Leakage, Infection, and Emergence of Injured Corn Seed

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ABSTRACT

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A technique was devised to injure corn seed quickly and uniformly. Fungicides largely restored the emergence of injured seeds and were most beneficial when the seed and seedling were under stress. Absorptiometer and conductivity tests of leachates proved that loss of ions and matter from the seed increased as the number of injuries and period of leaching increased.

Additional key words: leachate-conductivity, seed injury.

In Canada, concern recently has been expressed regarding mechanical injuries of corn seed during picking, combining, trucking, elevating, dropping, grading, and cleaning. The use of a grading system based in part upon the amount of injury is under consideration.

Increasing concern on the influence of seed injuries on corn germination and viability in the United States was indicated by Moore (3) in 1973.

Corn seed injuries may involve the breaking or chipping of a large segment from the seed and they give the seed poor eye appeal but often seed with that kind of damage can be removed during seed processing. Frequently minute invisible scars or bruises are present that can be highly detrimental to seedling emergence and survival.

In order to evaluate the significance of injury to corn seed we conducted laboratory and field tests to study the effects of seed injuries on seed exudation, weakening of seed, seedling emergence and infection, and the efficacy of protective fungicide treatment on injured and noninjured seed.

METHODS AND MATERIALS

Stewart 1A125 inbred and Stewart 2913 hybrid corn were used. Noninjured corn was obtained by hand-picking and -shelling of the corn.

Scarified (injured) corn seed (Fig. 2) was produced by pneumatic agitation of the seeds in a disposable soft-drink can (60 mm in diameter, 120 mm high) which had sharp metal edges projecting inwards on the bottom and sides as a result of having been punctured 200 times with a 5-cm (2-mm diameter) finishing nail. Adhesive tape was wrapped around the side of the can to limit the number of exit pores and thereby provide the appropriate degree of turbulence. The air pressure in the supply line was maintained at 24 ± 1 Kg/cm^2. The amount of injury was regulated by exposing the seeds to turbulence within the can for a specific number of seconds.

Crown-injured corn (Fig. 1) was produced by cutting one large chip out of the cap of the kernel. The chip always contained a small amount of white starchy endosperm.

Fungicide was applied at recommended rates by shaking the seeds with dust or slurry in a stoppered bottle until all the slurry or dust was wiped from the glass surface.

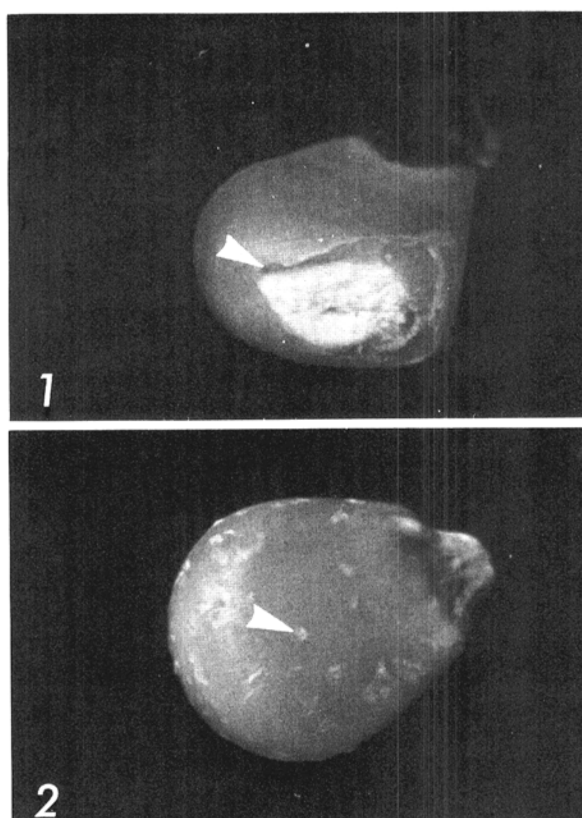

Fig. 1-2. 1) A crown-injured corn seed. It has one large chip from the crown or cap. Observe that some white starchy endosperm is removed. **2)** A scarified (injured) corn seed after 40 seconds of injury. Observe the many tiny lesions in the pericarp.

Germination and seedling tests were conducted in the field, in a glasshouse, and in a controlled-temperature room. The controlled-temperature room was illuminated at 94 lux and maintained at 20 C during a 16-hour day and 15 C during an 8-hour night. Corn seed was planted in the field the last week of April when the weather is frequently cold and wet, and during the normal planting season in May. Meterological records were obtained from a nearby weather station.

In the controlled-temperature room, emergence of corn seed was tested by planting it 15-cm deep in soil.

Leachates were obtained by placing 100 seeds in 100 ml of water at room temperature for up to 24 hours. The quantity of ions in the leachates from corn seeds was measured in micro-Siemens units with a conductivity meter. The turbidity of the leachate was measured by an absorptiometer.

RESULTS

Scarification and crown injury significantly reduced the emergence of corn seedlings in field tests (Table 1) and in experiments in a controlled-temperature room. Emergence from scarified seed which appeared to be only slightly injured was much lower than that from crown-injured seed which appeared to be drastically injured.

Reduction of emergence of scarified seed varied directly with the length of time the seed was exposed to injury (Fig. 3). Emergence of injured seed planted in the field during cold wet weather was much lower than that from noninjured seed, and lower than injured seed planted during warm weather. Also, injured seed planted 3 and 15 cm deep had a lower emergence than did noninjured corn, especially when the exposure to injury exceeded 20 seconds (Fig. 3).

Emergence of corn seed treated with Benlate T (benomyl + thiram) was much better than that of seed not treated with a fungicide (Table 1). Protectant fungicides such as captan gave similar results. In many field and

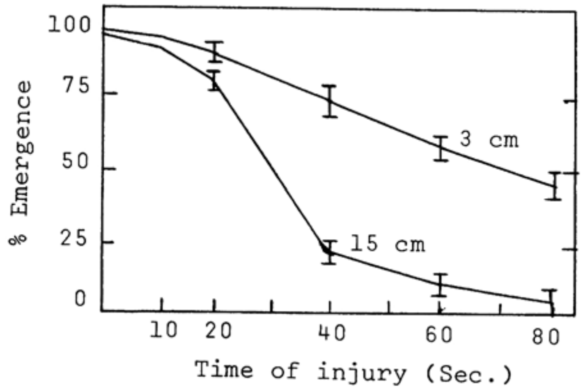

Fig. 3). Percentage emergence of hybrid corn with different amounts of injury when planted 3 and 15 cm deep in soil in a controlled-temperature room. Standard error of mean shown.

TABLE 1. Effect of corn seed injury and fungicidal treatment on emergence of inbred and hybrid corn in a field[a]

		Seedling emergence[b] (%)	
Injury	Treatment	Inbred	Hybrid
None	None	58	67
	Benlate T[c]	78	78
Crown	None	35	40
	Benlate T	70	75
Scarified	None	7	21
	Benlate T	64	71

[a]For two weeks after planting on 27 April, precipitation was heavy and temperature remained below 10 C for several periods.
[b]Average of three replications. Analysis of variance shows that crown and scarification injury in both hybrid and inbred significantly reduce emergence and the affect of scarification is significantly greater than crown injury ($P = 0.01$).
[c]Benlate T applied at rate of 2.1 g per kilogram.

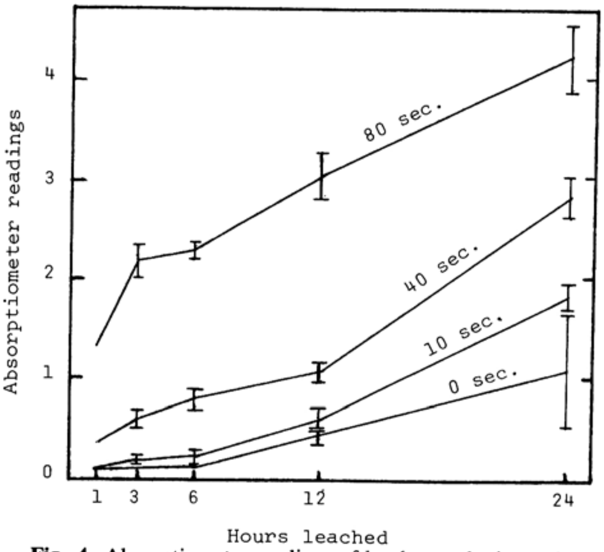

Fig. 4. Absorptiometer readings of leachates obtained after soaking hybrid seeds for different time periods with different amounts of injury. Standard error of mean shown.

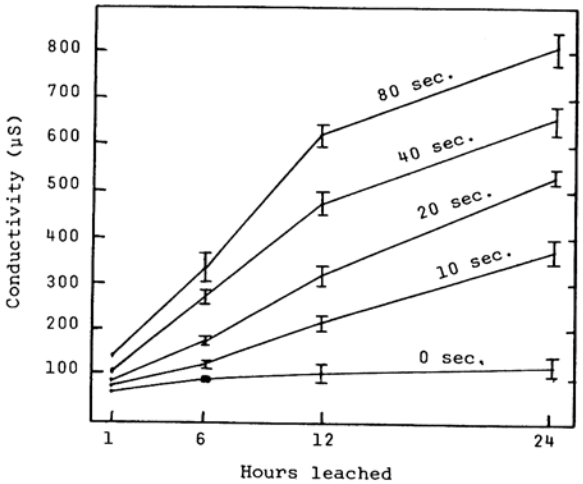

Fig. 5. Conductivity, in micro-Siemen units, of leachates from hybrid corn seeds with different amounts of injury and leached for various lengths of time. Standard error of mean shown.

greenhouse experiments the injured fungicide-treated seed emerged almost as well as noninjured fungicide-treated seed.

Scarified corn seed that was planted 15 cm deep in sterile soil had a much higher emergence, 540% better than the same kind of seed planted in ordinary field soil. Emergence of noninjured seed was only 48 percent higher in sterilized soil than in nonsterilized soil.

Absorptiometer readings of leachates were directly correlated with degree of seed injury. Also the readings increased as the time of leaching increased (Fig. 4).

Conductivity readings also increased with leaching time and amount of injury (Fig. 5). The conductivity of leachate from seed scarified for 20 and 40 seconds was 83 and 52 percent higher than that of leachate from crown-injured seed.

Phialophora radicicola Cain and a *Pythium* sp., two corn-root pathogens, grew faster and more luxuriantly on water agar supplemented with corn leachate.

DISCUSSION

The scarification technique proved valuable because a relatively large amount of corn seed could be randomly injured to any extent desired in a short time. Bouncing the seed against sharp metal edges injured the seed in a uniform way with many tiny wounds.

There was a positive relation between injury and seedling emergence and the correlation was more significant when the seedlings emerged during cold wet weather. In cold wet soil the germinating seed is exposed to leaching and pathogens for a long time. Corn grows very slowly or not at all if the temperature is below 10 C.

In the field, reduction in emergence for mechanically injured corn seed probably occurs because the injuries serve as portals of entry for pathogens and saprophytes and as exit pores for ions and other compounds. Also injuries may be responsible for attraction of saprophytes and pathogens to injury sites. The exudate certainly stimulated the growth of *Phialophora radicicola* and *Pythium* sp. Flentje (1) who used peas and Keeling (2) who worked with soybeans claimed that the seed exudates attracted pathogens.

Conductivity and absorptiometer results showed a positive correlation with injury and a negative correlation with emergence. The negative correlation was greatest with seeds planted in cold wet soil. This might be expected because in cold wet soil leaching occurred over a longer period and consequently the vigor of the seedling was reduced.

Seedlings produced from the injured seed were weaker than those from noninjured seed as noted by observation and proven by a lower emergence of the former when planted 15 cm deep. Similar results might be expected when the seed is attempting to emerge in baked soil or in cold wet soil. Thus, it is advisable to plant corn seed with the least possible injury.

Under ideal conditions for seed germination injury plays a less important role than under poor conditions for germination.

One large chip from the cap or crown of the seed extending into the white starchy endosperm did not lower emergence as much as did several small wounds in the pericarp. This may happen because the embryo is at the base of the kernel and far removed from the crown injury where nutrient is lost and most infection occurs.

The fact that poor emergence of injured seed can be largely prevented by fungicide even under conditions of stress, indicates that pathogens play a significant role during emergence. Obviously the pathogens may, and soil saprophytes must, enter through injuries in the pericarp.

These results show that commercial producers of corn seed should attempt to produce seed which is injury free and that seed should be treated with a fungicide. This is especially important in Canada, where corn is grown at its northern limit, and germination is often slow due to cold and wet soils in the spring.

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