Fertilization Effects on Soybean Sudden Death Syndrome

By D.D. Howard, A.Y. Chambers, P.W. Brawley and T.D. Bush

Sudden death syndrome (SDS) is a mid- to late-season, soil-borne soybean disease that can seriously diminish soybean yields. Tennessee research has shown that chloride (Cl) fertilization as potassium chloride (KCl) can significantly decrease SDS effects and improve yields.

SUDDEN death syndrome is a mid- to late-season, soil-borne soybean disease. The 1991 season was the most severe for SDS losses in Tennessee since the disease was diagnosed in soybeans in 1984.

The casual organism has been recently identified as *Fusarium solani*, a fungus found in many Tennessee soils. Severity of SDS has been observed to be favored by cool, wet weather, soils with high organic matter, the presence of the soybean cyst nematode, soils subject to water overflow and fields in rotation with corn. Planting soybeans after corn appears to increase the incidence and severity of SDS. Usually, healthy and vigorous soybeans are more affected by SDS than unthrifty, stressed beans.

Visual symptoms of SDS may first appear at flowering as yellow spots between leaf veins. The spots expand into yellow streaks which eventually die; only the major veins remain green. Severely diseased leaflets may drop, leaving the petioles attached to the plant. Root systems decay with brown vascular discoloration. Yield losses are due to leaf drop, flower and young pod abortion, pod drop and reduced seed size.

Until recently, the only control has been the use of varieties having tolerance to SDS. However, few varieties have resistance to SDS, stem canker and cyst nematode.

Research in the Great Plains, Northwest and Canadian Prairies has indicated that Cl applications can reduce or suppress the several fungal root and leaf diseases of wheat. Since diseases like take-all and SDS are both caused by soil-borne fungi, we thought Cl applications might also suppress infections in soybeans.

Tennessee Research

We evaluated the possible effect of Cl on SDS in soybeans. The original study was expanded to evaluate rotational effects with corn as well as Cl effects.

Studies were conducted at the Milan Experiment Station in 1990 on a Falaya silt loam soil with a history of SDS. The soil had a pH of 6.3 with 80 and 180 lb/A Mehlich I extractable phosphorus (P) and potassium (K), respectively.

Potassium rates of 120, 160 and 320 lb/A K_2O were applied in 1990. A rate of 80 lb/A K_2O as KCl was broadcast on the experimental area in the winter. On May 25, 40 and 80 lb/A K_2O as KCl and 80 lb/A K_2O as potassium sulphate (K_2SO_4) were broadcast on the plots. On June 26 a split application of 80 and 240 lb/A K_2O as KCl was applied to plots fertilized with 80 lb/A K_2O in the winter, giving a total K_2O rate of 160 and 320 lb/A.

The 1991 study was changed to a split-plot randomized complete block design with six replications. Main-plots were KCl rates, sub-plots time of application.

Dr. Howard is Professor, Plant and Soil Science Department; Dr. Chambers is Professor, Entomology and Plant Pathology Department; and Mr. Brawley and Mr. Bush are Research Assistants, all at West Tennessee Experiment Station, Jackson, TN 38305.

Potassium rates were also changed to 50, 100, 150 and 200 lb/A K_2O as KCl applied at planting, plus a delayed application on July 1. The control was 150 lb/A K_2O applied as K_2SO_4 on the same dates.

Plots were rated for SDS incidence and severity prior to harvest and leaf drop in 1991, but not in 1990. Plots were harvested, and root systems were evaluated and rated for SDS symptoms both years.

Positive Effects

The 1990 data indicated yield benefits from late side-dressing of KCl compared with applying KCl or K_2SO_4 at planting (**Table 1**). Higher rates of sidedressed KCl (240 lb K_2O, 180 lb Cl/A) increased yield compared to a rate of 80 lb K_2O/A (60 lb Cl/A). Delayed ratings of root deterioration by SDS were inconclusive.

In 1991, KCl applications significantly lowered SDS severity based on leaf and root ratings compared with K applied as K_2SO_4 (**Table 2**). However, yields were unaffected by treatment. The SDS symptoms developed late in the season and may not have had sufficient time to affect yields as observed in 1990. The SDS leaf ratings, disease severity, and root ratings indicated that KCl applications were more effective than K_2SO_4 in reducing SDS symptoms. These observations indicate that Cl rather than K application was affecting SDS.

SOYBEAN sudden death syndrome can cause serious yield losses. Chloride as part of potassium chloride fertilizer can decrease effects of the disease.

Benefits of delayed KCl application in 1990 may have been related to high rain fall (5.02 inches) and Cl leaching from KCl applications at planting.

Table 1. Effect of K rate, K source and Cl on soybean yield, 1990.

K_2O rate, lb/A				
At planting	Side-dressed	K Source	Cl rate, lb/A	Yield, bu/A
120	0	KCl	90	45
160	0	KCl	120	45
80	80	KCl	120	49
80	240	KCl	240	51
160	0	K_2SO_4	0	45
LSD (0.05)				2

Summary

Incidence and severity of SDS in soybeans were both reduced by Cl application as KCl. Yield effects varied in two years of study. Greatest yield benefit resulted when large amounts of precipitation occurred between planting and sidedressed KCl applications. More remains to be learned about the role of Cl in suppression of this disease, but results are encouraging. ■

Table 2. Effect of K rate, K source and Cl yield and SDS leaf and root ratings in soybeans, 1991.

				SDS Leaf Symptoms		
K_2O rate, lb/A	K Source	Cl rate, lb/A	Yield, bu/A	Incidence,[1] %	Disease severity,[2] 0-9	SDS root incidence[3]
50	KCl	38	44	53	3.3	3.3
100	KCl	75	44	28	2.7	1.8
150	KCl	112	43	28	2.3	1.3
200	KCl	150	45	19	2.0	1.2
150	K_2SO_4	0	43	83	4.2	5.6
LSD (0.05)			NS	5	0.5	0.8

[1] Incidence–percent plants affected by SDS.
[2] Disease severity (ratings 0-9, 9 being most severe)
[3] Number of plants/10 dug with affected roots.