June, 1945 TECHNICAL BULLETIN 59

AGRICULTURAL EXPERIMENT STATION
KANSAS STATE COLLEGE OF AGRICULTURE
AND APPLIED SCIENCE
MANHATTAN, KANSAS

WHEAT-SEEDING DATES AND THE HESSIAN FLY IN KANSAS

PRINTED BY KANSAS STATE PRINTING PLANT
FERD VOILAND, JR., STATE PRINTER
TOPEKA, 1945
20-6427

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WHEAT-SEEDING DATES AND THE HESSIAN FLY IN KANSAS[1]

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INTRODUCTION

The hessian fly, *Phytophaga destructor* (Say), frequently is abundant and injurious as a pest of wheat in the eastern one-half of Kansas, but much less so in the western one-half of the state. In eastern Kansas injury occurs somewhat less frequently than in states east of the Mississippi river but, owing to the immense wheat acreage in Kansas, these sporadic outbreaks of hessian fly cause serious losses. The losses in Kansas in the outbreak years of 1924, 1925, 1927, and 1943 were estimated at 20, 40, 20, and 25 million bushels, respectively.

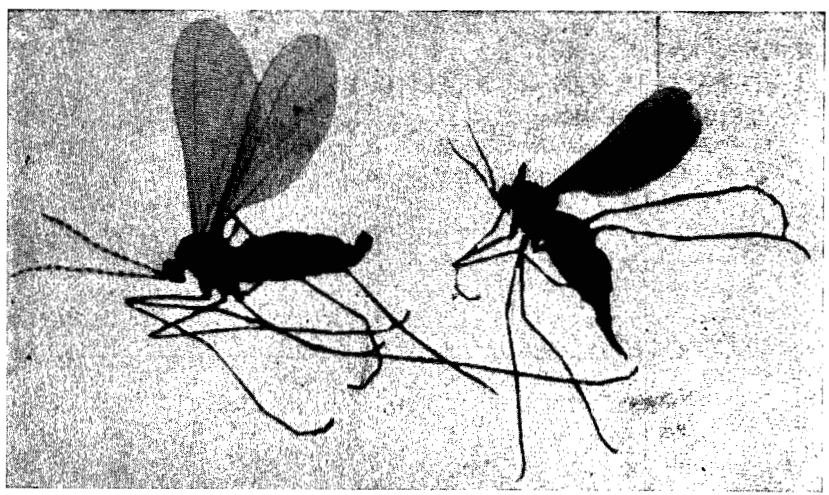

FIG. 1.—Adult hessian flies. Left, male; right, female. Magnified about ten times. (After Headlee and Parker.)

HABITS AND IMPORTANCE OF THE FLY

The habits and importance of the hessian fly have been described in general by Walton and Packard (5), and for Kansas in particular by McColloch (3) and Dean and Kelly (2). Ordinarily there are two main broods of the fly in Kansas, the spring brood and the fall

ACKNOWLEDGMENT.—Assistance of F. M. Wadley, statistical consultant of the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture, in summarizing and analyzing the data is gratefully acknowledged.

[1]Contribution No. 538 from the Department of Entomology.

[2]Died, April 7, 1944.

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brood. (Fig. 1.) These may be supplemented by late spring, midsummer, and late fall broods of varying size. The main periods of active development of the fly, however, are in spring and fall, and development is favored by abundant moisture and moderate temperature. Summer and winter periods are passed inside the plant sheaths in the puparium, or "flaxseed" stage. (Fig. 2.)

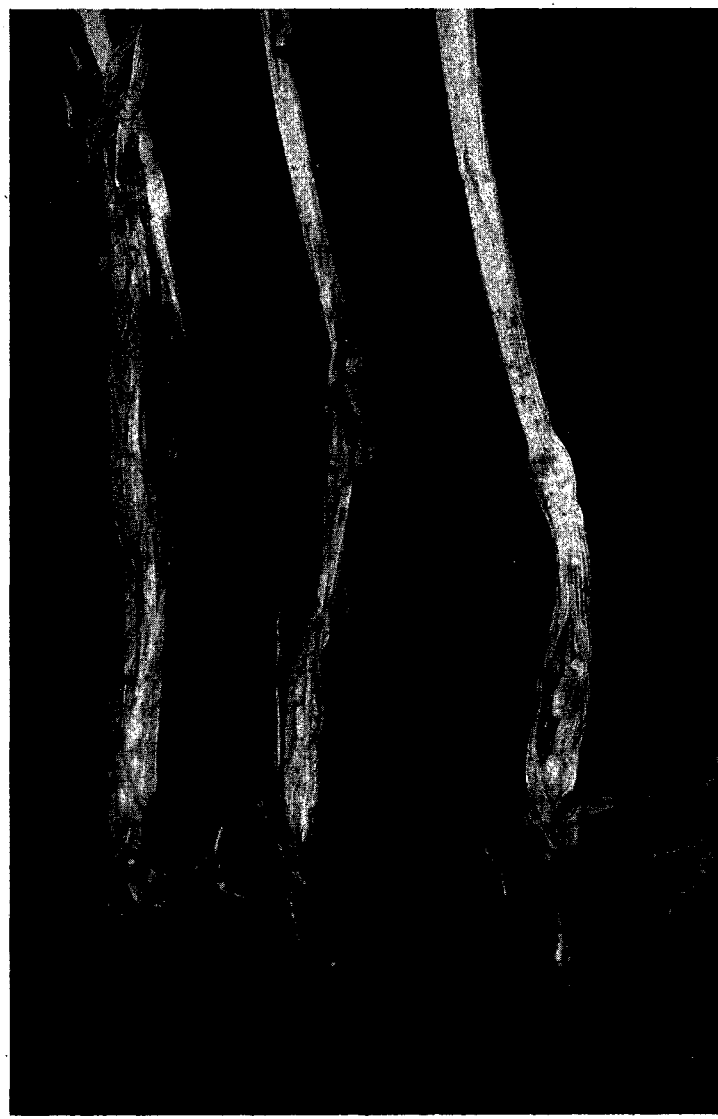

FIG. 2.—Wheat plants heavily infested with larvae and flaxseed of the hessian fly. (After McColloch).

CONTROL MEASURES

Control measures largely have been cultural, including rotation and clean-up methods and late sowing. Although the use of resistant varieties is growing in importance, and new, well adapted varieties of wheat now being developed show great promise, late seeding has for a long time been the major hope for avoiding heavy infestations, the idea being to so delay fall seeding that the wheat will not be up until most of the adult flies have emerged and died. To obtain the best yields, however, seeding must be early enough to allow sufficient time for a good growth of the wheat before winter. Dates satisfying these requirements fairly well have been estimated and published in the articles referred to.

CONTROL BY SEEDING-DATE METHOD

For two reasons, further examination of the seeding-date method of control is desirable. First, it is likely to be several years before varieties of wheat resistant to the hessian fly will be in full use. In the meantime, advantage should be taken of any possible improvement that can be made in the seeding-date method of control. Second, it is possible that previous work has tended to set the safe date later than is necessary. When or where seeding at the normal time is permissible it is definitely advantageous, because it results in higher yields.

The earliest dates when seedings can be made so as to escape infestation by the hessian fly will vary from year to year in any locality. Any fixed date will have a definite probability of both fly injury or winter injury. To sow late enough to avoid fly infestation altogether in all years would evidently result in reduced yields. The guide to an optimum between these two probabilities has been the experience obtained from seedings made in the state during a considerable period of years in representative localities.

EXPERIMENTS ON DATE OF SEEDING

Prior to the work reported in this bulletin, the Kansas Agricultural Experiment Station, in cooperation with the Bureau of Entomology of the United States Department of Agriculture, conducted extensive work on date of seeding as a method of hessian fly control. McColloch (3) and Dean (1) published much of the information obtained, together with conclusions.

During the period from 1918 to 1935 a series of date-of-seeding experiments were conducted in different localities in Kansas by the United States Bureau of Entomology directed from the laboratory at Wichita, and by the Kansas Agricultural Experiment Station from its main headquarters at Manhattan. Records of the hessian fly infestation and the yields in the seedings of these experiments are summarized in this bulletin. Work by the Kansas station since 1918 has been more limited than in the earlier years, but specific additional data which it has obtained have been incorporated here.

MATERIAL AND METHODS

In most localities the seedings were made by cooperating farmers. Five to seven seedings five days apart, centering around the generally accepted, safe date, were usually made side by side in the cooperator's wheat field. The period of seeding covered a range of about a month beginning near the second or third week of September. The experiments were replicated by years and localities. Entomologists took samples from the plots from which to determine fall infestations, spring infestations, and yields. Six linear feet of drill row, taken as one-foot, randomized samples, were examined from each plot for determination of infestation in late fall and at near harvest time. Five areas, each of one square yard, in each plot were harvested to estimate the yield. This plan was followed with but few minor variations. In some cases, nearby fields gave supplementary information. At Wichita, Hays and Colby more elaborate plots were maintained, and yields were determined by harvesting the entire plots.

RELATION OF SEEDING DATES TO INFESTATION

The earliest dates affording absolute freedom from fall fly infestation and those affording practical freedom (less than 10 percent of stems infested) for each locality and the year of the test are presented in Table 1. Supplementary practical data of less continuity are given in Table 2.

If no infestation was found in any of the experimental seedings, the notation "I" (indeterminate) has been inserted in Table 1. If both free and practically free dates are stated without note, fall infestation in the most heavily infested plot was between 10 and 20 percent of the stems. If no date was late enough to give freedom, the notation in the "Free" column is the latest date tried followed by "A" (after). If some infestation occurred, but not as high as 10 percent on any date, the "Practically Free" column contains the earliest date tried, followed by "B" (before). Years of abundant fall infestation (more than 20 percent of the stems infested in the heaviest infested plot) are shown by "H" (heaviest).

From Tables 1 and 2, the dates giving practical freedom from hessian fly injury in approximately 9 out of 10 years were determined by inspection. These estimates were modified by a reexamination of all data and of earlier records for Kansas and adjacent states, and a final practical, safe seeding date selected. The derived dates are shown in Table 3, and the modifications which were made are discussed below.

For Hiawatha the suggested date was modified in the light of information from similar tests nearby in Nebraska recently published by Walkden et al. (4). At Topeka, Hollenberg, and Paola the results of only a few years are available, and the results at other localities in the same area are taken into consideration. At Colby there were insufficient infestations to determine a practically safe

TABLE 1.—*Earliest wheat-seeding date giving freedom and practical freedom from hessian fly in different localities in Kansas, 1918-1934.*

(Symbols used in this table are interpreted in the text.)

FALL.	HIAWATHA.		TOPEFA.		HOLLENBERG.		SALINA.		HAYS.	
	Free.	Practically free.	Free.	Practically free.	Free.	Practically free.	Free.	Practically free.	Free.	Practically free.
1918										
1919									Sept. 22	Sept. 8 B
1920	Sept. 25 A	Sept. 9 B	Oct. 14	Sept. 16 B			Oct. 14	Sept. 9 B	Oct. 13 A	Sept. 8 B
1921	Oct. 10	Sept. 14 B	Oct. 8	Sept. 20 B					I	I
1922	Oct. 9	Sept. 20 B					I	I		
1923	I	I	Oct. 5 H	Oct. 2			I	I	Sept. 29	Sept. 8 B
1924	Oct. 2	Sept. 22 B	Oct. 11	Sept. 26 B			Oct. 9 A	Oct. 3	Oct 6A H	Sept. 29
1925	I	I	Oct. 2	Sept. 25 B			Oct. 1 H	Sept. 28	Sept. 29 H	Sept. 29
1926	I	I					Oct. 7	Oct. 7	Sept. 29	Sept. 15
1927	Sept. 28	Sept. 21 B					Oct. 10 H	Oct. 10	Sept. 29	Sept. 18 B
1928	I	I					Oct. 6	Oct. 2	I	I
1929	Sept. 28	Sept. 23 B					Oct. 15	Sept. 26	Oct. 6	Sept. 11 B
1930	Sept. 29 H	Sept. 29					Sept. 30	Sept. 25 B	Oct. 4	Sept. 13 B
1931	I	I			Oct. 2 A	Oct. 2	Oct. 7	Sept. 25 B	Oct. 6	Sept. 8 B
1932	I	I			Sept. 28	Sept. 25 B			Sept. 29 H	Sept. 22
1933					Oct. 1	Sept. 9 B			Sept. 19	Sept. 8 B
1934										

TABLE 1.—*Continued*

FALL.	COLBY.		PAOLA.		EMPORIA.		MCPHERSON.		LYONS.	
	Free.	Practically free.	Free.	Practically free.	Free.	Practically free.	Free.	Practically free.	Free.	Practically free.
1918										
1919										
1920			Oct. 18 H	Oct. 18	Oct. 17	Sept. 18 B	Oct. 15	Oct. 4		
1921			Oct. 10	Oct. 3 B	Oct. 17	Oct. 3	Sept. 26	Sept. 19 B		
1922			Oct. 9	Sept. 26 B			I	I		
1923					Oct. 4 H	Oct. 1	Oct. 1	Sept. 24 B		
1924	Sept. 25	Sept. 18 B			Oct. 16	Oct. 3				
1925	Sept. 22	Sept. 16 B			Oct. 3	Sept. 25 B			Sept. 28	Sept. 28
1926										
1927	I	I			Oct. 5	Sept. 30				
1928	I	I			Oct. 4	Sept. 21 B				
1929	I	I			Sept. 30	Sept. 28 B			Oct. 2	Sept. 23 B
1930	Oct. 5	Sept. 5 B			I	I			Oct. 3 H	Oct. 3
1931	Oct. 5	Sept. 5 B			Oct. 14	Sept. 30			Oct. 3	Oct. 3
1932					Oct. 6 H	Oct. 6			Oct. 14	Sept. 23 B
1933					Oct. 16	Oct. 9				
1934					Oct. 3	Sept. 27 B				

TABLE 1.—*Concluded*

FALL.	GREAT BEND-ELLINWOOD.		LARNED.		PARSONS.		WICHITA.		PRATT.	
	Free.	Practically free.	Free.	Practically free.	Free.	Practically free.	Free.	Practically free.	Free.	Practically free.
1918							Oct. 16	Sept. 25		
1919							I	I		
1920							Oct. 9	Sept. 18 B	Oct. 5	Sept. 14 B
1921							Oct. 3	Sept. 20 B	I	I
1922							Oct. 12	Sept. 21 B	Oct. 6	Sept. 29 B
1923					Oct. 6	Sept. 26 B	Oct. 4	Sept. 26 B	Oct. 4	Sept. 26 B
1924	Oct. 3	Sept. 26			Oct. 10 H	Oct. 10	Oct. 13	Sept. 25 B	Oct. 9 H	Oct. 9
1925					I	I	Oct. 2 H	Oct. 2	Oct. 5	Oct. 5
1926	Oct. 5	Oct. 5	Oct. 6	Sept. 15 B	Oct. 16	Sept. 25 B	Oct. 15 H	Oct. 8	Oct. 9	Oct. 5
1927	Oct. 11 H	Oct. 4	Oct. 13	Oct. 3	Oct. 14 A	Oct. 4 B	Oct. 14	Oct. 14	Oct. 14	Oct. 3
1928	I	I	I	I	Oct. 12 A	Oct. 8	Oct. 9	Sept. 21 B	Oct. 9	Sept. 27 B
1929	Oct. 5	Sept. 27	Oct. 1	Sept. 28	Oct. 12	Oct. 7	Oct. 12 H	Oct. 8	Oct. 12 H	Oct. 7
1930	Sept. 30 H	Sept. 27	Oct. 11	Oct. 11	Oct. 9	Sept. 24 B	Oct. 2	Sept. 26 B	Oct. 14 H	Oct. 7
1931	Oct. 7 H	Oct. 7	I	I	Oct. 14 A	Sept. 25 B	Oct. 15 A	Oct. 8	Oct. 14	Oct. 3
1932	Oct. 6	Oct. 3			Oct. 10 H	Oct. 7	Oct. 8 H	Oct. 8	Oct. 13	Sept. 23 B
1933					Oct. 17 H	Oct. 17	Oct. 9	Sept. 18 B	I	I
1934					Oct. 25	Oct. 9	Oct. 16	Sept. 27 B		

TABLE 2.—*Supplementary information on practical safe dates for seeding wheat for freedom from the hessian fly in Kansas**

SECTION OF STATE.	County.	Safe dates for calendar years stated.
Northeastern	Douglas	1923, Sept. 22; 1924, Sept. 29
	Jackson	1924, Oct. 4 (approximately)
	Riley	1918–1934, Oct. 4 (average)
North central	Ottawa	1923, Oct. 5
	Clay	1924, Oct 3
	Cloud	1930, Sept. 25
South central	Marion	1927, Oct. 6
	Harvey	1927†, Oct. 8; 1930†, Oct. 4
	Reno	1929, Oct. 11
Southwestern	Clark	1925, Oct. 2; 1927, Oct. 4
	Comanche	1925, Oct. 2
	Ford	1926, Sept. 25
West central	Rush	1924†, Oct. 3; 1925†, Oct. 1
	Ness	1924†, Oct. 1; 1925†, Sept. 28

* Data collected by the late J. W. McColloch.
† Years of abundant fall infestation (more than 20 percent of stems in the most heavily infested plot).

TABLE 3.—*Estimated practically safe seeding dates for freedom from the hessian fly in various localities in Kansas*

SECTION.	Locality.	Number of years work.	Date suggested by data of Tables 1 and 2.	Number of years safe.	Recommended date.
Northeastern	Hiawatha	13	Sept. 29	All	Oct. 1
Northeastern	Topeka	5	Oct. 2	All	Oct. 3
Northeastern	*	.....	Oct. 1	.....	.....
North central	Salina	11	Oct. 3	9	Oct. 3
North central	Hollenberg	3	Sept. 25	2	Sept. 30
North central	Hays	14	Sept. 29	All	Sept. 29
North central	*	.....	Oct. 1	.....	.....
Northwestern	Colby	7	.....	.....	Sept. 25
East central	Paola	3	Oct. 3	2	Oct. 5
East central	Emporia	13	Oct. 6	12	Oct. 6
Central	McPherson	4	Oct. 4	All	Oct. 4
Central	Lyons	5	Oct. 3	All	Oct. 3
Central	Great Bend-Ellinwood	8	Oct. 4	6	Oct. 4
Central	Larned	6	Oct. 3	5	Oct. 3
West central	*	.....	Oct. 1	.....	.....
Southeastern	Parsons	12	Oct. 10	11	Oct. 10
South central	Wichita	17	Oct. 8	16	Oct. 8
South central	Pratt	14	Oct. 7	13	Oct. 7
South central	*	.....	Oct. 8	.....	.....
Southwestern	*	.....	Oct. 2	.....	Oct. 2

* No locality name available.

date, but September 25 was safe five years out of seven years. In southwestern Kansas only meager data were available for establishing safe dates.

Experience with this problem has shown that the optimum seeding dates may vary a little even on farms close together, because of topography, soil, or other factors; and the plot records show also that they may vary from year to year on the same farm. Hence it seems desirable not to attempt a statement too detailed regarding

the dates, but to consider them as applicable to general localities. The best dates for seeding wheat in the localities where the experiments were conducted are shown in Figure 3. Those for intermediate localities may be determined by interpolation. Lines drawn through identical or nearly identical dates on the map would correspond in a general way to September isothermal lines for Kansas.

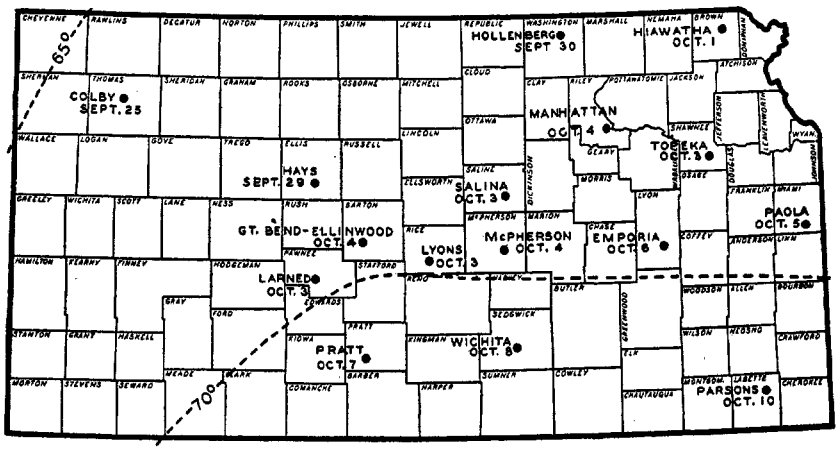

FIG. 3.—Map showing the locations of experimental wheat plots and estimates of safe seeding dates to avoid heavy infestations of the hessian fly in Kansas, and isothermal lines for 65° and 70° F. in September.

ANNUAL TRENDS OF INFESTATION

The summarized data of Table 4 show the annual trends of hessian fly infestations in the experimental plots for the crop years 1919-1935, and give an idea of the importance of the hessian fly in growing wheat under Kansas conditions. The fall infestation recorded in Table 4 is an average of the infestations of the plots seeded before selected date of Table 3.

It will be noted in Table 4 that considerable fly abundance in the middle Twenties and in the early Thirties, alternated with real scarcity from 1918 to 1922 and low infestation in the late Twenties. While little difference can be observed in the records from localities in the central and eastern sections of the state, considerable abundance has occurred at intervals as far west as Hays, Great Bend, and Pratt. Farther west, at Colby, infestation was very light even during the periods of abundance elsewhere. In southwestern Kansas infestation was not heavy in the periods of abundance, but some fairly heavy infestations occurred in counties Rush and Ness nearer the center of the state. It appears that in about one-fifth of the years the hessian fly may be abundant in central and eastern Kansas.

TABLE 4.—*Percentages of wheat tillers infested by the hessian fly in the fall in predate lots in experimental seedings in Kansas, 1918-1934*

FALL.	Hiawatha.	Topeka.	Hollenberg.	Salina.
1918				
1919				
1920	5.4	6.8		0.3
1921	0.2	6.3		
1922	0.8			0.0
1923	0.0	17.2		0.0
1924	0.2	2.1		10.0
1925	0.0	3.6		21.3
1926	0.0			9.7
1927	0.6			35.7
1928	0.0			8.0
1929	1.9			7.2
1930	15.7			2.7
1931	0.0		18.5	6.0
1932	0.0		0.5	
1933			1.8	
1934				

FALL.	Hays.	Colby.	Paola.	Emporia.
1918				
1919	0.3			
1920	3.9		24.6	3.5
1921	0.0		0.3	6.0
1922			0.9	
1923	5.2			17.9
1924	33.8	0.5		12.1
1925	42.1	1.9		3.8
1926	5.0			
1927	1.8	0.0		9.2
1928	0.0	0.0		0.4
1929	0.8	0.0		0.6
1930	4.1	1.0		0.0
1931	0.7	0.5		8.2
1932	37.0			53.7
1933	2.5			16.5
1934				2.0

FALL.	McPherson.	Lyons.	Great Bend-Ellinwood.	Larned.
1918				
1919				
1920	8.8			
1921	0.1			
1922	0.0			
1923	0.1			
1924				
1925			16.5	
1926			13.2	3.0
1927			24.2	8.8
1928			0.0	0.0
1929		5.4	3.4	6.1
1930		20.5	9.4	3.7
1931		12.0	18.6	0.0
1932		6.0	6.0	
1933				
1934				

TABLE 4.—*Concluded*

FALL.	Parsons.	Wichita.	Pratt.
1918	.....	8.3	.....
1919	.....	0.0	.....
1920	.....	2.3	0.5
1921	.....	2.0	0.0
1922	.....	0.8	0.4
1923	0.4	0.2	2.1
1924	17.1	3.1	42.0
1925	0.0	7.4	6.9
1926	0.6	18.4	8.5
1927	6.0	9.0	8.1
1928	9.7	0.5	0.6
1929	14.0	18.4	31.2
1930	2.0	1.0	39.7
1931	6.0	5.0	7.7
1932	32.0	22.2	2.5
1933	40.7	2.4	0.0
1934	10.3	0.8	.....

RELATION OF SEEDING DATES TO YIELDS

Samples from the plots seeded on the practically safe dates shown in Table 3 were used in computing the yields from the experimental test plots, Yield data are summarized in Table 5 by localities and years into averages for early plots (more than three days before selected date), safe-date plots (within three days of selected date) and late plots (more than three days after selected date). The data from the occasional November seedings are not used. The safe seeding dates for the respective localities are indicated in the column headings of Table 5.

The data reported in Table 5 were obtained where fall infestations of the hessian fly prevailed. All plots in those experiments were therefore also subject to spring infestation and the yields of the later seedings were probably reduced because of close proximity to the fall-infested, early-seeded plots. Information obtained in other studies shows an advantage in yield for seeding somewhat earlier than the fly-safe date in years when the fly is not prevalent. It appears, therefore, that seeding should be delayed until the fly-safe date when the fly is an appreciable hazard to early-seeded wheat, but that planting somewhat earlier than the fly-safe date is advisable when the fly is not a factor.

The data cited in Table 5 give little evidence of a reduction in yield from slightly delayed sowing. In some cases early seeding appears to give better results, in other cases the later seedings, and in still other cases little difference appears. Delaying the seeding until well beyond the safe date appears to show reduced yields more frequently than increased yields, but waiting until the estimated safe dates seems to give yields on the average about the same as earlier seeding. The Wichita data, which were much more precisely determined than those from other localities, show approximately equal yields from date and predate seedings, but a three-bushel average reduction for postdate seedings.

TABLE 5.—*Yields of wheat (bushels per acre) in seeding-date experiments, 1919-1935, in various localities in Kansas.*

CROP YEAR.	HIAWATHA (Oct. 1).			TOPEKA (Oct. 3).			HOLLENBERG (Sept. 30).			SALINA (Oct. 3).		
	Early.	Safe date.	Late.	Early.	Safe date.	Late.	Early.	Safe date.	Late.	Early.	Safe date.	Late.
1919	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1920	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1921	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1922	22.2	20.8	22.2	12.5	25.0	18.0	.....	.....	.....	.....	.....	.....
1923	27.1	29.2	10.8	.....	.....	.....	.....	.....	.....	27.6	32.3	28.2
1924	31.2	31.2	24.4	40.1	36.4	43.7	.....	.....	.....	17.7	31.8	29.1
1925	36.5	32.3	29.3	20.8	19.8	26.0	.....	.....	.....	14.6	23.4	21.9
1926	.....	21.8	19.8	37.5	40.1	39.0	.....	.....	.....	13.5	25.6	17.7
1927	24.0	10.4	13.0	.....	.....	.....	.....	.....	.....	22.4	29.2	23.4
1928	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1929	10.4	9.4	11.5	.....	.....	.....	.....	.....	.....	38.6	32.8	31.3
1930	6.3	14.6	15.1	.....	.....	.....	.....	.....	.....	37.0	36.4	34.0
1931	25.0	18.8	16.7	.....	.....	.....	.....	.....	.....	.....	.....	.....
1932	10.4	6.8	6.3	.....	.....	.....	2.1	1.0	.....	.....	.....	.....
1933	22.4	17.7	20.3	.....	.....	.....	16.7	17.4	13.2	.....	.....	.....
1934	.....	.....	.....	.....	.....	.....	8.8	10.9	.....	.....	.....	.....
1935	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Avg.*	**21.6**	**19.1**	**17.0**	**27.7**	**30.3**	**31.7**	**16.7**	**17.4**	**13.2**	**24.5**	**30.2**	**26.5**

CROP YEAR.	HAYS (Sept. 29).			COLBY (Sept. 25).			PAOLA (Oct. 5).			EMPORIA (Oct. 6).		
	Early.	Safe date.	Late.	Early.	Safe date.	Late.	Early.	Safe date.	Late.	Early.	Safe date.	Late.
1919	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1920	34.2	33.3	21.6	.....	.....	.....	.....	.....	.....	.....	.....	.....
1921	24.3	25.4	12.3	.....	.....	.....	.....	.....	.....	.....	.....	.....
1922	20.0	22.9	23.2	.....	.....	.....	.....	.....	.....	20.8	20.8	17.0
1923	.....	.....	.....	.....	.....	.....	30.0	22.4	16.6	.....	.....	.....
1924	40.9	40.8	37.7	.....	.....	.....	.....	.....	.....	15.1	25.0	11.4
1925	4.3	4.6	4.2	9.4	6.3	6.6	.....	.....	.....	31.3	34.4	28.1
1926	15.5	12.9	21.0	0.0	0.0	0.0	.....	.....	.....	40.6	29.7	16.7
1927	2.5	2.9	3.3	.....	.....	.....	.....	.....	.....	.....	.....	.....
1928	.....	.....	.....	0.0	0.0	0.0	.....	.....	.....	.....	.....	.....
1929	17.6	18.3	21.7	12.5	12.8	16.7	.....	.....	.....	24.2	30.2	.....
1930	29.6	.....	26.4	33.3	37.5	30.0	.....	.....	.....	21.9	25.0	.....
1931	26.1	27.9	28.3	33.0	30.7	26.6	.....	.....	.....	24.2	19.8	.....
1932	29.8	30.0	31.3	26.0	35.2	34.6	.....	.....	.....	.....	.....	.....
1933	14.8	19.0	14.9	.....	.....	.....	.....	.....	.....	18.7	27.3	.....
1934	.....	.....	.....	.....	.....	.....	.....	.....	.....	28.5	30.6	22.7
1935	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Avg.*	**20.9**	**21.6**	**20.0**	**16.3**	**17.5**	**16.4**	**30.0**	**22.4**	**16.6**	**27.3**	**28.1**	**19.2**

* The averages are for only those years in which records are given in all three columns for a locality.

TABLE 5.—*Concluded*

CROP YEAR.	McPHERSON (Oct. 4).			LYONS (Oct. 3).			GREAT BEND-ELLINWOOD (Oct. 4).			LARNED (Oct. 3).		
	Early.	Safe date.	Late.	Early.	Safe date.	Late.	Early.	Safe date.	Late.	Early.	Safe date.	Late.
1919	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1920	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1921	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1922	14.6	12.5	3.4	.....	.....	.....	.....	.....	.....	.....	.....	.....
1923	0.5	8.3	10.4	.....	.....	.....	.....	.....	.....	.....	.....	.....
1924	27.1	18.7	22.9	.....	.....	.....	.....	.....	.....	.....	.....	.....
1925	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1926	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1927	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.4	4.2	.....
1928	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1929	.....	.....	.....	.....	.....	.....	22.6	20.0	.....	34.4	31.3	38.6
1930	.....	.....	.....	7.8	10.4	7.3	15.6	15.6	.....	21.4	20.8	25.0
1931	.....	.....	.....	33.4	36.5	38.6	24.7	25.0	20.8	19.3	22.4	17.7
1932	.....	.....	.....	1.3	7.0	5.2	15.9	13.0	15.6	13.8	12.2	8.9
1933	.....	.....	.....	.....	.....	.....	1.4	0.8	0.5	.....	.....	.....
1934	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1935	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Avg.*	**14.1**	**13.2**	**12.2**	**14.2**	**18.0**	**17.0**	**14.0**	**12.9**	**12.3**	**22.2**	**21.7**	**22.5**

CROP YEAR.	PARSONS (Oct. 10).			WICHITA (Oct. 8).			PRATT (Oct. 7).		
	Early.	Safe date.	Late.	Early.	Safe date.	Late.	Early.	Safe date.	Late.
1919	.....	.....	.....	16.7	.....	10.4	.....	.....	.....
1920	.....	.....	.....	32.5	37.8	34.9	.....	.....	.....
1921	.....	.....	.....	26.3	25.3	23.5	24.9	.....	18.8
1922	.....	.....	.....	17.5	21.0	21.5	9.7	20.8	10.4
1923	4.3	12.2	9.5	22.7	21.8	12.8	13.5	12.5	11.6
1924	9.9	10.4	9.4	28.0	20.9	20.6	14.0	15.1	13.5
1925	13.8	17.7	17.7	10.9	10.6	14.3	7.3	7.3	6.3
1926	6.3	4.2	5.2	19.4	20.6	19.9	14.6	10.9	14.0
1927	15.6	.....	9.4	16.2	21.4	14.3	13.5	13.0	12.5
1928	9.4	.....	11.7	37.8	37.7	27.4	.....	.....	.....
1929	3.1	4.2	.....	29.2	23.9	23.9	17.2	17.2	16.7
1930	3.4	3.6	.....	20.4	14.9	15.6	27.1	30.2	29.2
1931	15.3	16.7	14.6	45.8	38.4	39.2	13.5	12.0	18.8
1932	15.6	12.0	13.5	20.0	27.6	25.7	5.8	14.0	24.5
1933	17.7	13.5	18.3	7.2	4.2	1.1	20.8	18.7	21.3
1934	17.2	18.8	22.4	33.9	32.4	22.3	19.6	20.8	24.0
1935	7.4	5.2	4.1	.....	.....	.....	.....	.....	.....
Avg.*	**11.9**	**12.3**	**12.7**	**24.5**	**23.9**	**21.1**	**14.7**	**16.0**	**16.9**

* The averages are for only those years in which records are given in all three columns for a locality.

When the lines of averages in Table 5 are examined it may be seen that the instances of lower yields in late seedings are often the result of markedly lower yields in certain years rather than a general tendency in that direction. In other years yields were nearly the same. The crop year, 1927, was marked by reduced yields in late sowing in several localities, as it was in Nebraska, and 1923 showed a somewhat similar condition. In other years the relation fluctuated among localities. Seedbed conditions relative to moisture and snow cover, as well as cold, are probably factors in determining the success of various seeding dates. It appears probable that in one or two years out of 10, seedings later than the safe date will be injured by cold. In some cases where infestation was heavy, lower yields are noted in early seedings. In other cases, infestations in early seedings were not sufficient to lower the yield markedly.

CONCLUSIONS

It is evident that the hessian fly is very general in occurence and numerous enough to be found in limited samplings nearly every year in the eastern one-half of Kansas. It apparently becomes abundant only occasionally, perhaps one year out of four or five on the average. Severe injury is even less frequent. In the western one-fourth of Kansas, the species often occurs, but seldom rises to threatening numbers, and is often hard to find.

It is concluded that dates somewhat earlier than those previously recommended will give practical safety. They range from October 1 in northeastern and southwestern Kansas, or even earlier for northwestern Kansas, to October 10 in the southeastern corner of the state. These dates of planting will result in little or no reduction in yields as compared with earlier dates, if soil and climatic factors are favorable, but seeding later than these dates will tend to reduce yields.

It is suggested that in central and eastern Kansas the dates shown in Table 3 should be observed when infestations warrant. In western Kansas no special attention need be paid to observance of safe-seeding dates in years when the fly is known to be scarce, but during the infrequent periods of fly abundance in those areas the safe-seeding dates should be observed.

A regular, summer hessian fly survey should be made annually to give growers the needed information on which to adapt seeding practices to the prevailing conditions. Very early seeding seems undesirable in any case. Very early seeding, or disregard of safe dates, especially in fly years, will allow development of general infestations with serious losses of wheat.

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