Survey of Incidence of Rice Diseases in the Sacramento Valley of California
2019

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Objective

Document the incidence of rice diseases in the rice growing area of the Sacramento Valley.

Methods

Eight Sacramento Valley counties where rice is grown were selected for the survey (table 1). Rice acreage in these counties represents 99% of the rice acreage in California. In each county, rice fields were randomly selected for inspection, trying to distribute the fields geographically to include most of the rice area in a county. The number of fields surveyed in each county varied with the size of rice acreage. Ten, five or two fields were surveyed in large, medium and small rice counties, respectively. The survey was conducted between September 12 and October 3.

In each field, three or four basins were selected. In each basin, a scout performed six to 15 inspections every 15 feet, as to have a minimum of 30 inspections per field. For each basing, half the inspections were conducted walking towards the center of the basin, and the other half walking in the opposite direction, towards the basin's edge. Each inspection consisted of a 1-minute search during which the scout looked for disease symptoms in nearby plants and recorded their presence or absence. Diseases surveyed, their symptoms, and location in the plant are described in table 13.

Each inspection was considered a sample unit. Inspections conducted within the same basin were considered a sample, and a percentage of inspections with disease symptoms was calculated for each sample. Sample size per county ranged from 4 to 40. Results are summarized by County and field as the average percentage of inspections with disease symptoms.

Results and Discussion

Inspected fields were at the grain filling and maturity stage during the survey dates. During this stage, rice diseases presented in table 2 can be easily identified.

Diseases not included in the survey were seedling disease and bakanae. Seedling disease affects rice during the first two weeks after planting, killing seeds before they germinate. Surveying this disease is difficult because it occurs before plant structures can be observed. Bakanae is a seedling disease that can be observed after plants have emerged through the water, 3 to 4 weeks after planting, or during grain development. However, the occurrence of this disease is minor and its effect on yield negligible at this time. The widespread use of sodium hypochlorite during seed soaking has greatly limited the incidence of this disease.

A total of 162 samples, consisting of 1,649 sample units, were taken (table 3). On average, stem rot and aggregate sheath spot were the most common diseases, found in all counties. Stem rot had a higher incidence than aggregate sheath spot. Blast was found in only three counties, with Glenn County having the highest incidence by far. Kernel smut was found in all but two counties.

Stem rot was present in every inspected field. For all counties, percentage of inspections with stem rot disease symptoms ranged from 10 to 100%, averaging 65%. Geographically, the distribution of stem rot is uniform across the Sacramento Valley (fig. 1). Aggregate sheath spot was present in 51 of the 54 inspected fields, with an average incidence of 35% for all counties. Higher incidence was found in the northern (Glenn and Butte) and eastern (Sutter, Placer, and Yuba) counties (fig. 2). In these counties, 35% of inspected fields had an incidence higher than 75%. Research has shown that aggregate sheath spot incidence and severity increases when potassium soil levels are below optimal. Typically, soils in the eastern part of the Valley tend to have lower potassium levels, explaining the higher incidence of the disease in these counties. While soils in the northern part of the valley are not typically low in potassium, their clay type can fix potassium, making it unavailable to the plant.

Stem rot has been a problem in California since the beginning of rice cultivation. Aggregate sheath spot became a problem after the introduction of high-yielding, semidwarf varieties by the end of the 1960s. These two diseases can be highly influenced by agronomic practices, especially straw management. These two pathogens form resting structures at the end of the season called sclerotia. The sclerotia survive in straw tissue during the winter, and accumulate in the soil over the years. Research has shown that higher levels of sclerotia in the soil correlate with higher disease incidence and severity. To reduce the survival of sclerotia, straw residue needs to be degraded or burned. Fertility can also influence these diseases. Excess nitrogen can increase the severity of stem rot, and potassium deficiency that of aggregate sheath spot. All varieties grown in California are equally susceptible to both pathogens.

Blast was present only in 14 fields in Butte, Glenn, and Colusa counties (fig. 3). Highest levels were observed in Glenn County, with half the fields inspected having more than 50% of inspections with disease symptoms. Incidence in Butte and Colusa counties were low, with the highest levels only reaching 17%. Blast was first identified in California in Glenn and Colusa counties in 1996. Since then, rice blast has become endemic in these counties, showing up at varying levels every year, mostly due to climatic conditions. Blast infections are favored by long periods of leaf wetness, high relative humidity and mild temperatures (63ºF to 82ºF). In Glenn County, several areas have micro climates that offer these conditions most years. In years when these conditions are mode widespread, disease epidemics can occur throughout the Valley, such as in 2010.

Blast can be affected by agronomic practices. Excess N and water drain increase the susceptibility of plants to blast infection. Blast can survive in straw residue, therefore straw residue management is an important component of disease management. A recently released variety, M-210, is resistant to the races of blast present in California.

Kernel smut was present in most counties, but higher incidence was found in north Glenn and Butte counties, and Yuba County (fig. 4). This disease had been considered a minor rice disease in California; however, in recent years, its incidence and severity seem to be increasing. For example, 2018 was a very severe smut year, and a few fields in Colusa, Butte, and Glenn counties reported losses due to the disease. Several factors can affect the development of this disease, such as nitrogen level and variety. Additionally, contaminated seed can spread the disease and may play a role on the increased levels of the disease. Finally, spores of kernel smut can remain in the field after harvest, contaminating the following crop.

Integrated disease management in California relays on several tactics to reduce the impact of diseases on rice yield and quality. As mentioned above, variety selection, fertility, water and straw management, are key components of a successful disease management program. Straw management is especially important in managing stem rot and aggregate sheath spot, and can also aid in the prevention of blast and smut. Fungicides are also used to manage diseases. Widespread fungicide use in California started with the identification of blast. Since then, fungicide use has expanded to cover all the diseases observed in the survey.

In conclusion, stem rot and aggregate sheath spot were commonly found during this survey. While stem rot was uniformly distributed across the Sacramento Valley, aggregate sheath spot was more important in the northern and eastern areas of the Valley. Rice blast was only found in three counties, but at high incidence in Glenn County. Kernel smut was found in most counties, but its incidence was generally low.

Table 1. Counties surveyed, their rice acreage, and number of fields sampled, 2019.

County	Rice Acreage*	% of statewide acrage	Number of fields sampled
Butte	105,000	19	10
Colusa	150,000	28	10
Glenn	75,000	14	10
Sutter	120,000	22	10
Yolo	32,500	6	5
Yuba	36,100	7	5
Placer	10,000	2	2
Sacramento	8,800	2	2
Total	537,400	99	54

*2016 growing season, National Agricultural Statistics Service and County Crop Reports

Table 2. Diseases surveyed, causal organism, symptoms and plant part inspected, 2019.

Disease	Organism	Symptoms	Plant part inspected
Stem rot	*Sclerotium oryzae*	Stem lesions	Stems at the water line
Aggregate sheath spot	*Rhizoctonia oryzae-sativa*	Stem lesions	Stems at the water line
Rice blast	*Pyricularia grisea*	Necrotic tissue	Panicles
Kernel smut	*Tilletia barclayana*	Infected panicles	Panicles

Table 3. Disease survey sample size per county and average percentage of inspections with disease symptoms present, 2019.

County	Sample size	Stem rot (%)	Aggregate sheath spot (%)	Blast (%)	Kernel smut (%)
Butte	40	65.42	36.35	3.85	13.13
Colusa	30	69.00	9.33	2.67	11.00
Glenn	20	68.33	29.00	43.00	13.67
Sutter	37	65.64	56.83	0	19.19
Yolo	15	60.00	32.67	0	11.33
Yuba	10	71.33	84.67	0	55.33
Placer	4	36.67	98.33	0	0
Sacramento	6	51.67	15.00	0	0
All counties	**162**	**65.14**	**38.50**	**6.75**	**15.81**

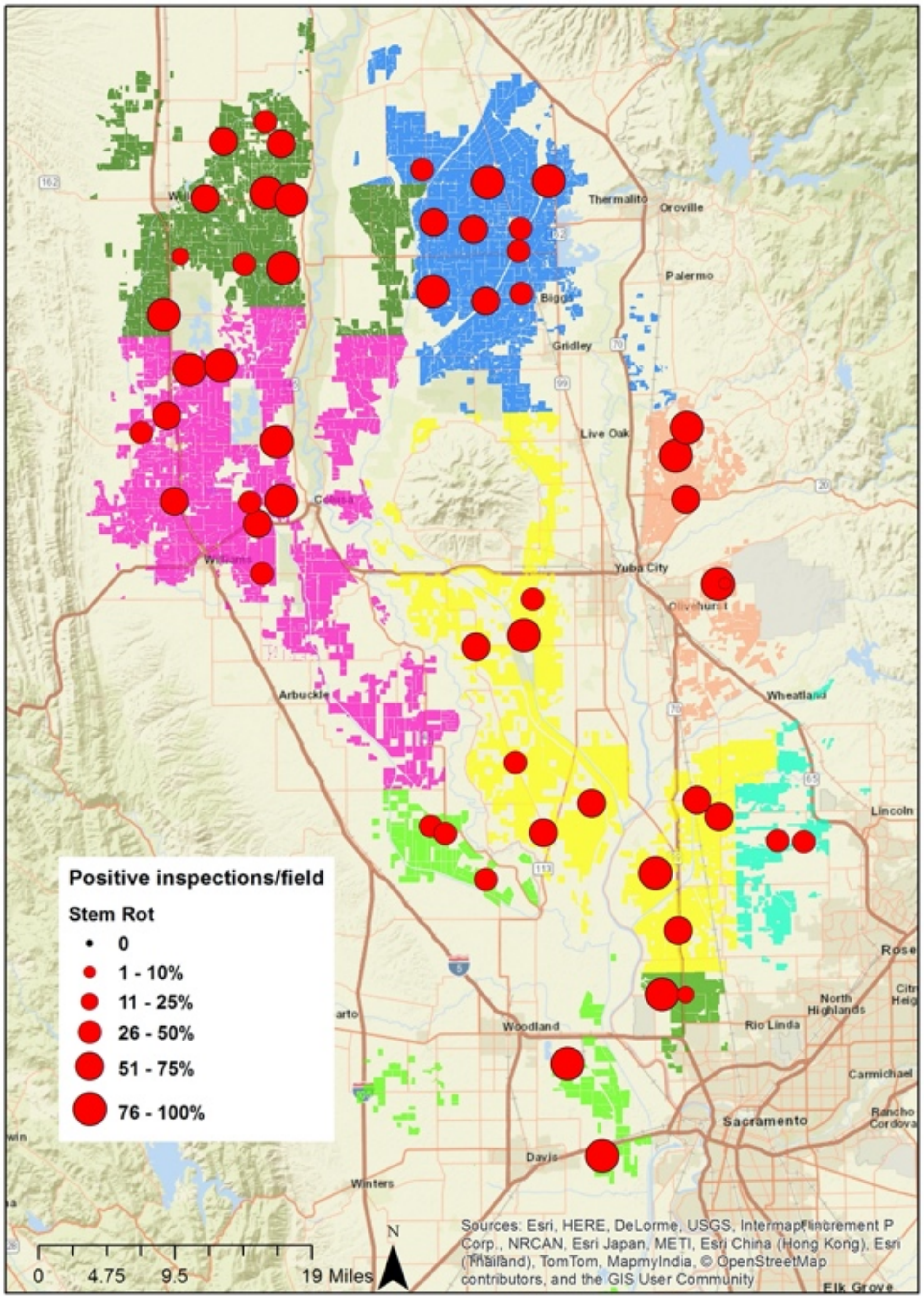

Fig. 1. Percentage of inspections per field with stem rot symptoms present, 2019.

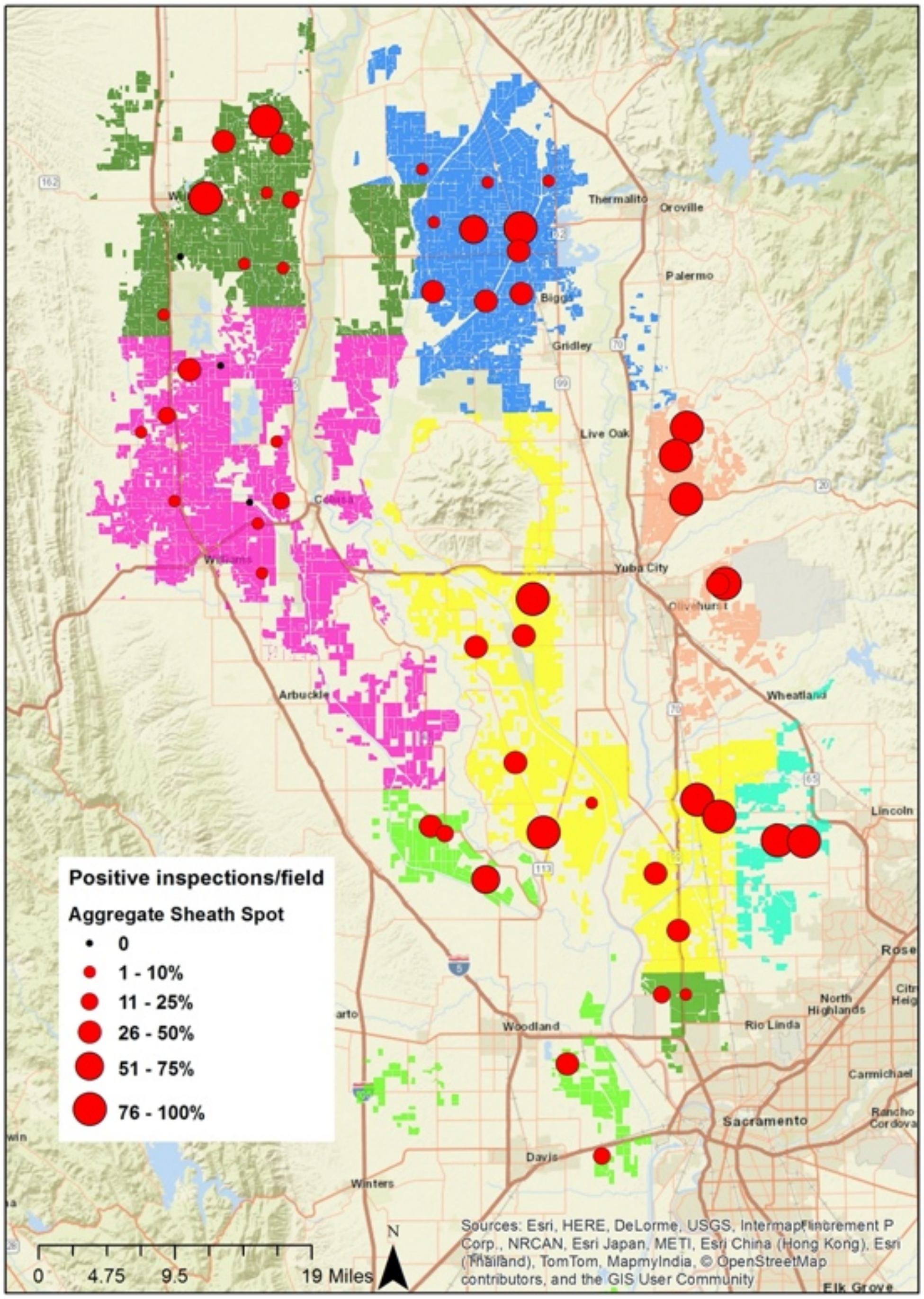

Fig. 2. Percentage of inspections per field with aggregate sheath spot symptoms present, 2019.

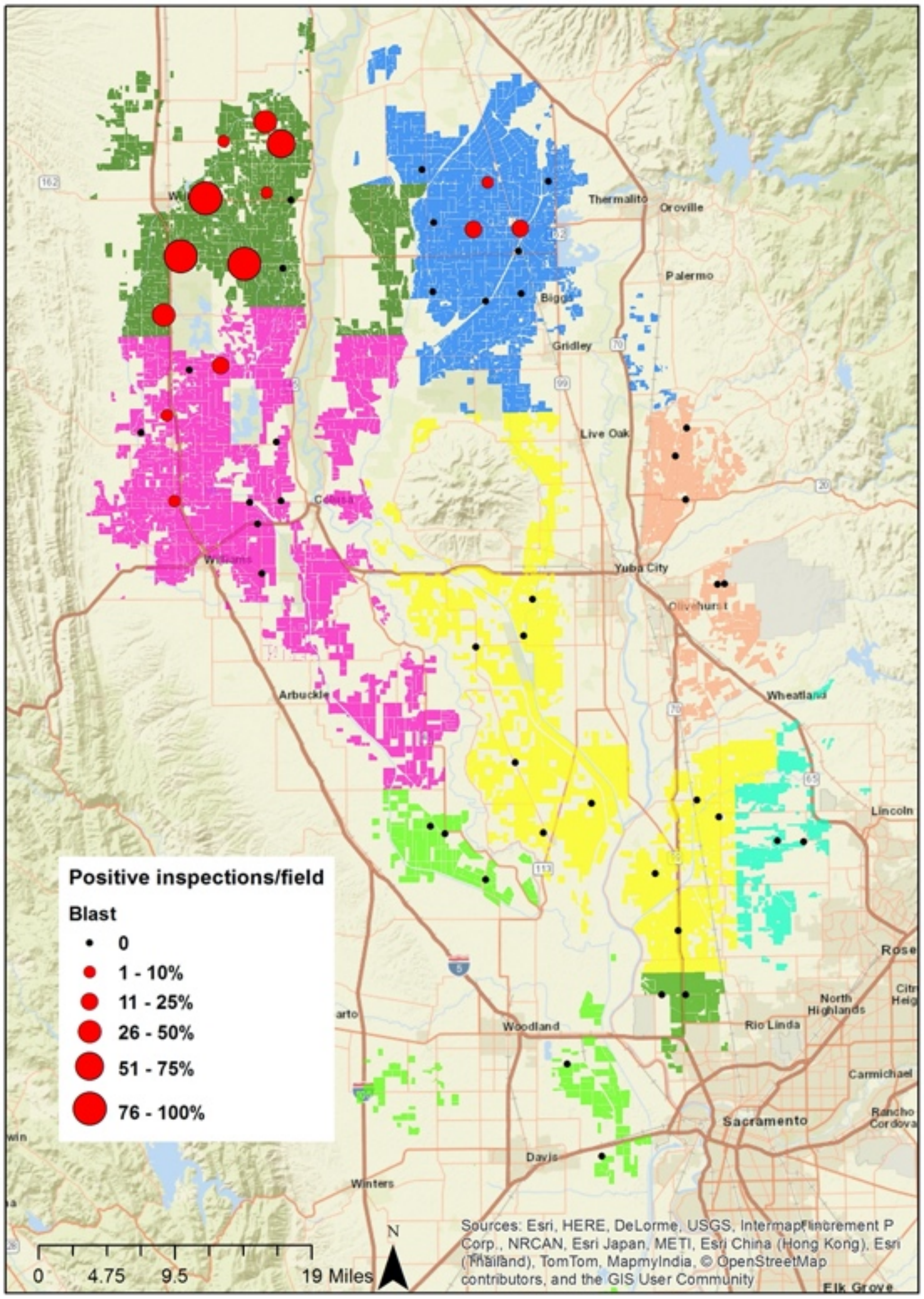

Fig. 3. Percentage of inspections per field with blast symptoms present, 2019.

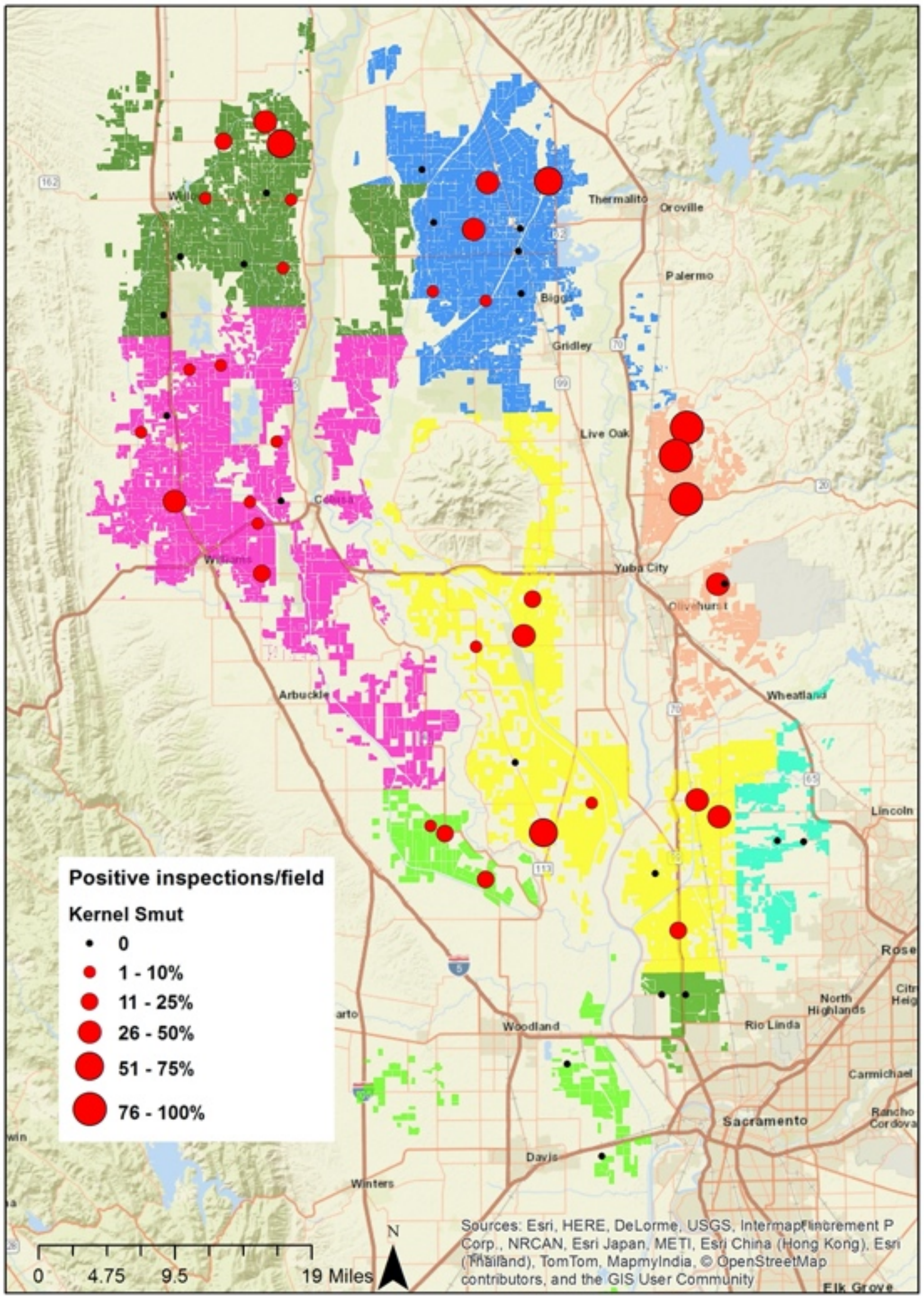

Fig. 4. Percentage of inspections per field with kernel smut symptoms present, 2019.