SORGHUM MIDGE PEST MANAGEMENT
in the San Joaquin Valley

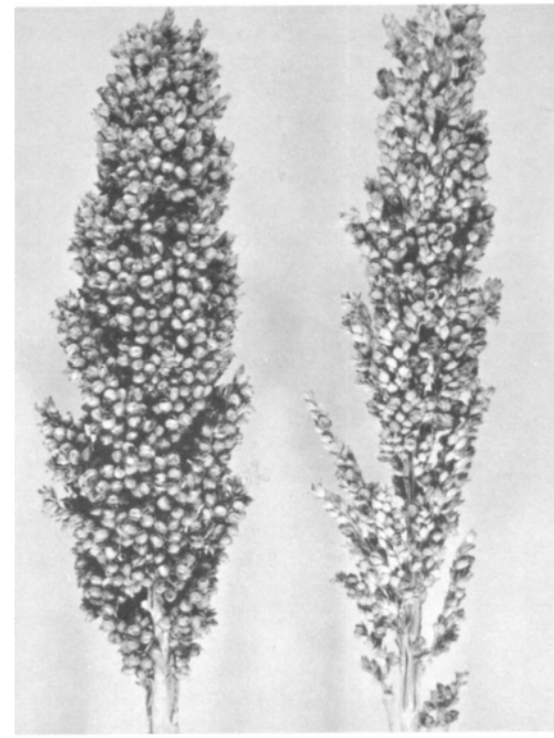
C.G. SUMMERS • R.L. COVIELLO • W.E. PENDERY • R.W. BUSHING

The sorghum midge was first discovered in California (Tulare County) in 1960 and currently causes damage to grain sorghum throughout the southern San Joaquin Valley. The losses attributable to this pest throughout its range are unknown, but we estimated that losses in Tulare County in 1973 exceeded one-half million dollars.

The damage is caused by the larvae of this tiny fly. Eggs are laid beneath the glumes next to the developing ovary. Upon hatching, the larva begins to feed on the developing ovary, causing it to abort. This results in an empty spikelet and a condition known as blast or blight of the head (see photo). Damage is often severe, particularly in late-planted sorghum, and at times, the remaining crop is not worth the costs incurred in harvesting.

The seasonal pattern of midge development in the San Joaquin Valley is shown in the graph. The adult midge emerges from diapause in mid- to late May and begins ovipositing in Johnsongrass blooms. About 13 to 15 days are required to complete the life cycle (egg to adult). Populations continue to develop on Johnsongrass for the next several weeks but do not increase in numbers to any great extent. As early-planted sorghum fields begin to bloom (about mid-July) a few midges may be found attacking the florets, although their numbers are still too low to cause much damage or grain loss. By mid-August, midge populations are building up rapidly, and any field blooming after the end of the third week of August is likely to suffer severe damage and yield loss.

We conducted a 3-year study at the Kearney Horticultural Field Station (KHFS) and in Tulare County to determine the most effective means of combating this pest.

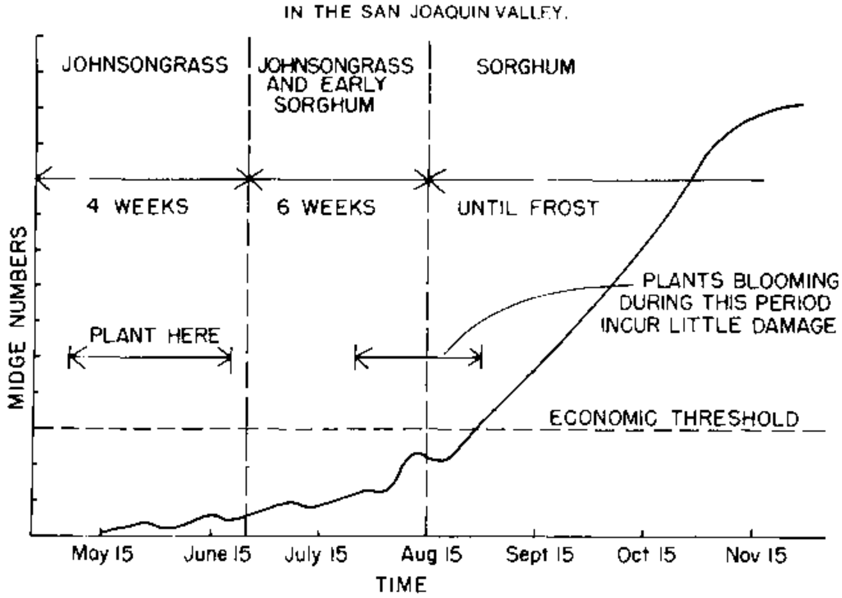


Damage caused by sorghum midge. Severely blasted head on right; undamaged head on left.

Chemical control studies

Dimethoate, at the rate of 0.20 pound active ingredient (AI) per acre, was applied by air to one-half of five late-planted grain sorghum fields in Tulare County. The remaining half of each field was used as an untreated control. Two applications were made, the first when 50 percent of the heads in each field were showing some bloom, and a second 5 days later. Both the insecticide and the timing of application were chosen because studies in Texas had shown this combination to be effective in controlling midge.

DIAGRAM OF SEASONAL POPULATION BUILD-UP OF THE SORGHUM MIDGE IN THE SAN JOAQUIN VALLEY.



The midge infestation level was determined by selecting 30 heads at random from both the treated and untreated portions of the fields, holding them in an ice cream carton emergence chamber, and counting the number of adults emerging. Yields were determined by harvesting ten 25-foot sections from the treated and untreated half of each field.

The midge infestation level in all fields was high enough to cause some damage. There was no significant difference, however, in the number of adult midges emerging from heads taken from the treated and untreated portions of each field. Grain yields are shown in table 1. Yields were slightly higher in the treated half of two fields (B and C) but slightly higher in the untreated half of the other three (A, D, and

TABLE 1. GRAIN YIELDS FROM THE TREATED AND UNTREATED HALF OF 5 FIELDS, TULARE COUNTY, CALIFORNIA, 1972.

Field	Yield in tons per acre: Treated half	Untreated half
A	3.55	3.95
B	3.57	3.41
C	2.91	2.59
D	3.43	3.57
E	2.9[illegible]	2.94
Ave	3.26 1/	3.27 1/

1/ Average yield is not significantly different between the treated and untreated half at the 5% level of probability.

These studies demonstrate that attempts to control the sorghum midge with insecticides do not work under California conditions. Yield losses can be minimized, however, by strict adherence to a planting cutoff date. Fields planted before June 15 will probably escape midge damage. Those planted between June 15 and 22 may or may not escape damage, depending on the season. Virtually all plantings made after June 22 risk severe midge infestation and yield reduction. Plant population had no significant influence on yield, and high plant population (12 plants per foot) are not recommended because of increased seed costs. It is suggested that double-crop sorghum in in the San Joaquin Valley be planted no later than June 22 with a plant spacing of 4 to 8 plants per foot for maximum grain production and minimum midge damage.

E). Overall, there was no significant difference in yield between the treated and untreated field halves. This is due primarily to the heterogenous nature of many California fields, which results in an uneven and protracted period of bloom that may last for 4 weeks. Since sorghum must be protected throughout the bloom period, this means that as many as four to five insecticide applications may be required to give complete protection and increase yield. Such a large number of treatments is economically and environmentally unrealistic.

Planting date and plant population

Since chemical control is impractical, we sought to develop a pest management program for sorghum midge based on planting date and plant population. Plots were established at KHFS in 1973 and 1974 using the medium maturity hybrid Amak R-10. Ammonium sulfate (150 pounds N per acre) was broadcast before planting and incorporated with a disc. Plots were arranged in a randomized complete block design with four replications. Each plot consisted of four single rows planted on beds with 30-inch centers. Rows were 25 feet long. In 1973, plantings were made weekly from June 1 to July 6. Two plant populations, 4 and 12 plants per foot, were used. In 1974, plantings were made every 2 weeks from June 1 to July 13 and three plant populations, 4, 8, and 12 plants per foot, were used. The desired plant populations were obtained by hand-thinning the plots 5 to 7 days after seedling emergence.

The midge infestation level was determined as previously described, and yields were determined by hand-harvesting the two center rows from each plot and threshing the heads in a single head thresher. Samples for moisture determination were taken and yields adjusted to 15 percent moisture.

Table 2 shows the results of the 1973 studies. Yields were not affected by plant population or the interaction between planting date and plant population. Significant yield losses did not occur until the midge infestation exceeded 40 adults emerging per head in plots planted on June 29 and blooming on August 29 to 30. Maximum losses occurred in plots planted on July 6 and blooming September 10 to 11. This indicates that plantings made no later than June 22 (blooming no later than the third week of August), although infested with midge, will escape damage severe enough to cause yield reductions. Although the number of midges in plots planted on July 6 and thinned to 4 plants per foot was nearly twice that in plots planted the same day and thinned to 12 plants per foot, there was no significant difference in yield. This was due to the large heads produced by the plants in 4-per-foot plots, indicating that these plants were better able to tolerate high levels of midge infestation without suffering a commensurate yield reduction.

Table 3 gives results of the 1974 trials. As in 1973, yields were not affected by plant population or the interaction between planting date and plant population. Significant yield losses did not occur until midge infestation levels exceeded 40 adults per head in plots planted June 29 and blooming the last week of August.

C. G. Summers and R. L. Coviello are Assistant Entomologist and Staff Research Associate, respectively, Department of Entomological Sciences, University of California, Berkeley, and San Joaquin Valley Agricultural Research and Extension Center, Parlier. W. E. Pendery is Farm Advisor, Tulare County. R. W. Bushing is Assistant Entomologist, Department of Entomology, Davis.

TABLE 2. GRAIN YIELD AND MIDGE INFESTATION LEVELS FROM SIX PLANTING DATES AND TWO PLANT POPULATIONS, KEARNEY HORTICULTURAL FIELD STATION, PARLIER, CALIFORNIA, 1973.

Planting date	Date of 50% bloom[1/]	No. plants per ft.	No. midges per head	Yield tons per acre[2/]
June 1	Aug. 4	4	3.4	2.59a
	Aug. 5	12	2.4	2.61a
June 8	Aug. 6	4	3.2	2.52a
	Aug. 6	12	6.7	2.51a
June 15	Aug. 12	4	25.3	2.26a
	Aug. 13	12	17.0	2.79a
June 22	Aug. 21	4	19.2	2.95a
	Aug. 21	12	33.7	2.66a
June 29	Aug. 29	4	56.4	2.27b
	Aug. 30	12	52.4	2.02b
July 6	Sept. 11	4	641.8	0.71c
	Spet. 10	12	261.9	0.90c

[1/] Upper one-half of most heads showing yellow flowers.

[2/] Means followed by the same letter(s) are not significantly different at the 5% level of probability.

Plant populations N.S. P = 0.05

Plant population x planting date N.S. P = 0.05

TABLE 3. GRAIN YIELD AND MIDGE INFESTATION LEVELS FROM FOUR PLANTING DATES AND THREE PLANT POPULATIONS, KEARNEY HORTICULTURAL FIELD STATION, PARLIER, CALIFORNIA, 1974.

Planting date	Date of 50% bloom[1/]	No. plants per ft.	No. midges per head	Yield tons per acre[2/]
June 1	Aug. [illegible]	4	5.[illegible]	2.50ab
	Aug. [illegible]	8	5.0	2.75ab
	Aug. [illegible]	12	[illegible].2	2.91a
June 15	Aug. 15	4	[illegible].4	2.27 bc
	Aug. 15	8	13.5	2.27 bc
	Aug. 16	12	12.3	2.56abc
June 29	Aug. 27	4	43.[illegible]	1.[illegible] c
	Aug. 27	8	47.3	1.54 [illegible]
	Aug. 28	12	23.3	1.97 c
July 13	Sept. 15	4	1[illegible].0	0.94 e
	Sept. 16	8	162.9	1.05 e
	Sept. 16	12	71.1	1.14 e

[1/] Upper one-half of most heads showing yellow flowers.

[2/] Means followed by the same letter(s) are not significantly different at the 5% level of probability.

Plant populations N.S. P = 0.05

Plant populations x planting date N.S. P = 0.05