1981 and 3 May and 18 May in 1982. Planting densities were 44,460 (low), 51,870 (medium), and 59,480 (high) seeds per hectare. The experimental design was a split-split-split-split plot with four replicates, and whole plots were arranged in randomized complete blocks. Whole plots were planting dates, subplots were planting rates, sub-subplots were hybrids, and sub-sub-subplots were seed treatments. Sub-sub-subplots were 1.52 m wide (two rows) and 9.1 m long. Plant stands were determined about 6 wk after planting. Grain yields were obtained by hand harvesting each sub-sub-subplot and adjusting the grain weight to 15.5% moisture. Soil temperatures 10.2 cm below ground were obtained for the 10 days after planting at Urbana and Dekalb from the Illinois Natural History Survey, Urbana. Data were analyzed with PROC ANOVA (SAS Institute Inc., Cary, NC). Least significant differences (LSD) were determined for each location and year by the formula: $t(0.05, N_D)\,[2E_D/r]^{1/2}$, where N_D = degrees of freedom for error D, E_D = mean square for error D, and r = replicates (9). Comparisons were made between captan and talc seed treatments for each hybrid.

RESULTS

Experiment 1. Each hybrid was evaluated at a minimum of 25 locations (Table 1). The 15 captan-treated hybrids had significant increases ($P = 0.05$) in plant stand (three to 16 locations) and

grain yield (three to 14 locations) compared with the talc-treated hybrids. The percent increase ranged from 18.5 to 26.7% for plant stand and from 17.1 to 23.6% for grain yield at locations with significant increases. Six hybrids (B73 × LH38, B73 × Mo17, B73 × MS71, Mo17 × A634, Mo17 × B73, and PX87) had significant increases in plant stand at 11 or more locations, whereas five hybrids (A632 × LH38, B73 × Pa91, FR19 × Mo17, Mo17 × A634, and PX72) had five or fewer locations where plant stands were significantly increased.

Of the 37 test locations, only seven did not have hybrids with significant increases in plant stand, and five did not have significant increases in grain yield resulting from the captan treatment (Table 2). More than one-half of the hybrids at five locations (Champaign and Dekalb, IL; Atlanta, IN; and Arcanum and McGuffey, OH) had significant increases in plant stand, but only two locations (Arcanum and McGuffey) had more than one-half of the hybrids with significant increases in grain yield.

Over all 15 corn hybrids and 37 locations, the mean increase resulting from captan seed treatment for plant stand was 10.2% (47,450 plants per hectare with captan and 43,040 plants per hectare with talc) and 9.9% for grain yield (8,129 kg/ha with captan and 7,533 kg/ha with talc). However, the mean increases in plant stand and grain yield for those locations with significant ($P = 0.05$) increases were 22 and 20%, respectively.

Experiment 2. Mean squares from selected analyses of variance (split-split-split-split-plot design) for each location are presented in Table 3. Year, planting date, hybrid, and seed treatment were highly significant ($P = 0.01$) for plant stand and grain yield, except hybrid and seed treatment in 1982 at Dekalb and planting density in 1981 at Urbana for grain yield. The planting date × seed treatment interaction was highly significant ($P = 0.01$) for both plant stand and grain yield at Dekalb in 1981 but not in 1982. At Urbana, this interaction was significant for both plant stand and grain yield in 1982 but not in 1981.

Plant stands were significantly increased with the captan seed treatment for all hybrids, except XL55A at the highest planting density (59,480 seeds per hectare), on the 8 May planting date at Dekalb in 1981 (Table 4). Grain yields were significantly increased for at least one planting density for five of the six hybrids. Only two hybrids had significantly higher plant stands and one hybrid had a significantly higher grain yield for the 19 May planting data at Dekalb in 1981. In 1982 at Dekalb (Table 5), all six hybrids had at least one population with significantly higher plant stands for the captan seed treatment for the 3 May planting date. However, only two hybrids had significantly higher grain yields for the same planting date. For the 18 May planting date, four hybrids had significantly higher plant stands but none of the hybrids had significantly higher grain yields.

All six hybrids had significantly higher plant stands with the captan seed treatment for a minimum of one planting density for the 27 April and 22 May planting dates in 1981 at Urbana (Table 6). Only one hybrid for the 27 April and three for the 22 May planting dates had significantly higher grain yields in 1981. All six hybrids for the 26 April and four for the 14 May planting dates had significantly higher grain yields for a minimum of one

Table 3. Mean squares selected from analyses of variance of experiment 2 in a split-split-split-split-plot design for plant stands and grain yields at the Northern Illinois Agronomy Research Center, Dekalb, and the Agronomy-Plant Pathology South Farm, Urbana, in 1981 and 1982

Sources of variation	df	Mean squares[a] Dekalb 1981	Dekalb 1982	Urbana 1981	Urbana 1982
		Plant stand			
Planting date (Da)	1	2,162**[b]	302**	1,634**	2,479**
Planting density (PD)	2	7,032**	8,034**	5,051**	9,999**
Hybrid (H)	5	1,578**	1,173**	626**	562**
Seed treatment (T)	1	2,151**	2,217**	2,838**	1,116**
Da × T	1	1,755**	14	89	340**
PD × T	2	0	22	52	53
H × T	5	204*	145	41	31
Error D	109	86	88	81	76
		Grain yield			
Planting date (Da)	1	24,830**	5,325**	101,156**	4,241**
Planting density (PD)	2	2,856**	4,164**	497	1,532**
Hybrid (H)	5	3,819**	292	4,269**	2,813**
Seed treatment (T)	1	2,902**	1,101**	7,423**	8,024**
Da × T	1	17,686**	446	553	1,105**
PD × T	2	367	175	8	212
H × T	5	961	65	351	623*
Error D	109	468	296	381	197

[a] Each mean square was tested with the appropriate error term.
[b] * = Significant at $P = 0.05$ and ** = significant at $P = 0.01$.

Table 4. Summary of plant stands and grain yields from the two planting dates in 1981 at the Northern Illinois Agronomy Research Center, Dekalb

Hybrid	Planting density	8 May 1981 (10 C)[a] Plant stand (plants/ha) Captan	Plant stand (plants/ha) Talc	Grain yield (kg/ha) Captan	Grain yield (kg/ha) Talc	19 May 1981 (15 C) Plant stand (plants/ha) Captan	Plant stand (plants/ha) Talc	Grain yield (kg/ha) Captan	Grain yield (kg/ha) Talc
A632 × LH38	L[b]	36,797*[c]	23,169	7,988*	4,998	35,434	34,860	7,593	6,645
	M	38,016*	26,898	8,139*	5,909	40,886*	36,510	8,114	7,082
	H	46,265*	35,004	9,439*	7,132	50,282	48,274	7,480	7,850
B73 × Mo17	L	35,147*	30,844	8,930*	7,582	37,730	34,645	7,605	6,853
	M	42,535*	34,430	8,403	9,017	43,611	42,105	7,574	7,196
	H	48,058*	41,603	9,715	8,861	47,198	47,198	7,845	7,682
B73 × MS71	L	38,949*	25,822	9,037*	6,259	40,383	40,025	7,756	7,600
	M	43,324*	29,409	9,282*	6,577	45,405	45,835	8,823	7,594
	H	50,784*	34,645	9,941	8,905	53,366	51,215	7,963	8,636
FR19 × Mo17	L	40,168*	35,864	8,736	7,719	41,531	40,345	7,345	7,769
	M	46,527*	41,101	9,232*	6,983	48,130	48,274	8,214	7,444
	H	54,873*	48,058	8,478	7,887	52,455	55,160	7,473	8,374
Mo17 × A634	L	37,299*	32,851	8,528*	7,120	43,324*	37,945	8,999*	6,515
	M	45,763*	37,873	9,929*	8,156	48,130	45,691	8,666	8,043
	H	53,797*	47,700	10,463*	9,061	52,936	53,295	7,366	7,345
XL55A	L	41,962*	38,949	9,696	8,624	42,679	43,826	8,917	7,613
	M	46,624*	43,970	9,985	9,697	51,143	52,290	7,448	8,174
	H	54,371*	55,936	10,450	10,084	55,231	56,370	7,241	7,401
LSD (0.05)		3,325		1,321		3,325		1,321	
C.V.		8.7%		17.7%		8.7%		17.7%	

[a] Mean soil temperature 10.2 cm below ground for the 10 days after planting.
[b] Planting densities: L (low) = 44,460, M (medium) = 55,870, and H (high) = 59,480 seeds per hectare.
[c] * = Significant ($P = 0.05$) increase for the captan treatment compared with the talc treatment.

planting density at Urbana in 1982 (Table 7). Four hybrids for the 26 April and two for the 14 May planting dates had significantly higher grain yields at Urbana in 1982.

Mean soil temperatures for the 10 days after planting at 10.2 cm below ground at Dekalb were 10 C on 8 May and 15 C on 19 May in 1981 and 12 C on 3 May and 15 C on 18 May in 1982. Mean soil temperatures at Urbana were 11 C on 27 April and 16 C on 22 May in 1981 and 12 C on 26 April and 14 C on 14 May in 1982.

DISCUSSION

The RPAR issued by the EPA stated that if human risks and/or environmental risks are not successfully rebutted or if risks appear to outweigh benefits, the registration on captan may be cancelled. This study was designed to assess the need of the corn industry for captan. In experiment 1, 15 hybrids were evaluated at 37 locations throughout the corn belt. There were differences between hybrids (Table 1) and locations (Table 2). If all 15 hybrids and 37 locations were combined, plant stand and grain yield were reduced 10.2 and 9.9%, respectively. However, this does not fully assess the benefits of captan under unfavorable weather conditions. If only those locations with significantly higher plant stands and grain yields were combined, a 22% plant stand and 20% grain yield increase were observed. Further, if only the Arcanum, OH, location was considered, a 66% increase in plant stand (46,170 plants per hectare with captan and 27,700 plants per hectare with talc) and a 59.2% increase in grain yield (4,986 kg/ha with captan and 3,132 kg/ha with talc) occurred.

The second part of this study, experiment 2, was an attempt to determine if there were specific factors (planting date, planting densities, or hybrids) that affected the need for captan. Only planting date interacted significantly with seed treatment for yield (Table 3), indicating plant densities and hybrids did not significantly influence the need for captan as a seed treatment.

In summary, there are three main conclusions: 1) captan is a very effective seed treatment for corn. 2) Although new hybrids have been developed and cultural practices have changed since the 1950s, captan is still needed. 3) The one factor that appears to be very important in determining plant stand and grain yield reductions is soil temperature for the 10 days after planting.

Table 5. Summary of plant stands and grain yields from the two planting dates in 1982 at the Northern Illinois Agronomy Research Center, Dekalb, IL

		3 May 1982 (12 C)[a]				18 May 1982 (15 C)			
		Plant stand (plants/ha)		Grain yield (kg/ha)		Plant stand (plants/ha)		Grain yield (kg/ha)	
Hybrid	Planting density	Captan	Talc	Captan	Talc	Captan	Talc	Captan	Talc
A632 × LH38	L[b]	38,375	39,092	7,825	7,756	37,658*	27,472	8,585	7,875
	M	45,189	42,248	9,571	9,684	44,831	41,962	8,258	8,018
	H	53,797	44,113	9,872	9,210	47,556	46,624	9,225	9,210
B73 × Mo17	L	40,383*[c]	35,506	8,974	8,961	39,451	36,438	9,006	8,256
	M	45,763*	38,590	10,086*	9,185	44,687	42,679	8,610	8,106
	H	52,577	49,350	9,137	8,380	54,012*	48,991	8,761	8,212
B73 × MS71	L	40,025	37,514	9,225	8,642	40,742*	36,797	8,214	7,738
	M	47,700*	43,396	9,156	8,880	43,396*	39,451	8,170	7,894
	H	54,155	51,286	9,690	9,622	49,708	47,341	8,597	8,886
FR19 × Mo17	L	43,970*	37,658	8,164	7,763	41,101	38,590	8,993	8,162
	M	51,860	48,776	10,048	9,410	50,569	49,134	8,491	8,324
	H	57,025*	51,143	9,759	9,722	55,231	52,219	8,773	9,104
Mo17 × A634	L	42,535	39,810	8,754	8,112	40,527*	35,506	8,365	7,769
	M	50,210*	46,624	9,634	8,836	46,122	45,763	9,238	8,436
	H	55,949*	50,426	9,784	9,759	52,936	50,569	9,753	9,707
XL55A	L	43,970*	35,865	9,401*	7,763	43,755	39,810	8,365	8,599
	M	52,219*	44,329	8,911*	7,669	49,708	49,350	7,951	8,318
	H	58,101	58,316	9,703	9,198	58,459	58,674	8,893	8,349
LSD (0.05)		3,364		1,053		3,364		1,053	
C.V.		6.8%		12.2%		6.8%		12.2%	

[a] Mean soil temperature 10.2 cm below ground for the 10 days after planting.
[b] Planting densities: L (low) = 44,460, M (medium) = 55,870, and H (high) = 59,480 seeds per hectare.
[c] * = Significant ($P = 0.05$) increase for the captan treatment compared with the talc treatment.

Table 6. Summary of plant stands and grain yields from the two planting dates in 1981 at the Agronomy-Plant Pathology South Farm, Urbana, IL

		27 April 1981 (11 C)[a]				14 May 1981 (16 C)			
		Plant stand (plants/ha)		Grain yield (kg/ha)		Plant stand (plants/ha)		Grain yield (kg/ha)	
Hybrid	Planting density	Captan	Talc	Captan	Talc	Captan	Talc	Captan	Talc
B73 × Mo17	L[b]	34,789*[c]	30,341	9,809*	8,599	34,430	34,430	8,409	7,644
	M	42,894*	35,147	11,423*	10,159	43,037*	35,865	8,139	7,213
	H	40,527	39,810	9,257	9,373	46,480	43,611	8,591*	7,026
B73 × Pa91	L	41,962*	37,658	11,725	11,552	40,527	39,810	8,717	8,468
	M	48,058*	44,472	12,378	12,418	49,350*	45,405	7,944	8,530
	H	50,928	49,350	11,888	11,326	54,371	52,936	9,605*	7,837
Mo17 × A634	L	38,375*	34,645	9,420	8,387	41,818*	37,299	8,459	7,887
	M	44,687*	36,223	9,232	8,324	46,265*	42,535	8,151	7,469
	H	47,198*	41,962	9,414	8,923	55,088*	48,058	7,994	7,076
Mo17 × B73	L	38,734*	33,354	11,021*	9,310	40,025	38,500	8,139	8,749
	M	47,700*	40,168	11,116*	9,379	45,907*	42,535	8,170	8,330
	H	51,143*	38,375	11,869*	9,641	52,219*	48,991	8,553	8,330
Mo17 × H100	L	37,873*	33,211	9,841	9,348	43,970*	37,514	8,296	7,769
	M	47,198*	39,451	10,921	10,121	48,274*	44,113	8,880	8,212
	H	49,852	43,037	10,984*	9,366	55,088*	48,991	7,668	7,245
PX87	L	35,506	34,430	11,053	11,145	38,734	36,080	9,056*	7,257
	M	44,329*	40,383	12,076*	10,577	45,046	44,113	8,428	7,482
	H	45,046*	38,590	11,492	11,201	53,438*	46,624	8,214	7,650
LSD (0.05)		3,228		1,190		3,228		1,190	
C.V.		7.7%		13.3%		7.7%		13.3%	

[a] Mean soil temperature 10.2 cm below ground for the 10 days after planting.
[b] Planting densities: L (low) = 44,460, M (medium) = 55,870, and H (high) = 59,480 seeds per hectare.
[c] * = Significant ($P = 0.05$) increase for the captan treatment compared with the talc treatment.

Table 7. Summary of plant stands and grain yields from the two planting dates in 1982 at the Agronomy-Plant Pathology South Farm, Urbana, IL

Hybrid	Planting density	26 April 1982 (12 C)[a]				14 May 1982 (14 C)			
		Plant stand (plants/ha)		Grain yield (kg/ha)		Plant stand (plants/ha)		Grain yield (kg/ha)	
		Captan	Talc	Captan	Talc	Captan	Talc	Captan	Talc
B73 × Mo17	L[b]	38,590*[c]	27,472	11,091*	8,730	40,025*	36,080	9,050	8,393
	M	44,329*	39,810	9,878	9,329	48,058	45,189	9,835	9,628
	H	50,210*	39,666	10,544*	9,379	50,426	52,936	9,860	9,878
B73 × Pa91	L	42,177*	37,873	10,877*	9,984	44,037	46,122	9,156	9,615
	M	51,501	49,493	11,097	10,502	53,797	53,438	9,294	8,905
	H	59,176*	48,776	11,166*	9,940	59,392*	52,577	9,734	8,880
Mo17 × A634	L	39,666*	36,438	8,195	8,056	42,405	41,329	8,943	8,212
	M	50,426*	34,573	9,200*	7,276	53,653	50,569	9,175	8,730
	H	56,881*	48,919	9,809*	8,499	57,383	56,666	9,244	8,474
Mo17 × B73	L	41,244*	35,147	9,200	8,705	44,831	43,396	9,929*	8,992
	M	50,784*	42,894	10,400*	8,942	51,650*	42,679	11,109*	9,578
	H	54,514	55,590	10,827	10,758	56,164	58,894	8,710	9,379
Mo17 × H100	L	41,459*	36,582	9,590	9,167	46,480	45,189	9,797	9,716
	M	49,134	46,122	10,004	9,959	53,438	52,004	9,282	8,986
	H	56,666	53,653	11,009	10,546	58,544	57,252	9,407	9,430
PX87	L	39,953*	31,212	10,739*	9,435	42,177	40,168	10,255*	8,137
	M	49,852*	33,713	11,273*	8,967	49,780*	40,383	10,306*	9,185
	H	56,666*	38,232	10,657*	8,992	58,316*	55,949	9,502	9,472
LSD (0.05)		3,127		860		3,127		860	
C.V.		6.0%		9.2%		6.0%		9.2%	

[a] Mean soil temperature 10.2 cm below ground for the 10 days after planting.
[b] Planting densities: L (low) = 44,460, M (medium) = 55,870, and H (high) = 59,480 seeds per hectare.
[c] * = Significant ($P = 0.05$) increase for the captan treatment compared with the talc treatment.

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