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The Sorghum Midge in Mississippi

The sorghum midge, *Contarina sorghicola* (Coquillett), is a pest of grain sorghum wherever it is grown. It is the principle insect pest on sorghum grain heads in Mississippi, particularly where the crop has been grown in small acreages in the same area for several years and where johnsongrass is prevalent. With the increased demand for livestock feed and food for human consumption, there is a growing need for information to control this pest and other insect pests on sorghum.

In Mississippi, where sorghum is grown for grain and silage, practical and economical insect pest management is needed for this crop. Effective pest management practices would reduce the losses in seed yield attributed to the sorghum midge and would make production of this low value per acre crop more attractive.

The sorghum midge is a small (1/16 inch-long) orange-bodied, gnatlike fly or diptera in the family Cecidomyiidae. The midge adults are feeble fliers and can be seen crawling over the seed head when it is in bloom---yellow anthers exposed on the florets (Figure 1). Adults do not damage sorghum. The males live only a few hours and females live one or two days.

The female deposits eggs within the glume of the floret. The eggs hatch in two to three days into legless larvae (maggots) which feed on the juice of the developing seed. The larvae injure or destroy the developing seed causing it to shrivel and the seed coat to become discolored. Where there is complete loss of seed, the sorghum head has a slim compact look (Figure 2).

When the midge is present in large numbers, it can reduce sorghum grain yields significantly, particularly in small plantings or in stands that do not bloom uniformly. Large fields planted early and fruiting uniformly usually lose only a few seed, and this loss may be compensated for by the remaining seed becoming larger. Light infestations on early-planted and uniform stands may not require insect control. However, late plantings or stands that do not bloom uniformly may not escape the large midge populations that can build up in the surrounding area on johnsongrass and early planted sorghum.

Good crop and insect management practices can eliminate or minimize midge damage to grain sorghum. A necessary condition for developing effective manage-

Figure 1. Adult female sorghum midge laying an egg in a sorghum floret (greatly enlarged illustration).

ment and production practices for control of the midge in grain sorghum is a thorough understanding of the biology and behavior of the insect, and of the ecosystem in which it resides.

Biological traits of the sorghum midge have been reported by Harding (1965), Randoff and Doering (1963) and Walter (1941). The insect overwinters as diapausing larvae within the florets of sorghum, johnsongrass or other host plant residue from the previous season. These larvae emerge in late spring or early summer, pupate and turn into a new generation of midges.

The females of this generation start the next generation by laying eggs in the glumes of florets of grain sorghum or other host plants. The larvae hatched from these eggs pupate after 9 to 11 days, depending on climatic conditions, and the pupae move to the tips of the glumes as they near the time for adult emergence. When adults emerge the pupal cases are left hanging from the tips of the glumes, and these can be easily seen bristling on heavily infested heads. The complete development of a new generation of the sorghum midge requires 14 to 18 days in the summer.

This report supplements an earlier bulletin[1] that reported results of studies of crop production practices for insect pest management in grain sorghum. Here we report in greater detail the results of 1971-73 studies of the sorghum midge. Major emphasis is on cultural practices as they affect winter survival of the midge, population and dispersal of the midge on johnsongrass, the relationship of date of planting to midge damage in grain sorghum and control of the midge with insecticides.

Figure 2. A midge-damaged head (left) and a healthy sorghum head.

Cultural Practices and Winter Survival of the Midge

We made traps of pyramid-shaped frames (one yard square at the bottom) by covering the sides with fine-mesh nylon screen and fitting a quart fruit jar (coated on the inside with vaseline) upside down at the top (Figure 3). In March we placed these traps over sites chosen on the basis of

[1]*Green, H. B., H. N. Pitre, L. M. Gourley and J. P. Roth, 1975.* **Management and Production Practices fo Control of Insect Pests in Grain Sorghum.** *Mississippi Agricultural and Forestry Experiment Stati Bulletin No. 817. 8 pp., April 1975.*

Figure 3. Pyramid-shaped cage 1 yard square at the base, covered with a fine mesh nylon screen and fitted with a quart jar on top.

characteristics suspected to be favorable to overwintering of the sorghum midge. The sample areas were:

1. Johnsongrass residue at the borders of grain sorghum fields that were heavily infested with the sorghum midge in the previous growing season, and
2. Fields where the residue from a grain sorghum crop in the previous year
   a. had not been disturbed by either winter or spring tillage,
   b. had been plowed under in mid-March,
   c. had been disked in the fall and planted to wheat, and
   d. had been plowed and disked in the fall and planted to wheat.

The collection jars were examined weekly (weather permitting) for 11 weeks and the number of adults in each jar was recorded. The jars were cleaned, recoated with vaseline and replaced on the traps on the day of examination.

Results---The first adult emergence from overwintering was recorded in the first week of April in 1972 (Figures 4 and 5) and in 1973. Adult emergence from all overwintering sites did not end until the third week in June.

There were two peaks of emergence from johnsongrass residue and from fields where sorghum residue had not been disturbed by either winter or spring tillage---one in mid-April and one in early May (Figure 4). The single peak of emergence from fields planted to wheat after sorghum occurred in early May (Figure 5).

Tillage practices alone did not appreciably affect adult emergence from overwintering diapause. Emergence patterns were similar from areas where sorghum residue was exposed on the soil surface through the winter and where the residue was plowed under in early spring. Emergence patterns were also similar from wheat fields that

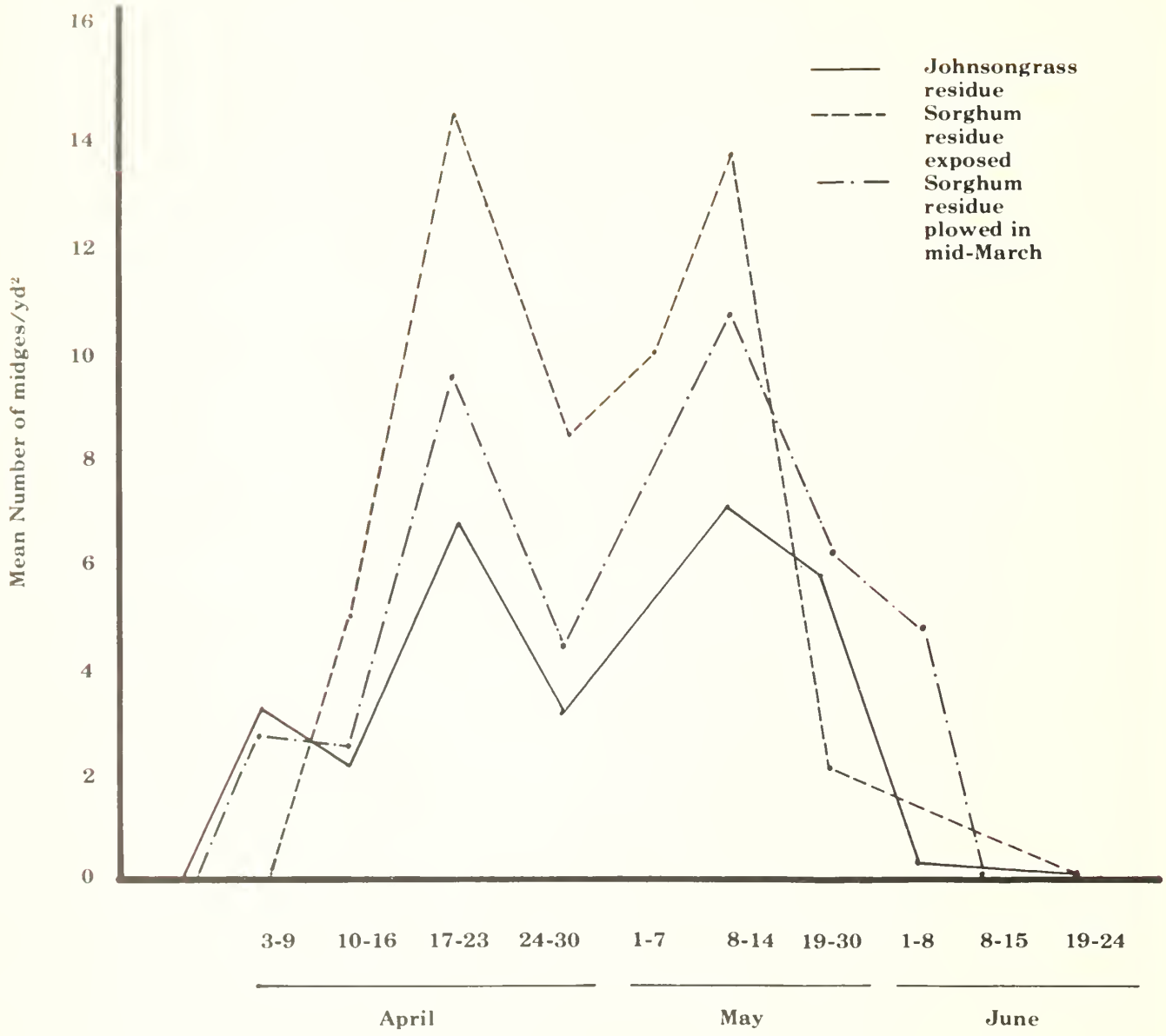

Figure 4. Mean midge emergence from overwintering sites. Oktibbeha County, Mississippi, 1972.

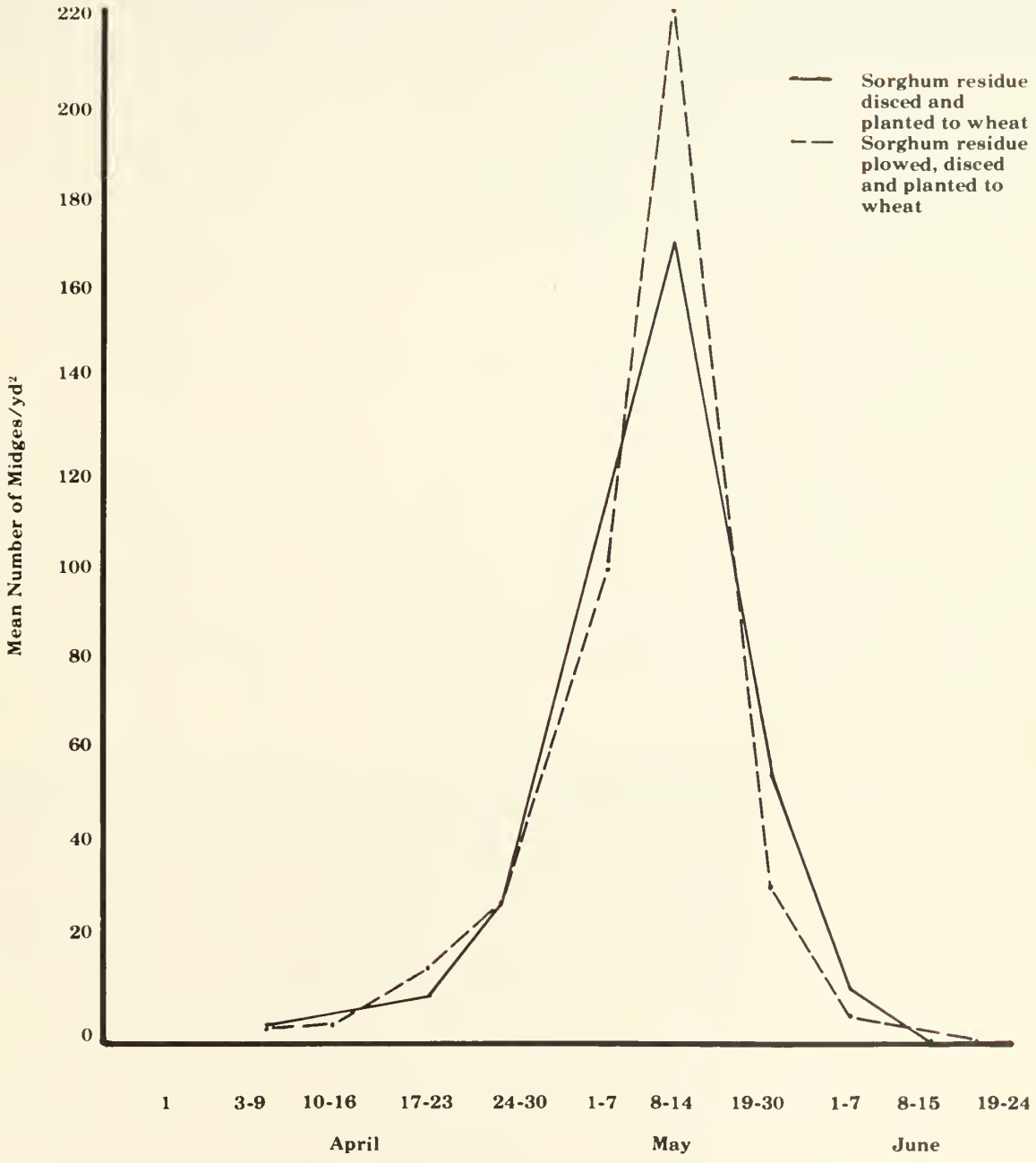

Figure 5. Mean midge emergence from overwintering sites. Oktibbeha County, Mississippi, 1972.

had been plowed and disked or disked only before wheat was planted.

Double cropping affects winter survival of the midge significantly. We collected 7 to 12 times as many adults from fields planted to wheat after sorghum than from any other sites (Table 1). Double cropping also increases the likelihood of midge damage to sorghum planted behind a winter grain crop. The wheat harvest, for example, delays sorghum planting and late-planted sorghum normally suffers the greatest midge damage.

Table 1. Midge emergence from overwintering sites, Oktibbeha County, Mississippi, 1972.

Sample areas	Midge per square yard	Estimated midge per acre
	number	number
Johnsongrass residue	33	159,300
Sorghum residue	51	247,808
Sorghum residue---plowed (mid-March)	58	279,752
Sorghum residue---disked (fall) and wheat planted	392	1,865,828
Sorghum residue---plowed, disked and wheat planted (fall)	409	1,981,012

Population and Dispersal of the Sorghum Midge on Johnsongrass

The long period of adult emergence from overwintering and the interval between the last day of adult emergence and first sorghum bloom suggest the necessity of an alternate or reservoir host plant for the sorghum midge. Peak adult emergence from overwintering occurred when large amounts of johnsongrass were beginning to bloom. The sorghum midge has not been recorded on other potential host plants in Mississippi; therefore, we investigated the role of johnsongrass in sustaining the sorghum midge population.

We selected johnsongrass stands at distances of 10, 20, 30 and 100 feet from the border of a sorghum field that had been tilled and seeded to wheat in the previous fall. Adult sorghum midges were collected from developing johnsongrass seed heads in each site selected. There was no johnsongrass growing between the border of the field and the johnsongrass stand 100 feet from the border.

One-half gallon cardboard containers were placed over twenty-five johnsongrass seed heads that had just completed pollination in each stand. They were placed initially in mid-May and each week thereafter until about October 1 when johnsongrass stopped blooming.

The inside of the lid of the cardboard container was coated with vaseline, each container was fitted with a cloth sleeve tied around the johnsongrass stem and the containers were supported by wooden stakes (Figure 6). Containers placed on seed heads on each date were examined each 7 days for 3 weeks---the approximate time required for all midges to emerge from an infested johnsongrass seed head. Midge numbers were recorded at each examination and the containers were handled as were the jars used in collecting midges in the overwintering study.

Results---The dispersal of adult sorghum midges from overwintering sites appears to be dependent

Figure 6. One-half gallon cardboard containers fitted with a sleeve and placed over developing johnsongrass seed heads to trap emerging adult sorghum midge (cages supported by wooden stakes).

on the availability of johnsongrass n bloom (Figure 7.) In all of our counts they were most numerous on johnsongrass nearest the overwintering site. The population was highest on johnsongrass seed heads 10 feet from the border of the overwintering field and decreased progressively on johnsongrass stands 20 and 30 feet from the border. But, when the nearest johnsongrass was 100 feet from the overwintering site, the emerging adults moved to it and the population was comparable to that on johnsongrass stands only 10 feet away from the overwintering field.

Adult emergence from johnsongrass ranged from 0 to 168 per head and emergence per head per week increased from an average of

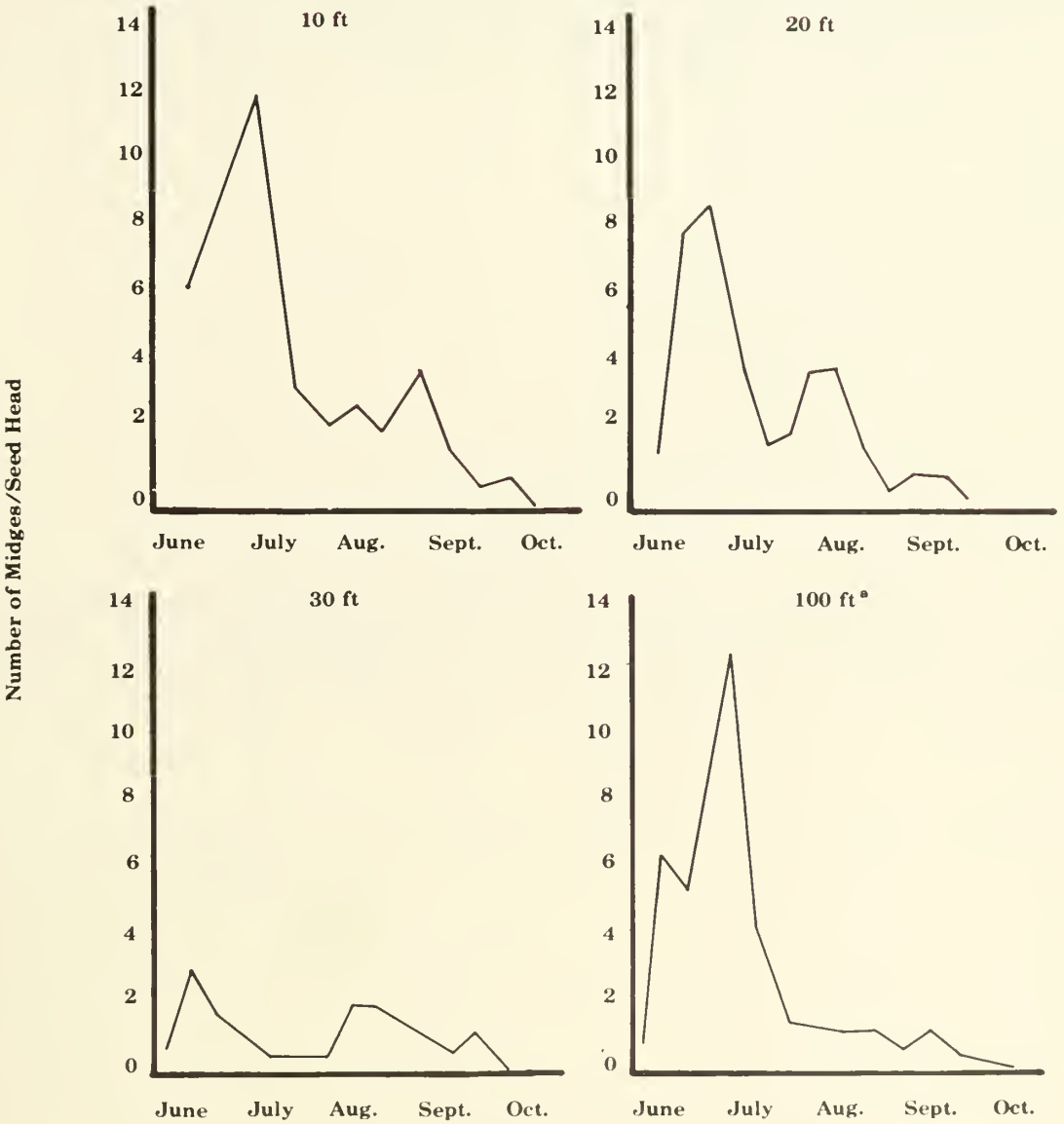

Figure 7. Mean weekly midge emergence from johnsongrass at four distances from the border of an old sorghum field, Oktibbeha County, Mississippi, 1972.

**There was no johnsongrass between the 100 foot collection site and the border of the old sorghum field.*

7 during the week of June 19-24 to 13 during the week of July 17-24 (Figure 8). We recorded no emergence from johnsongrass after October 15, two weeks after it had stopped blooming.

Our results lead us to conclude that the relationship of johnsongrass to the sorghum midge in this area of Mississippi can best be explained as that of a reservoir or alternate host capable of sustaining the insect in relatively low numbers.

Generations of the Midge on Johnsongrass---The long period of adult emergence from overwintering results in overlapping of generations on johnsongrass and sorghum (Figure 9). Peak emergence from johnsongrass coincides with the first widespread bloom of volunteer and early-planted sorghum in the area.

Based on the midge life cycle of 14 to 18 days and the temperature range during the growing season in North Mississippi, this insect is capable of completing 9 to 11 generations during the five to six months that johnsongrass blooms. The midge was active in the test area on late-blooming sorghum tillers until first frost in November. Therefore, there could be 11 to 14 generations of the midge if it uses both its wild and cultivated hosts to their full potential.

Economic Infestations---The female midge may lay 30 to 100 eggs in the flowering spikelets of grain sorghum. Based on egg lay-

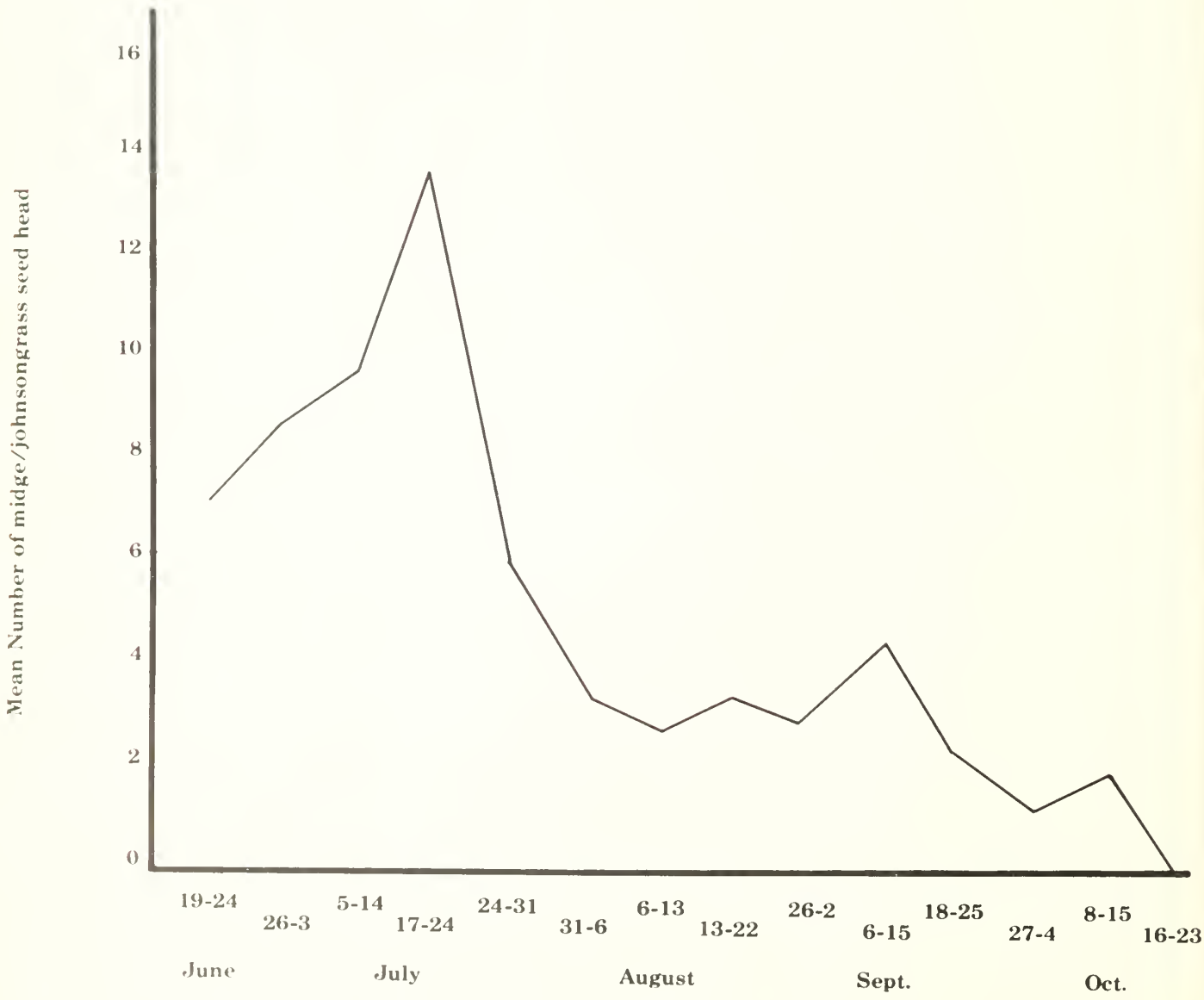

Fig. 8. Mean weekly midge emergence from johnsongrass seed heads, Oktibbeha County, Mississippi, 1972.

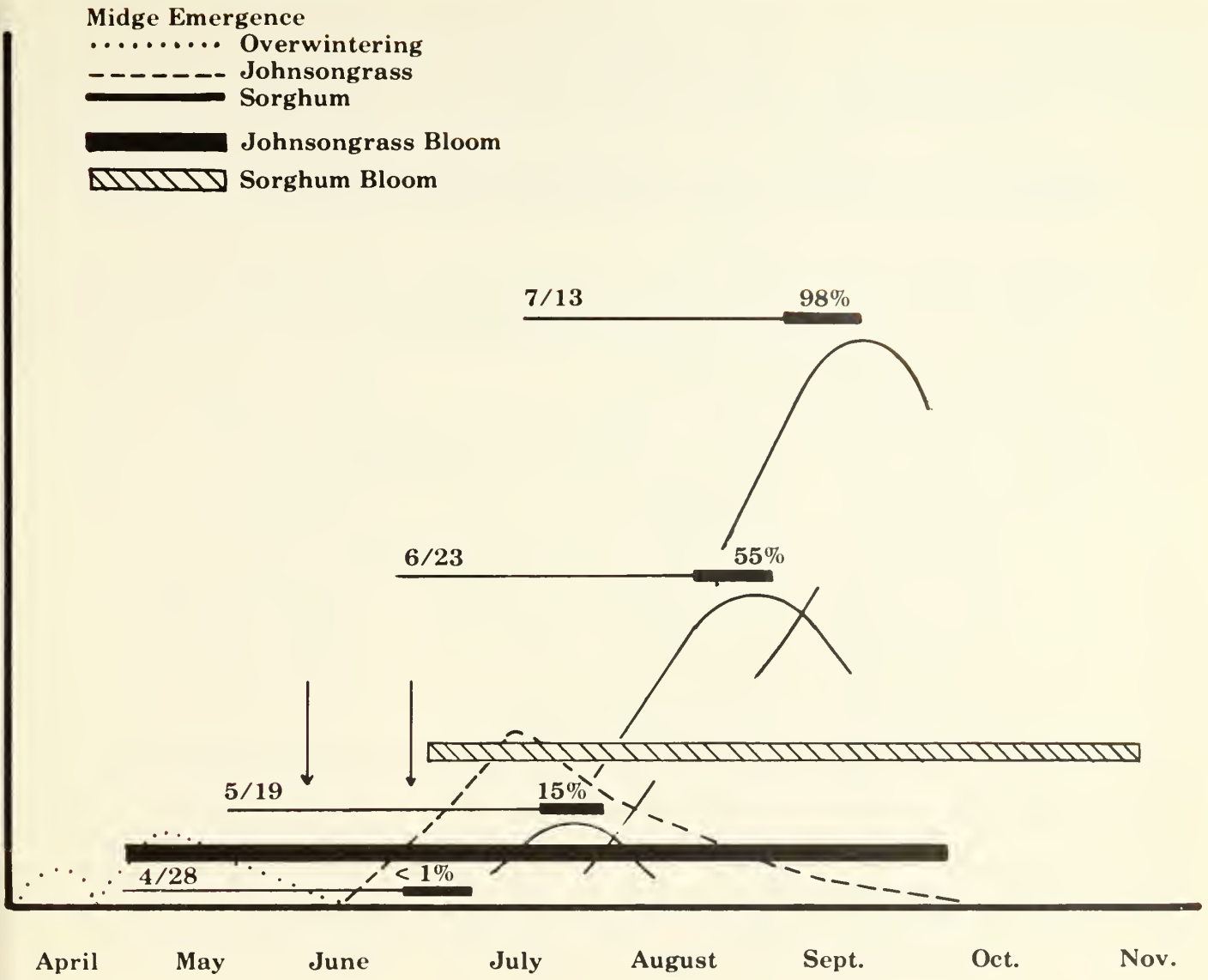

Figure 9. Seasonal midge populations, sorghum planting dates and percent seed loss. Oktibbeha County, Mississippi, 1972.

ing alone two to three females can lay sufficient numbers of eggs to significantly damage a head of grain sorghum. A single johnsongrass seed head could produce enough midges to economically damage approximately 28 sorghum heads.

The low numbers of midges that emerged from scattered johnsongrass along field borders or along fence rows indicate that midge populations produced on this host are not likely to cause economic damage to large fields of grain sorghum. This may not be the case where sorghum is grown in small fields, because there would be less dilution effect (midge numbers per sorghum head) as a result of the smaller ratio of cultivated area to johnsongrass infested area.

Johnsongrass Control---Johnsongrass eradication to prevent its use as a host for the midge is not practical in Mississippi but management of this host plant in and around sorghum fields can be beneficial. Johnsongrass can be clipped before seed heads form and shortly before sorghum begins to bloom. Since adult midges can move considerable distances, this practice will lead to the production of a new generation on johnsongrass throughout the general area.

On the other hand, if johnsongrass immediately surrounding the field is allowed to bloom, the midge will disperse to it from

overwintering and produce a more concentrated new generation. In this case, the johnsongrass can be clipped in June, after peak midge emergence from overwintering and before first sorghum bloom (Figure 9). Some midges will survive clipping, particularly those that have completed most of their larval development before clipping. Controlled burning in place of clipping or of the clipped johnsongrass residue can increase the effectiveness of this means of depressing midge populations.

Date of Sorghum Planting

Early planting of grain sorghum is recommended in Mississippi to escape economically damaging populations of the sorghum midge. However, early planted sorghum in small acreages is occasionally severely damaged by adult midges from nearby johnsongrass stands.

We planted two sorghum types of different bloom dates to investigate the relationship of planting and bloom dates to midge populations and midge damage on early planted sorghum. The two varieties were planted at Mississippi State on May 25, 1973 and at Scott on May 30, 1973. One tenth of the acreage at each location was planted to Reliance; the other nine tenths to DeKalb E-57, which blooms ten days later.

We also investigated the effect of different planting dates on midge populations and midge damage to grain sorghum. The cardboard containers used in the johnsongrass study were placed over the seed heads of DeKalb BR-64 grain sorghum planted on four dates in 1972. We determined emergence of adult midges by the same techniques used in the johnsongrass study and made visual estimates of the percent of seed destroyed on each seed head.

Results---Reliance was in bloom at both locations during the week of July 15, at the peak of emergence of adult midges from johnsongrass. Midges were attracted to this cultivar and it incurred serious damage (Table 2). When DeKalb E-57 was in bloom during the week of July 25, few adult midges were observed on sorghum and johnsongrass in the area---most of the adult females had died after starting a new generation, the larvae of which were busy destroying seed of the Reliance sorghum. Consequently, the DeKalb E-57 sorghum developed through most of the bloom period before adult midges emerged from Reliance or possibly from johnsongrass. There was only slight damage to the main crop; however, late DeKalb E-57 tillers were severely damaged.

The incidence of adult emergence from sorghum heads and the amount of grain damage increased with each delay in planting our 1972 tests (Table 3 and Figure 9) and sorghum in bloom after mid-July was infested by large midge populations and also suffered heavy damage. Sorghum planted on April 28 (bloom June 22-July 1) suffered seed loss of less than 1 percent. Sorghum planted on May 19 (bloom July 13-22), on June 23 (bloom August 25-September 1) and on July 13 (bloom September 8-15) suffered seed losses of 15 percent, 55 percent and 98 percent, respectively.

Although johnsongrass in the test area served as the initial source of midge infestation, economically damaging populations developed within sorghum plots during the season, by midges produced in one planting infesting the next planting with its later bloom date. In large sorghum fields, this type of midge population build-up may occur when the crop is planted on several dates or when the stand does not bloom uniformly.

Table 2. Midge damage to early planted sorghums of different bloom dates, Mississippi, 1973.

Location	Planting date	Seed head damage	
		Reliance	DeKalb E-57
		--------percent--------	
Scott	5/30/73	88.7	3.8
Mississippi State	5/25/73	100.0	5.2

Reliance, inbred line (50% bloom 7/13/73, Mississippi State and 7/15/73, Scott, Mississippi).

DeKalb E-57 (50% bloom 7/21/73, Mississippi State and 7/25/73, Scott, Mississippi).

Table 3. Midge emergence and crop damage on grain sorghum planted on different dates, Oktibbeha County, Mississippi, 1972.

Planting date	Midge per seed head	Seed loss
	number	percent
April 28	Not recorded	1
May 19	167+40	15
June 23	192+17	55
July 13	311+22	98

DeKalb BR-64 grain sorghum in 38 in. rows.

Estimated.

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Errata (Page 11)

Table 4. Control of the sorghum midge with insecticides, Oktibbeha County, Mississippi, 1971.[1]

Treatment[2]			
Insecticide and formulation	Rate	Seed loss per head[3]	Yield/ 20 heads[4]
	(lb/A)	(percent)	grams
Ethion 4EC*	0.50	43.5 a[5]	899 a
Ethion 4EC*	0.25	44.4 ab	884 a
Phosvel 3EC	0.50	54.7 bc	817 abc
Guthion 2EC	0.50	55.5 c	894 ab
Diazinon 4EC*	0.50	57.3 cd	811 abc
Phosvel 3EC	0.25	58.0 cd	749 abc
Lannate 90% WP	0.50	61.5 cd	786 cd
Di-Syston 6EC	0.50	66.5 de	653 cd
Di-Syston 6EC	0.25	72.5 ef	662 cd
Guthion 2EC	0.25	72.9 ef	801 abc
Diazinon 4EC*	0.25	74.5 efg	852 ab
Sevin 80% WP*	0.50	77.4 fgh	676 c
Sevin 80% WP*	0.25	80.3 fghi	503 e
Malathion 57% EC*	0.25	81.0 fghi	698 bc
Cygon 2EC	0.25	83.6 ghi	481 e
Cygon 2EC	0.50	84.5 ghij	509 e
Lannate 90% WP	0.25	86.1 hij	657 cd
Malathion 57% EC*	0.25	90.9 ij	667 cd
Untreated		95.1 j	255 j

*Material labeled for use on grain sorghum for sorghum midge control (WP = wettable powder; EC = emulsifiable concentrate).

[1]DeKalb BR-64 planted, June 23, 1971.

[2]Insecticide spray applied when 50% of the plants were in early bloom (August 19); second application 5 days later (August 24).

[3]Damage attributed to sorghum midge.

[4]Total dry matter (head weight) at harvest (9/15/71).

[5]Means followed by the same letter are not significantly different at the .05 level of probability as determined by Duncan's New Multiple Range Test.

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Early Planting and Crop Uniformity---Early planting of grain sorghum, particularly in small fields, without regard for the midge population developing on large acreages of seedling johnsongrass and without regard for the bloom dates of sorghum varieties planted may result in severe economic loss due to midge damage. Severe midge damage may be circumvented by early planting geared to the development of midge populations on johnsongrass and to the bloom dates of the sorghum variety planted.

Our results also lead us to conclude that uniformity of planting is important to the production of sorghum because the later blooming portion of a crop may be subject to severe damage by midges produced on earlier blooming heads. These later maturing plants, upon losing their primary fruiting heads because of midge damage, put on secondary fruiting heads, tillers, that are even later in development. Thus, a vicious cycle of seed losses often begins with poor fruiting uniformity because, for all practical purposes, a new generation of adult midges develops every two weeks. Also, secondary heads often develop on sorghum soon after the seed on the primary head reach physiological maturity and this creates a problem in harvesting grain.

Insecticide Control of the Midge

Light infestations of the sorghum midge on early-planted, uniform stands of grain sorghum normally do not require insecticide control. However, in fields where midge adults are detected in large numbers on the early blooming heads, a preventive insecticide program may be needed to protect the crop during the remainder of the bloom period.

We evaluated nine insecticides for control of the sorghum midge on DeKalb BR-64 planted in Oktibbeha County on June 23, 1971 (Table 4). Rates of 0.25 and 0.50 pounds per acre in five gallons of water were tested in four replications in a randomized complete block design. Sprays were applied over-the-top of the heads with a hand-held, compressed air sprayer. Two applications were made---the first at 50 percent bloom on August 19, the second five days later on August 24. Head weight and the percentage of seed damaged per head were recorded at harvest.

Rates of insecticides ranging from 0.10 to 1.00 pounds per acre in 6.3 gallons of water were tested in 1972 using the same procedures as in the 1971 tests. DeKalb BR-64 was planted on June 28 and the first insecticide applications were made on September 5 when 10 percent of the crop was in early bloom. These were followed by applications on September 9 and September 13. Only the percentage of seed damaged per head was recorded.

Results---None of the test materials gave satisfactory control of the sorghum midge in 1971.

Table 4. Control of the sorghum midge with insecticides, Oktibbeha County, Mississippi, 1971.[1]

Treatment[2]			
Insecticide and formulation	**Rate**	**Seed loss per head[3]**	**Yield/ 20 heads[4]**
	(lb/A)	**(percent)**	**grams**
Ethion 4EC*	0.50	43.5 a[5]	899 a
Ethion 4EC*	0.25	44.4 ab	884 a
Phosvel 3EC	0.50	54.7 abc	817 abc
Guthion 2EC	0.50	55.5 abc	894 ab
Diazinon 4EC*	0.50	57.3 abcd	811 abc
Phosvel 3EC	0.25	58.0 abcd	749 abc
Lannate 90% WP	0.50	61.5 abcd	786 abcd
Di-Syston 6EC	0.50	66.5 abcde	653 abcd
Di-Syston 6EC	0.25	72.5 abcdef	662 abcd
Guthion 2EC	0.25	72.9 abcdef	801 abc
Diazinon 4EC*	0.25	74.5 abcdefg	852 ab
Sevin 80% WP*	0.50	77.4 abcdefgh	676 abc
Sevin 80% WP*	0.25	80.3 abcdefghi	503 abcde
Malathion 57% EC*	0.25	81.0 abcdefghi	698 abc
Cygon 2EC	0.25	83.6 abcdefghi	481 abcde
Cygon 2EC	0.50	84.5 abcdefghij	509 abcde
Lannate 90% WP	0.25	86.1 abcdefghij	657 abcd
Malathion 57% EC*	0.25	90.9 abcdefghij	667 abcd
Untreated		95.1 abcdefghij	255 abcdefghij

***Material labeled for use on grain sorghum for sorghum midge control (WP = wettable powder; EC = emulsifiable concentrate).**

[1] DeKalb BR-64 planted, June 23, 1971.

[2] Insecticide spray applied when 50% of the plants were in early bloom (August 19); second application 5 days later (August 24).

[3] Visual estimate of damage.

[4] Total dry matter (head weight) at harvest (9/15/71).

[5] Means followed by the same letter are not significantly different at the .05 level of probability as determined by Duncan's new multiple range test.

However, the first spray was applied when 50 percent of the plants were in heavy bloom and the midge population was very heavy. Ethion was the most effective insecticide. Other treatments with less than 60 percent seed loss in order of effectiveness were: Phosvel, 0.50 pounds/A; Guthion, 0.50 pounds/A; diazinon, 0.50 pounds/A and Phosvel, 0.25 pounds/A (Table 4).

All treated plots had significantly less seed damage than did the untreated plot in 1972 (Table 5). Diazinon, Phosvel, Zolone and ethion were the most effective insecticides.

Inadequate control of the sorghum midge results from improper timing of applications, too few applications and the use of insecticides that are not effective. Our results indicate that insecticide applications may be timed to protect the sorghum crop from midge damage if an effective insecticide is first applied when midge adults are first detected at levels of two or three per head when the crop is in early bloom (10 percent of the crop in bloom). The sorghum should complete blooming in five to ten days if it is in a uniform stand, thus two or three insecticide applications on a three- to four-day schedule may be required.

Minimum Effective Rates---Effective insecticides may be applied at rates much higher than needed for satisfactory midge control. The excessive use of insecticides is costly and may be harmful to the environment.

We found no significant differences between the higher and lower rates of diazinon, Phosvel, Zolone and ethion in our 1972 tests. Therefore, the lower rates may be used for effective midge control. This would reduce the cost of insecticide per application, thereby making it more practical to increase the number of applications in a spray schedule. An increase in the number of applications normally would result in a longer and more effective period of plant protection.

Table 5. Control of the sorghum midge with insecticides, Oktibbeha County, Mississippi, 1972.[1]

Insecticide and formulation[2]	Rate	Seed loss per head[3]
	(lb/A)	percent
Diazinon 4EC*	0.10	17.7 a[4]
Phosvel 3EC	0.25	19.7 a
Zolone 3EC	0.50	19.9 a
Ethion 4EC*	0.25	20.4 a
Phosvel 3EC	0.50	20.7 a
Diazinon 4EC*	0.25	21.6 a
Meta-Systox-R 3EC	0.50	22.6 a
Sevimol 4EC*	1.00	24.3 ab
Ethion 4EC*	0.10	25.0 ab
Zolone 3EC	0.25	26.2 abc
Di-Syston 6EC	0.50	29.4 bc
Sevin 80% WP*	1.00	32.2 bc
Di-Syston 6EC	0.25	35.9 cde
Meta-Systox-R 3EC	0.25	45.4 def
Cygon 2EC	0.10	45.9 ef
Cygon 2EC	0.25	48.0 f
Untreated		70.1 g

***Material labeled for use on sorghum for midge control.**

[1] DeKalb BR-64 planted, June 28, 1972.

[2] Insecticide applied on September 5 when 10% of the crop was initiating bloom, and on September 9 and 13.

[3] Visual estimate of damage. Means followed by the same letter are not significantly different at the .05 level of probability as determined by Duncan's new multiple range test.

Conclusions

Tillage practices alone do not appreciably affect emergence of adult sorghum midges from overwintering diapause. About the same number emerge from fields where sorghum residue is exposed on the soil surface through the winter and where the residue is plowed under in early spring. However, when wheat or other small grains are seeded after the sorghum harvest, a favorable overwintering habitat is provided and adult sorghum midge emergence is significantly greater. Also, harvest of the small grain delays sorghum planting in the spring. Thus, the likelihood of midge damage to grain sorghum planted behind a grain crop is greater.

The dispersal of adult sorghum midges from overwintering sites appears to be dependent on the availability of johnsongrass in bloom. The relationship of johnsongrass to the sorghum midge can best be explained as that of a reservoir or alternate host capable of sustaining the insect in relatively low numbers.

The long period of adult emergence from overwintering results in overlapping of generations of the sorghum midge on johnsongrass and sorghum. The low numbers of midges that emerge from scattered johnsongrass along field borders indicate that midge populations produced on this host are not likely to cause economic damage to large fields of uniformly-fruiting grain sorghum.

This may not be the case where sorghum is grown in small fields, because there would be less dilution effect (midge numbers per sorghum head) as a result of the smaller ratio of cultivated area to johnsongrass infested area.

Early planting of grain sorghum is recommended in Mississippi to escape economically damaging populations of the sorghum midge. However, early planting of grain sorghum, particularly in small fields, without regard for the midge population developing on large acreages of heading johnsongrass and without regard for the bloom dates of sorghum varieties planted may result in severe economic loss due to midge damage.

Sorghum fields that do not fruit uniformly normally suffer severe midge damage. The later blooming portion of the crop is subject to attack by midges produced on earlier blooming heads. These later maturing plants lose their primary fruiting heads because of midge damage and put on tillers that are even later in development. Thus, a vicious cycle of seed losses often begins with poor fruiting uniformity because, for all practical purposes, a new generation of adult midges develops every two weeks.

Management and Crop Production Practices for Control of the Sorghum Midge---Johnsongrass eradication to prevent its use as a host plant for the midge is not practical in Mississippi but management of this host plant in and around sorghum fields can be beneficial. If johnsongrass immediately surrounding the field is allowed to bloom, the midge will disperse to it from overwintering and produce a concentrated new generation. Then the johnsongrass can be clipped in June, after peak midge emergence from overwintering and before first sorghum bloom. Some midges will survive clipping but controlled burning in place of clipping or of the clipped johnsongrass residue can increase the effectiveness of this means of depressing midge populations.

Timeliness of planting, selection of varieties and crop production practices designed to assure uniformity of fruiting all are important to minimizing midge damage as a limiting factor in grain sorghum production.

Severe midge damage may be circumvented by early planting geared to the development of midge populations on johnsongrass and to the bloom dates of the sorghum variety planted.

The more important crop production practices for achieving uniformity of fruiting include crop rotation, selection of land, proper seedbed preparation, proper application of recommended fertilizers, proper seeding rate and uniform planting. All of these directly affect uniform germination and growth of seedlings, without which uniformity of crop maturity cannot be attained.

Insecticide Control of the Midge---Failure to control the sorghum midge with management and production practices necessitates a preventive insecticide program to protect the crop. The crop should be observed closely from the time it starts to bloom (yellow anthers exposed) until flowering is practically completed. When as many as two or three adult midges are found per grain head, treatment should begin.

Control of the midge requires the application of an effective insecticide at this time. Continuing treatment at three- to four-day intervals until the crop stops blooming may be necessary. Diazinon, Phosvel, Zolone, and ethion have been the most effective insecticides in our tests.

Minimum Effective Rates of Insecticides---Low dosages of these insecticides can be used to effectively control the sorghum midge and dosages higher than those required should be avoided. Excessive use of insecticides will add unnecessarily to the cost of the spray program and may build up resistance in insect populations. Judicious use of insecticides and sound management can include the conservation of natural enemies of the sorghum midge and other insect pests on grain sorghum.

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