Incidence and Distribution of Septoria Diseases of Wheat in California

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ABSTRACT

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Septoria tritici, cause of speckled leaf blotch of wheat (*Triticum aestivum*), was first recognized as an important pathogen in California in 1975. Results of a survey of 17 counties in 1978, coupled with additional observations in 1979, 1980, and 1981, confirmed that the disease was widespread in the northern two-thirds of the Central Valley, with relative incidence and severity increasing in a south-to-north gradient. Severity of speckled leaf blotch, where it occurred annually, represented a significant economic impact to spring wheat production. The presence of *S. nodorum*, cause of glume blotch of wheat, although limited in distribution, is reported for the first time in California.

Three species of *Septoria*, including *S. tritici* Rob. ex Desm. (teleomorph: *Mycosphaerella graminicola* (Fuckel) Sand.), and *S. nodorum* (Berk.) Berk. (teleomorph: *Leptosphaeria nodorum* Müller), and *S. avenae* Frank f. sp. triticea Johns. (teleomorph: *L. avenaria* Weber f. sp. *triticea* Johns.), are known to cause leaf and glume blotch diseases worldwide on wheat (*Triticum aestivum* L.) (10,11). In California, only *S. tritici*, cause of speckled leaf blotch, has been reported previously (2,3).

In 1929, Mackie reported that the disease was common in northern California but presented no supporting data (8). Although no subsequent published information exists, speckled leaf blotch has been observed annually on spring wheat in the Central Valley but was considered to be of minor importance until 1975 (5). Widespread fall planting of short-statured, *S. tritici*-susceptible spring wheat cultivars, coupled with normal winter rainfall early in 1975, provided conditions favorable for disease development. Epidemic levels were reached in many areas following extended spring rains. In certain susceptible cultivars grown in a regional yield trial at Davis, nearly all leaves were destroyed before the soft dough stage (5). Consecutive years of below-average winter rainfall that followed in 1976 and 1977 were accompanied by a virtual disappearance of the disease. However, the return of normal winter rainfall patterns since that time witnessed a reappearance of speckled leaf blotch beginning in 1978.

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The purpose of this report is to record the incidence, distribution, and relative severity of speckled leaf blotch in the Central Valley, where approximately 431,000 ha of spring wheat is grown annually, and to determine whether *S. nodorum* or *S. avenae* f. sp. *triticea* occurs in California at the present time.

MATERIALS AND METHODS

Distribution and relative severity of Septoria diseases in the Central Valley of California were recorded in 1978 in a survey of 17 counties representing the major wheat-growing areas of both the Sacramento and San Joaquin valleys. Random fields were chosen to obtain equal coverage of each area and to include the areas where speckled leaf blotch was observed in 1975.

The survey was conducted in each of three areas indicated in Figure 1 when the grain had reached the late milk stage (Feekes stage 11.1) (7). Five random, 1-m^2 areas in each field were assessed visually for pycnidia-filled, necrotic lesions characteristic of speckled leaf blotch. The plants in each area were evaluated using a scale of 1–10 for an average severity index (ASI) graduated in 10% increments from 0 to 90% necrosis of the leaf area on the upper half of the plant. Because greenhouse and field inoculations with conidia of representative California isolates of *S. tritici* indicated that pycnidia form in all lesions soon after necrosis is evident, necrotic areas without pycnidia were not counted in the overall assessment (1).

An average rating was recorded for each surveyed field from the individually assessed areas. No correction was made for the particular cultivar assessed because all cultivars currently grown in California

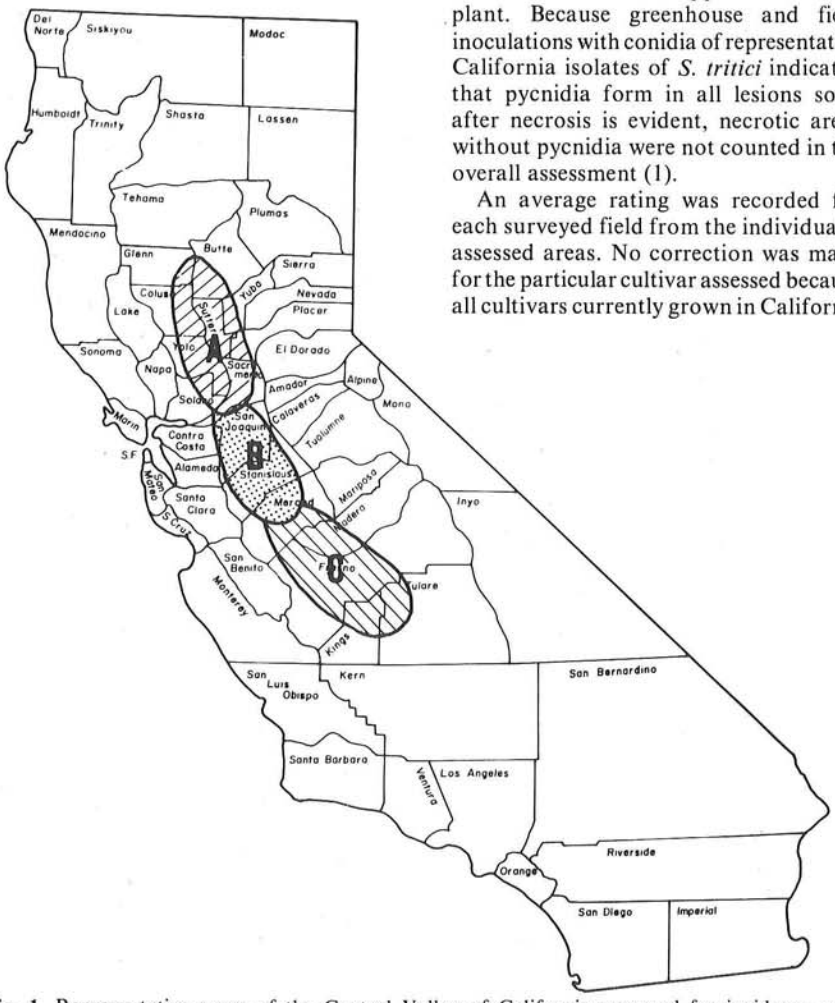

Fig. 1. Representative areas of the Central Valley of California surveyed for incidence and distribution of Septoria diseases of wheat.

are known to be susceptible to *S. tritici*; more than 70% of the total acreage is planted to three equally susceptible cultivars (Anza, Inia 66R, and Yecora Rojo) (1,9). When necrotic lesions containing pycnidia were found, either on leaves or spikes, samples were collected from each field for laboratory examination and species identification.

To identify the *Septoria* species present, tissue samples with necrotic lesions bearing pycnidia were moistened with sterile water to induce pycnidiospore liberation. A minimum of 10 leaves was sampled from each of the five random areas examined per field. Microscopic examination of spore morphology and dimensions were used to confirm the identity of the *Septoria* species present, according to the description given by Weber (12). Isolations of random, single pycnidiospores were made to establish cultures representive of the areas where the disease occurred for confirmation of pathogenicity and examination of conidia produced in culture.

RESULTS AND DISCUSSION

The incidence and relative severity of speckled leaf blotch, recorded at the late milk stage (Feekes stage 11.1), were distributed in a nonrandom fashion in the Central Valley in 1978 (Table 1). In general, both the incidence and the relative severity decreased from the northern to the southern regions of the valley (Table 1). In the northern one-third of the Central Valley, commonly known as the Sacramento Valley (area A, Fig. 1), the disease was found in all 26 fields examined. About 25% of these fields had an ASI of 4 or greater, which corresponded to necrotic tissue over 30% or more of the leaf area in the upper half of the plants examined. In separate studies conducted in 1978 at Davis, CA, ASI ratings of 4 at a similar growth stage were correlated ($r = 0.90$, $P = 0.01$) with measured yield losses of 27–30% for the three wheat cultivars Anza, Inia 66R, and Yecora Rojo (1). The remaining 75% of the fields in area A (Fig. 1) had an estimated disease severity level equivalent to 20% or less necrotic tissue, although none had less than 5–10% lesion coverage of leaves in the upper half of the plants.

Disease incidence became progressively less in area B (Fig. 1), where 43% of the fields surveyed were free of detectable speckled leaf blotch lesions (Table 1). The distribution of the disease within area B was variable, although fewer fields with disease were found in the southern portions of this area. In fields with disease, nearly half had an ASI of 4 or greater. In contrast to areas A and B, the 33 fields surveyed in area C (Fig. 1) were free of detectable *S. tritici* lesions (Table 1). Thus the southern third of the Central Valley was relatively free of speckled leaf blotch, with the disease becoming both more prevalent and more severe in a south-to-north gradient beginning in area B.

Laboratory evaluation of lesions on leaf and spike specimens collected from all diseased fields in areas A and B during 1978 confirmed that *S. tritici* was present as the singular species in all samples collected, with two exceptions. Both leaf and spike specimens collected from one field in area A and one field in area B were determined to have mixed infections by *S. tritici* and *S. nodorum*.

Pycnidia from lesions caused by *S. tritici* were black at maturity, ostiolate, substomatal, and ranged in size from 105 to 150 μm in diameter. Pycnidiospores were hyaline, filiform, slightly tapered, measuring 40–60 × 2–2.4 μm, with one to four indistinct septa. Conidia of *S. tritici* produced on Elliot's V-8 media (6) were variable in size and shape and were generally shorter than pycnidiospores from infected leaves, measuring 35–45 × 2–2.4 μm. Pycnidia from lesions identified as *S. nodorum* were brown, ostiolate, substomatal, and slightly larger than those of *S. tritici*, measuring 160–200 μm. Pycnidiospores were hyaline, 20–30 × 3 μm in size, with one to three indistinct septa. The mature pycnidia of *S. tritici* were readily distinguished on field lesions from those of *S. nodorum* based on the black and brown colors of the respective pycnidia.

In both plantings where *S. nodorum* was found in 1978, the cultivars were commonly adapted cultivars that had been planted unusually early (September). Both plantings had used local seed sources, and laboratory examination of the respective seed sources by the methods of Cunfer (4) failed to reveal any seedborne inoculum of *S. nodorum*. Subsequent specimens collected in 1979, 1980, and 1981 from several diseased fields in areas A and B revealed *S. nodorum* in mixed infections, with *S. tritici* only in area A; incidence was restricted to Glenn County in area A, where *S. nodorum* was originally found in 1978. *S. nodorum* was not found without *S. tritici*, nor did the relative frequency or distribution of *S. nodorum* appear to increase since 1978.

In all instances where *S. nodorum* was found, the wheat seedlings had emerged before mid-October, indicating a possible relationship between *S. nodorum* infection and early planting. In one field situation observed in 1979 in area A, with a 12 September planting date, the severity of *S. nodorum* infection in the spikes resulted in a complete loss of harvestable grain. The wheat cultivar in this case, Anza, is grown on about 48% of the wheat acreage in the Central Valley. Therefore, it would appear that the potential for high disease severity caused by *S. nodorum* exists in California but thus far has been observed only when an unusually early planting schedule is followed. No pycnidiospores characteristic of *S. avenae* f. sp. *triticea* were found in any sample examined.

Rainfall patterns in 1979, 1980, and 1981 were near normal and were associated with widespread distribution of speckled leaf blotch. Systematic surveys were not conducted in these 3 yr, but extensive field observations in all three areas outlined in Figure 1 indicated that the incidence, distribution, and relative severity of speckled leaf blotch were similar to those recorded in 1978. Based on observations conducted over the past 4 yr and consideration of long-term, average rainfall patterns in the Central Valley, speckled leaf blotch should continue to be of limited concern in area C because of lack of rainfall after the tillering stage (Feekes stage 2–3) in this general region.

Because all cultivars presently grown in California are susceptible to *S. tritici*, this pathogen is now considered to represent a potentially significant economic threat to areas with disease-conducive, late-season rain, especially where the disease has occurred annually since 1978. Lastly, this report represents the first confirmation of the presence of *S. nodorum* in California. Although *S. nodorum* is apparently limited in current distribution, its disease potential presents a concern for future spread and impact in California.

Table 1. Relative distribution and disease severity of speckled leaf blotch caused by *Septoria tritici* in the Central Valley of California in 1978

Survey area[a]	Fields (no.) in disease severity category[b]									
	1	2	3	4	5	6	7	8	9	10
A	0	10	9	3	1	1	1	0	0	1
B	10	4	3	1	2	1	0	0	0	2
C	33	0	0	0	0	0	0	0	0	0

[a] The Central Valley of California was divided into three areas corresponding to A (northern third), B (central third), and C (southern third), with 26, 23, and 33 fields examined, respectively. The areas are outlined in Figure 1.

[b] Disease severity was based on a 1–10 rating scale graduated in 10% increments, with 1 = 0% and 10 = 90% of the leaf area covered with pycnidia containing lesions. Leaves on the upper half of the plants were rated in five random, 1-m^2 areas per field where typical speckled leaf blotch lesions were found.

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