Within the state systematic pest reporting from all sections offers additional advantages in enabling immediate action to be taken by the entomological staff in the case of insect injury about which they have no previous information. It also enables them to send outlines of the life histories and control measures of the common insects to representative growers in every county, a feature which will result in as extensive and desirable a form of entomological education as could be worked out.

PRESIDENT WILMON NEWELL: Is there any discussion?

MR. E. P. FELT: I believe a volunteer pest reporting service is of material value in assisting in the detection of recently introduced insects, though I cannot support this by facts. About 20 years ago, the speaker had a similar service and two of these voluntary observers, as we called them at that time, are now active, energetic entomologists. I do not know whether they started with the voluntary pest service or not, but one of the things that we need to develop throughout the country is a more general appreciation of scientific work and more general cooperation, not only on the part of entomologists, but agriculturists, foresters, and laymen in general. We must secure the sympathy and cooperation of the latter, and in doing that, we will immensely increase our efficiency. I believe this is an activity that has not been given sufficient attention in many places.

MR. W. E. HINDS: I would call attention to the Mexican Bean Beetle situation in Alabama as an instance where a voluntary pest reporting service failed. This insect came to the attention of a county agent in Alabama a year before it was reported to the Experiment Station, because he failed to appreciate its importance. He recognized the insect and had some printed information concerning it, but failed to report.

MR. W. R. WALTON: I have had considerable experience with voluntary crop pest reporting service. A great many of the Federal reports are received in the Bureau of Crop Statistics and are referred to our office. They are usually 30 days late and do not give information quick enough to be of material use.

PRESIDENT WILMON NEWELL: The next is a joint paper by H. A. Gossard and T. H. Parks, on the "Value of Entomological Service to the Ohio Farm Bureaus in Their Efforts to Control the Hessian Fly."

HESSIAN FLY PREVENTION

By H. A. GOSSARD and T. H. PARKS

For many years, the standard recommendation of entomologists to prevent Hessian fly injury has been to seed late. All have assumed the advice to be good and Hessian fly has been cited perhaps, more frequently

than any other insect as an illustration of what can be done by adapting agricultural practice so as to strike at the weak point in an insect's life history.

During the past few years, some entomologists have inquired somewhat further and have tried to find safe seeding dates for the different sections of our nation, basing them on the average dates determined through a series of years on observation plots seeded on different dates. However, for several years, some of the Ohio entomologists have greatly distrusted for fly prevention, the reliability of the seeding dates commonly depended on to secure a maximum yield and also to escape fly damage. They have, therefore, sought to find some more certain method of putting the young wheat beyond the reach of flies which sometimes decline to obey the schedules made out for them by the entomological brotherhood. The method devised has been used quite successfully during two different seasons to determine the best dates, but does not seem to promise constant and uniform success. Supplemented by the judicious use of other known methods it bids fair to prove valuable.

To discover the gradual approach of a Hessian fly outbreak has engaged our attention. Few entomologists in the field have had the opportunity and facilities to study this phenomenon and thereby obtain sufficient knowledge to certainly predict the visitation and hence, prevent it, or curtail in part the losses it would cause. The entomological workers of Ohio through the Annual Wheat Insect Survey, have determined such a means of forecast and have successfully used it to foretell and greatly to reduce the most serious outbreak the state has experienced for many years; viz, that of the fall of 1919.

PRELIMINARY WORK OF 1919

In the summer of 1917, the Ohio Experiment Station, as a war activity, organized the wheat survey. So much of promise seemed involved in its continuance, that each year since 1917, all of the entomological workers of Ohio State institutions have been called together to make the Wheat Insect Survey, the general direction of the work being shifted from one to the other of the State Entomological departments according to convenience. In July, 1919, this practice resulted in detecting the presence of the Hessian fly in threatening numbers. Since a progressive development of the pest was clearly indicated by the data gathered by this and the preceding surveys, a campaign for "safe seeding" was at once organized by the Extension Entomologist. This was conducted through farm bureaus and local, county, and state papers, circular letters, posters and community meetings, the effort being specially centered on northern Ohio. The seeding dates recommended were

those which had been generally accepted by our entomologists and agriculturists as safe in previous years.

RESULT OF THE LATE-SOWING CAMPAIGN OF 1919

In the northern counties, probably nearly eighty percent. of the growers waited for the suggested dates before sowing. In the central and southern counties, about ninety percent. of the growers in counties having farm bureaus waited for the proper dates. The wisdom of this was seen in November, by which time the early sowed wheat all over Ohio had been destroyed by a very heavy fall brood of fly. Those who sowed before the dates suggested, everywhere suffered heavy and sometimes total loss. This is well illustrated by the yields obtained from the "date of sowing" plats on the Miami County Experiment Farm, which are here given:

When Sowed	Percent. of plants infested Nov. 1919	Yield in July 1920
Sept. 8	100	16.5 bu.
Sept. 16	100	18.5 "
Sept. 23	100	12.5 "
Sept. 27	55	27.0 "
Sept. 29	10	37.4 "
Oct. 2	0	40.0 "
Oct. 4	0	37.8 "
Oct. 13	0	36.1 "
Oct. 20	0	21.6 "

The seeding dates proved generally trustworthy for southern Ohio but not for northern, where wheat was damaged if sown as late as September 26, or eight days later than recommended. By November, it was determined that there was a range of only five days in the departure of the fall brood from Lake Erie on the north to Cincinnati on the south, instead of 14 days, as should be the case, if it had obeyed the law of latitude. In southern Ohio less than 10 percent. of the wheat became infested, but 80 percent. is our estimate for several northern counties.

PRELIMINARY WORK OF 1920

During July, 44 counties were visited by the surveyors and the distribution of the spring and summer damage was found to conform to the previous fall infestation. The area of greatest density of infestation had moved from north-central to north-western Ohio. In one county, eighty-nine percent of all straws had been killed or damaged by the fly. On many of the best farms in northern Ohio the average wheat yield was not over eight bushels per acre, where in other years yields of 35 bushels had frequently been obtained. Many wheat fields were cut for timothy.

The survey showed that 44 percent. of all straws examined in the state were either killed or damaged by fly. Material was collected in

each county visited and sent to Wooster and to the Field Laboratory of the Bureau of Entomology at Lafayette, Indiana, to be examined for parasitism. No particular section of the state was found to be favored in the distribution of these parasites.

By August first, we were sure that the state was again threatened by serious fall damage, and another campaign of late sowing seemed necessary. This time it was not necessary to solicit the interest of the county agents nor of many of the farmers. The question most frequently asked was: "When shall we sow?" Uniform sowing dates had been decided upon by the entomologists working on this problem in Illinois, Indiana and Ohio, and these were given wide publicity in Ohio as the probable safe dates to sow to avoid both Hessian fly and winter-killing.

To supplement the sowing dates and better guide the growers of northern Ohio past the expected damage from the fall brood, the three entomological departments of Ohio arranged to establish three field observation points where the daily emergence and egg-laying could be watched during September. It was hoped in this way to be able to hold back sowing until the danger of the brood was past, if the dates previously chosen were again too early. To explain this plan, and also organize the counties in the worst infested area, the Extension Entomologist, during August, met with the crops committees of the farm bureaus in 19 of the north-western counties, as it was thought best to let these committees take the lead in the campaign work in their counties. A "fly meeting" was held in conference with these men, who at these meetings chose the earliest date they wanted any wheat sown in the county and outlined their plan to prevent wheat being sowed early this year. The county agents of these counties were instructed to keep in touch with the records from the rearing cages and egg-laying counts that were to be made by the entomologists, and have the organizations in readiness to further postpone the sowing dates if necessary. The committees in these counties conducted their own campaign. This was done through circular letters, meetings, daily press items, posters, and rubber stamps used on the mail of county firms doing business with farmers. Eight county agents had attractive exhibits of adult Hessian flies at County Fairs while the University featured this at the State Fair.

METHOD FOR DISCOVERING THE SEEDING DATE

In the JOURNAL OF ECONOMIC ENTOMOLOGY, February 1916, pp. 142-144 a description was given of a new method used to determine the seeding date, and it will be remembered that Miami County, Ohio, was almost wholly freed from Hessian fly by one season's work. Substantially the same method was followed this season, but we endeavored

to make our breeding stations perform a statewide service and added some new types of cage or trap to either breed out flies or else to catch them in natural flight in the field. The three most practical were named and defined as follows:

1. Concentration cage. This was a tight store box without bottom and with circular holes cut in the top for lantern globes fitted into them, the globes being covered over the top with cheese-cloth tied in place. Into this cage was put about two bushels of stubble and surface earth known to contain healthy "flaxseeds" in great numbers. If the stubble and earth heap was not moist, this was or should have been wetted with one or two pailsful of water, because this loose heap dries out more rapidly than field soil, and normal conditions are more nearly preserved by adding the water. Water was also added as each rain occurred.

2. Migration wire. Five linear feet of ordinary wire fly-screen, two or three feet high, was set up on a frame with the lowest edge elevated about eight inches to one foot above the ground and standing north and south. A similar trap was set at right angles to it, east and west. By this arrangement the chance for catching flies was equally good no matter from which direction the wind blew. The wire was coated with tanglefoot, the flies removed with a brush after each day's count, and the tanglefoot renewed or freshened by brushing over it.

3. Egg Record. Besides the traps just described, a strip of wheat was seeded at each station in time to be of inviting size at the date when the flies were expected to appear. A number of these plants were so marked that they could be identified easily, and when the flies began to appear all eggs were counted and removed. Each day, thereafter, the eggs were counted and removed.

The records of fly activity at one of the four stations were registered by these devices as follows:

HESSIAN FLY RECORD * * * 1920, SANDUSKY, OHIO																																	
September																														Oct.			
Dates Kind of cage	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1												
Concentration	3	2	4			6	10	11	34	87	129	161	152	72	76	43	18	37	2	0	1												
Migration ..									2	127	201	268	99	65	44	82	48	38	8	3	0												
Totals	3	2	4			6	10	11	36	214	330	429	251	137	120	125	66	75	10	3	1												
Eggs counted on 100 plants						192	66	96	37	475	1247	1577	458	193	253	158	69	34	24	10													

While stations were also maintained at Bryan, Wooster and Columbus, the brood at the last two points was much lighter and results were not pronounced. For these two points, we were obliged to fall back on

our old seeding dates, but felt more sure of them after having the data from Bryan and Sandusky. We found that for the successful management of an emergence station the entire time of one entomologist is required.

We had meetings at both Bryan and Sandusky of farmers and county agricultural agents, and after showing them our equipment and the results, agreed with them on seeding dates. While the migration wire and the egg counts seemed to give the truest record regarding the activity of the brood, the concentration cage was the best asset from a psychological standpoint to gain the attention and support of the county agents and farmers. When they could see a swarm of flies which had emerged within the preceding 24 hours in the glass globe, and found this record supported by egg counts and the catch of the migration wire, they were readily convinced that wheat exposed to attack would certainly suffer. The other types of cage gave valuable information regarding density of emergence and furnished a check on the concentration cage, the migration trap and egg-laying records. From them we knew that emergence in the concentration cage was nearly normal, not lagging more than a day or two behind that in the cages with field conditions.

After the experience in Miami County in 1915 and this season's experience, we feel confident that if, in years of Hessian fly abundance, a half dozen competent entomologist are stationed at six fly-emergence stations in selected localities over our state, we can determine from their observations favorable seeding dates for different sections with about as much certainty and precision as the United States Weather Bureau can predict the weather. While some of the records may prove indecisive, others are likely to give a clear record, assisting greatly in determining the trustworthiness of the seeding dates usually followed. We concede that the date, thus found, may be a few days later than the best date for maximum yield, but this latter can hardly be established for years with heavy infestation, and we, therefore, favor finding the safest date it is possible to discover.

RESULT OF LATE SOWING CAMPAIGN OF 1920

The daily emergence and egg-laying records were wired or mailed to the county agents in the counties it was desired to guide, and it was found necessary to delay seeding several days longer than the dates at first selected to sow by some of these county farm bureaus. On September 25th, the emergence and egg-laying had subsided greatly at Bryan, and two days later at Sandusky. Analyses made of "flax-seeds" in the old stubble showed that most of the flies had emerged.

A considerable number, which had not emerged, contained Hessian-fly larvae which apparently would not emerge until spring. The word was given to Williams and surrounding counties to sow wheat after the 27th. For Erie and surrounding counties, October 1st was the date selected. On September 28th, many drills were starting in the north-western counties, though some chose to wait a little longer.

The result of the extension effort was indeed gratifying, and the response almost unanimous. Less than one percent. of the wheat had been sowed before the final dates chosen. In many townships not an early sowed field could be found. Seeding proceeded promptly during the first ten days of October. At no point were many Hessian-fly eggs found from September 30th until October 14th. The young wheat had escaped a very heavy infestation and was looking well. The little early-sowed wheat that could be found. in most counties, had become heavily infested with the fall brood soon after it came up.

OCTOBER EGG-LAYING

An unexpected appearance of adult flies during mid-October over all except north-eastern Ohio, resulted in many eggs being deposited between October 14th and 19th. This emergence was over by October 20th. Wheat which came up too late to become infested by the main fall brood, then became infested with eggs, and later with the maggots of the fly. At Columbus 802 eggs were deposited upon 100 plants kept under observation during that time.

Proof was obtained that this late wave of emerging adults came from flaxseeds which developed during June on the main crop. Hence they did not represent a true supplementary brood, but came from "hold-over" flaxseeds which did not give up their occupants during September as previously observed. This "holdover" stock of summer flaxseeds was exceedingly large, and only a part of them gave up adult flies during October. The remainder are carrying their occupants, doubtless to enhance the numbers of the spring brood. Instead of emerging in September, the fall brood of 1920 divided into three parts as follows: 1—September emergence of the normal fall brood. 2—Mid October emergence or "late wave." 3—"Carry over" flaxseeds still unemerged in midwinter.

The maggots which hatched from the eggs deposited by the late wave adults grew quite slowly, and caused some damage to all wheat above ground before October 16th. About 20 percent. of these plants became infested.

Thus, by an eleventh hour effort, the Hessian-fly prevented what looked to be a complete and statewide control as the result of the united

effort of the growers. The damage from the late wave of October flies is considerable, but insignificant when compared with the result of the visitation of the main fall brood of 1919, the like of which the farmers of Ohio missed in 1920 by pulling all together.

SUMMARY

Summarizing the Ohio work we believe we are justified in claiming:

First, that an annual entomological wheat survey just before harvest, such as Ohio has maintained for four seasons, will reveal an approaching outbreak of Hessian fly and prevent surprise.

Second, that several fly emergence stations located at selected points over the state will furnish the most dependable data obtainable upon which to base recommendations for safe seeding dates for the different localities. If some or all of the emergence stations fail to yield decisive results, the sowing dates established by plot tests through a series of years should be used to guide the sower.

Third, that a well organized extension service cooperating with the county farm bureaus can get the recommended dates for seeding into the hands of the farmers within 24 hours or less after they are determined from the emergence records. And, further, that by energetic preliminary work the Extension Entomologist can secure the ready cooperation of 99 percent. of the farmers in a seeding campaign.

Fourth, that as a result of our annual surveys and correlated efforts, a threatened heavy brood of fly has been kept suppressed, and that there will be twice as many bushels of wheat in Ohio in 1921 as would have been the case, had we given the insect no attention.

MR. W. P. FLINT: The experiences stated in this paper are about the same as those we have had in Illinois this year, particularly concerning the great variation in the actual fly-free dates. From 1918 to 1920, the dates varied 22 days at Champaign, Ill.

MR. J. J. DAVIS: My recent observations in southern Indiana indicate that the late wave of fly is still in the larval stage and very likely these larvae will not mature and not issue next spring.

MR. T. H. PARKS: The change from the larva to the flaxseed stage in Ohio has been very recent. Three weeks ago there were very few in the flaxseed stage in southern Ohio, but now over half of them are in that stage.

MR. H. A. GOSSARD: Three-fourths of them are in that stage in northern Ohio.

PRESIDENT WILMON NEWELL: The next paper entitled "The Potato Leafhopper and Tarnished Plant Bug in 1916," will be presented by Mr. S. Marcovitch.