Four commercial varieties were tested for blanking at several widely different California locations.

Rice panicle 100 percent blanked.

Rice sterility

Floret sterility, commonly called blanking, has been recognized as a problem in California rice production for a considerable period. Surveys in 1971 and 1972 showed average sterility of 12.5 and 12.8 percent, respectively. Data from tropical areas also indicate an average sterility of 10 to 12 percent. Sterility losses sometimes are two to three times this level, however, depending on the variety, production area, and year.

Cold night temperatures below 60° F 10 to 14 days before heading are known to be one of the major causes of sterility, and the rice-growing region subjected to cool marine airflow from the San Francisco Bay (San Joaquin, Sacramento, and Yolo counties) has a reputation for high sterility. Other factors also considered to be causes are hot temperatures at flowering time and high levels of nitrogen fertilization (rates above 150 pounds per acre).

Sterility has displayed high varietal as well as geographic variation. The purpose of this research was to analyze the sterility performances of four commercially important rice varieties at widely different locations to assess the variety-environment factors related to high sterility.

M-101, M9, S-201, and L-201, commercial varieties with early maturity, short stature, and high yield, were selected for investigation. Varieties were grown in a randomized complete block design with four replications at the following locations: 12 miles east of Stockton in San Joaquin County; 5 miles east of the Sacramento metropolitan airport in Sacramento County; between Knights Landing and Dunnigan in northern Yolo County; 5 miles north of Marysville in Yuba County; in Kern County near Bakersfield; and at the Davis Rice Research facility (early and late plantings), 1 mile west of Davis, Yolo County.

If one looks at the overall varietal means (table 1), M-101 had significantly less sterility than the other three varieties. L-201 was significantly higher in sterility than the other three varieties. S-201 and M9 had similar, intermediate sterility between M-101 and L-201. However, the varieties did not perform similarly at all locations. A significant variety x location interaction was demonstrated.

Analyzing the sterility performance of M9 and M-101 at the different locations explains this interaction. Although M9 had higher overall sterility than M-101 and S-201, M9 had the lowest sterility of all four varieties in the moderate-temperature areas (Yuba, northern Yolo, Sacramento, San Joaquin counties). Moderate areas are defined as those in which air temperatures stayed above 55° F at meiosis (10 to 14 days before flowering) and below 95° F at flowering (see table 2). Cold areas are those where minimal temperatures at meiosis fall below 55° F (the two Davis trials). Hot areas sustain temperatures above 95° F at flowering (Kern County).

The sterility performance of M-101 and M9 was reversed in the Davis trials (cold). The effect was especially pronounced in the early Davis trial, which was afflicted with cool irrigation water, resulting in colder canopy temperatures. M9's sterility increased greatly from 4.5 to 49.7 percent between the Sacramento County and Davis (early) locations. In the same comparison, M-101 only increased from 7.3 to 17.7 percent. Thus, M9 was much more susceptible to cold than M-101, whereas in moderate areas M9 had less sterility than M-101 and the other varieties.

L-201 and S-201 showed a fairly consistent pattern of increased sterility in colder areas. In moderate areas, they had higher sterility than M9, with L-201 the highest of the three. In the colder Davis trials, L-201 and S-201 generally were intermediate between the low sterility of M-101 and high sterility of M9.

Comparison of sterility between locations gives some insight into the effect of different environmental factors on sterility. Sterility in the Davis (early) test was significantly higher than in all other locations. This supports the current knowledge that cold temperatures do cause significant sterility. These conditions probably occur rarely in most parts of the rice-growing region, but when they do occur, large increases in sterility can be expected.

The data also show a significant difference in sterility between locations in the moderate temperature area. Sacramento County had significantly less sterility than San Joaquin County. Yuba and Yolo (north) trials both had significantly higher blanking than the San Joaquin and Sacramento tests. Since the four locations are in a moderate temperature area, the sterility differences must be due to factor(s) other than temperature extremes (either high or low). A possible factor to consider is nitrogen fertilization rate. Our previous work (*California Agriculture,* November-December 1980) has shown that sterility significantly increased when nitrogen application was higher than 120 pounds per acre. We did not determine the amount of nitrogen in the soil at planting time, nor were different rates of nitrogen applied. Therefore it was impossible to obtain positive evidence that nitrogen fertilizer rates affected sterility. However, it may be more than coincidental

that the two locations with the highest nitrogen rates (Yuba and Yolo, north) had the highest sterility.

Temperature up to 100° F at flowering time does not appear to contribute significantly to sterility. Sterility data at the hot Kern County trial were incomplete because of bird damage. However, samples of M9 and S-201 were taken. Although maximal temperature during flowering at this test was much higher (over 100° F) than in any other area in the rice-growing region, sterility was low. Data from sterility studies in the Imperial Valley (author's unpublished data) indicate that some California varieties maintain high floret fertility under hot conditions at flowering time. Calrose 76 and M7 had sterility percentages of only 22.4 and 21.2 percent, respectively, while lines reported to be heat tolerant introduced from the tropics showed sterility ranging from 30 to 80 percent.

TABLE 1. Sterility comparisons between varieties at different locations in 1979 statewide trials

Location	Sterility of cultivars*				
	M-101	S-201	M9	L-201	Mean
	%	%	%	%	%
Sacramento County	7.3 c	9.1 ef	4.5 f	9.9 d	7.7 d
San Joaquin County	9.3 c	10.0 def	7.5 def	12.3 cd	9.8 c
Yolo County (north)	10.4 c	15.2 bcd	6.4 ef	19.4 b	12.9 b
Davis (late)	12.3 bc	8.4 f	16.1 bc	15.8 bc	13.2 b
Yuba County	16.4 ab	14.0 cde	11.0 cde	14.5 bcd	14.0 b
Davis (early)	17.7 a	31.3 a	49.7 a	41.3 a	35.0 a
Kern County		8.9 †	8.0 †		
Mean	12.2 c	14.7 b	15.9 b	18.9 a	

*Means not having the same letter in common are significantly different at the .05 level according to Duncan's New Multiple Range Test. Comparisons were calculated for the same variety at different locations, different overall location means, and different overall variety means.
†Not included in the means or the statistical analysis.

varies with area and variety

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In summary, the sterility data of M-101, M9, L-201 and S-201 in the 1979 statewide trials demonstrate some important points about this phenomenon. Sterility markedly increases when rice is grown in areas where air temperatures fall below 55° F during meiosis. However, significant sterility differences can also occur between locations within moderate areas. Hot temperatures at flowering are an unlikely cause, since low sterility occurred in S-201 and M9 when grown in the hot Kern County locations.

M-101 showed the least sterility of all four varieties when data were averaged over all locations. However, an analysis of variety means at specific locations shows that M9 actually has less blanking in moderate areas, but M-101 demonstrates lower sterility in colder areas. L-201 had significantly higher overall sterility than the other three varieties. S-201 was fairly stable, having less sterility than L-201 at all locations, but generally more than M9 and M-101. However, in colder areas S-201 had less sterility than M9. Results of these trials should be useful to rice growers when choosing varieties for different planting dates and climatic areas.

TABLE 2. Heading and temperature data for varieties tested for sterility in 1979 statewide trials

Location	Variety	Seeding date	Mean heading date	Mean min. temp. during meiosis*	Mean max. temp. at flowering†
				°F	°F
Davis (early)	M-101	5/7/79	8/22	51.1	87.8
	M9		9/1	53.8	87.3
	L-201		9/7	53.6	93.3
	S-201		8/30	54.1	87.4
Davis (late)	M-101	5/18/79	8/19	51.7	86.7
	M9		8/30	54.1	87.4
	L-201		9/3	52.9	89.0
	S-201		8/26	52.4	87.2
Yolo County (north)	M-101	5/15/79	8/10	59.2	94.4
	M9		8/14	56.3	93.3
	L-201		8/24	55.0	89.7
	S-201		8/20	54.5	90.2
Yuba County	M-101	5/15/79	8/8	64.3	92.6
	M9		8/12	63.8	91.6
	L-201		8/18	61.8	86.2
	S-201		8/14	62.1	91.3
Sacramento County	M-101	5/8/79	8/8	59.4	97.1
	M9		8/11	57.5	94.3
	L-201		8/14	54.8	93.2
	S-201		8/14	54.8	93.2
San Joaquin County	M-101	5/14/79	8/10	64.9	94.2
	M9		8/16	62.6	88.4
	L-201		8/25	61.0	90.2
	S-201		8/22	60.7	91.4
Kern County	M9	5/11/79	7/31	76.0	100.2
	S-201		8/7	74.6	100.8

*Mean minimal temperature averaged over the period 10 to 20 days before heading.
†Mean maximal temperature over a 10-day period begining 5 days before heading.

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