Wheat yields reduced in 1961 by

STRIPE RUST EPIDEMIC

in central California

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During 1961 losses from stripe rust (*Puccinia glumarum*) in California were higher than known for any previous year. The unprecedented severity of this rust in the Sutter Basin in 1961 may be attributed in part to favorable environmental conditions or, on the other hand, may indicate a recent shift in pathogenic races of the organism.

Stripe rust was first collected in California in 1915 on wild barley (*Hordeum leporinum*) growing near Tehachapi in Kern County. The same year stripe rust was found for the first time also on wheat near Sacaton, Arizona. Since that time the disease has been reported from 14 western states and three western provinces in Canada.

In California, stripe rust appears on wheat each year during the cool spring season. The development of this rust, however, is usually arrested by hot weather in May or early June, thus preventing epidemics. Rust development is favored by foggy, humid winters followed by cool, wet springs. These ideal weather conditions were present in the Sutter Basin during 1960–61, along with a substantial amount of rust inoculum presumably from heavily infected volunteer wheat or other grass hosts. More than 60 species of grasses are known to harbor stripe rust. In California stripe rust commonly occurs in nature on *Hordeum leporinum, Hordeum hystrix, Bromus marginatus,* and *Phalaris minor,* all possible inoculum reservoirs.

Yield losses

The center of the stripe rust epidemic was the Sutter Basin area, with about 10,000 acres planted to wheat. Yield losses in this area were estimated to range from 28 to 56 per cent of normal yields. In Sutter County, wheat yields average better than 3000 pounds per acre during normal years. In 1961, stripe rust damage brought the lowest-yielding field down to 1400 pounds per acre, with a bushel weight of 52 pounds (normal 61–62 pounds). The highest yield in the area was 2300 pounds per acre, with a bushel weight of 58 pounds. Reduction in yields was due to a decrease in the size and number of heads per plant, and in size and number of kernels per head, and to a shrivelling of the kernels.

A survey of commercial wheat fields in May of 1961 revealed that stripe rust was present in seven counties in central California. Heaviest incidence of stripe rust was found in Sutter County, with an estimated 70 to 98 per cent of the total leaf area destroyed. In Glenn County, 65 to 85 per cent of the leaf area was infected; in Colusa, 40 to 60 per cent; in Yolo, 20 to 30 per cent; and there was a trace of sporulation in wheat fields in Tehama, San Joaquin, and Solano counties.

Most of the California wheat varieties grown in the Agronomy Department's experimental plots at Davis were heavily rusted, with an estimated 70 to 90 per cent of the total leaf area destroyed in Big Club, Ramona, Poso, White Federation, Onas, Baart, and Pacific Bluestem. In trials conducted in both Sutter and Yolo counties, however, certain experimental selections were found resistant to stripe rust (as shown in table), thus offering a promising method of rust control. It should be emphasized, however, that more extensive testing will be necessary to evaluate these varieties adequately with respect to rust reaction, agronomic performance, and quality.

High residual soil nitrogen resulting from previous overfertilization was observed to intensify stripe-rust infection. High soil nitrogen increased plant height and tillering in Big Club 60 wheat but also promoted considerably more rust development. Five samples of grain from each of the low- and high-nitrogen areas, grown in the presence of severe stripe rust, revealed an average of 30 per cent greater yield and 40 per cent greater kernel weight in the wheat grown on soil with the lower nitrogen level.

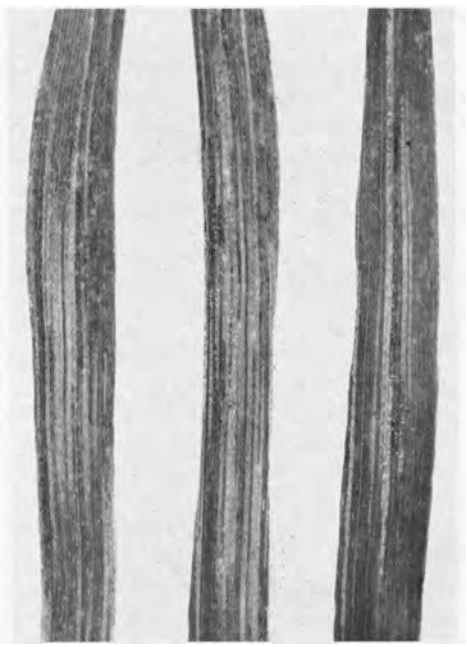
Newly formed uredospores of *Puccinia glumarum* germinate readily in the range of 41 to 68°F, with optimum germination at 50 to 54°F. The longevity of uredospores, however, is short. At room temperature they survive only two to three months, at 41°F only six months, and at 32°F up to 14 months. Since stripe rust spores are sensitive to high temperatures, the fungus survives the hot, dry summer

STRIPE RUST REACTION AND YIELD DATA FOR WHEAT VARIETIES IN CENTRAL CALIFORNIA TRIALS IN 1961

Wheat varieties	Sutter County*		Yolo County*	
	% Leaf area rusted	Yield lbs/acre	% Leaf area rusted	Yield lbs/acre
RAMONA 50	90	2720	90	4420**
WHITE FEDERATION 54	80	2200	84	2880
ONAS 53	75	2110	80	2210
BAART 46	80	1820	80	2230
Experimental Line 1	Zero	4380	Zero	4750
Experimental Line 2	Zero	4140	6	4060
Experimental Line 3	3	4120	4	3680
Experimental Line 4	10	3590	1	3600

* Stripe rust was of greater severity and longer duration in Sutter County than in Yolo County, resulting in lower yields of commercial wheats in the Sutter Basin.

** Ramona 50, a rust-susceptible variety, escaped severe damage in Yolo County because of the later appearance of the rust there.



Stripe-rust symptoms on leaves of Ramona wheat.

months as dormant mycelium in grass hosts and volunteer wheat. Similarly the fungus overwinters as hibernating mycelium inside the leaves of wheat or grasses. The importance of cool temperature to stripe rust development is emphasized by the fact that high temperatures may render susceptible plants resistant to infection. Thus susceptible wheat plants grown at 77°F were found completely resistant to stripe rust, whereas the same plants grown at 55°F were completely susceptible.

Stripe rust is capable of forming a new crop of spores every 12 to 13 days under favorable conditions. The rust sporulates on leaf blades, on leaf sheaths, inside the glumes, and even on wheat kernels themselves. When the seed is infested, germination may be reduced by 50 per cent; however, the disease is not transmitted from one crop to the next by infested seed wheat. Stripe rust is thus neither seed- nor soil-borne, but large clouds of spore inoculum are wind-borne.

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BLACK-EYED PEAS as a swine feed

HUBERT HEITMAN, JR. · JACK A. HOWARTH

Feeding trials with rations including ground black-eyed cowpeas for swine resulted in reduced consumption and utilization of feed as well as lower gains—but there was no evidence of toxicity. Twenty-four growing hogs with an initial weight of about 80 pounds were fed a control ration and rations containing 20 per cent and 50 per cent ground black-eyed cowpeas (Vigna sinensis) for an experimental period of 70 days. As the percentage of black-eyed peas increased, gain in weight decreased. The pigs on the ration containing 50 per cent black-eyed peas gained about 38 per cent less weight than the controls.

Composition of the cleaned, cull, black-eyed peas used in the experiment included: dry matter, 91.5 per cent; crude protein, 23.2 per cent; nitrogen-free extract, 60.9 per cent; ether extract, 1.0 per cent; crude fiber, 2.6 per cent; and ash, 3.8 per cent. The peas were ground and added to three of the four rations shown in the table. The second ration differed from the first (control) by the substitution of 20 per cent black-eyed peas for an equal amount of barley. This substitution caused an increase in the crude protein content of the ration. In the third ration, black-eyed peas were substituted for barley and all of the cottonseed and soybean meals, giving the ration a crude protein content about equal to that of the control ration.

PERCENTAGE COMPOSITION OF RATIONS FED TO PIGS*

Ration number	1	2	3	4
Ground barley	80.5	60.5	68.5	38.5
Ground black-eyed cowpeas	....	20	20	50
Dehydrated alfalfa meal	5	5	5	5
Soybean oil meal	4	4	....	....
Cottonseed meal	4	4	....	....
Meat and bone scraps (45% protein)	6	6	6	6
Salt	0.5	0.5	0.5	0.5

* Plus 0.45 lb. zinc sulphate per ton.

The 24 purebred Duroc barrows used in the trial were weighed in at about 80 pounds each and sorted into four lots with rations assigned at random. They were fed in concrete pens with self-feeders for an experimental period of 70 days. At the conclusion of this feeding period, two hogs were picked at random from each lot for slaughter. The four remaining hogs being fed ration No. 4 (50 per cent black-eyed peas) were switched to a ration of black-eyed peas only, for an additional 28 days and then slaughtered.

GAIN AND FEED CONSUMPTION OF PIGS* FED BLACK-EYED PEAS

Ration number and description	1 Control	2 Black-eyed peas 20%	3 Black-eyed peas 20%	4 Black-eyed peas 50%
Inital weight, lb.	79.0	81.3	79.7	80.0
Av. total gain, lb.**	110.3	91.0	87.0	68.3
Av. daily gain, lb. per pig	1.58	1.30	1.24	0.98
Av. daily feed consumption, lb.	5.76	4.58	4.53	4.09
Feed per lb. of gain, lb.	3.65	3.52	3.65	4.17

* Six pigs per lot for 70 days.

** Analysis of variance yielded a mean square of 1780.22 which is statistically highly significant ($P<0.01$). The Duncan (1955) multiple range test showed that gains of pigs on both rations 1 and 4 differed from all other lots at the 1% level. The difference in gains between pigs on rations 2 and 3 lacked statistical significance.

Results

Results of the 70-day feeding trial indicate that the substitution of black-eyed peas for barley, or for barley and the oil meals, causes a reduction in weight gain. Less feed was apparently consumed when black-eyed peas were included in the ration. Statistical analysis of feed data could not be carried out as the animals were group-fed. Feed utilization appeared lowest on the ration containing 50 per cent black-eyed peas.

Rations containing black-eyed peas did not appear as palatable as the control ration, and much more feed was wasted. The 50 per cent black-eyed pea group (ration 4) had the greatest wastage. During the 28-day period on a ration of straight black-eyed peas, the group of four hogs gained 0.59 lb. per pig per day and consumed only 3.43 pounds of black-eyed peas (or ration) per pig per day. Feed consumption was very low initially, but increased to almost 5 pounds daily at the conclusion of the 28 days.

Examination at slaughter and histological studies of kidneys showed no apparent differences between hogs fed the different rations.

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