

M 1153

Impact of the Red Imported Fire Ant, *Solenopsis invicta* Buren (Hymenoptera, Formicidae), on Harvest of Soybeans in North Carolina¹

M1153

C. T. ADAMS, J. K. PLUMLEY, W. A. BANKS, AND C. S. LOFGREN

*Insects Affecting Man and Animals Research Laboratory, Science and Education Administration,
U.S. Department of Agriculture, Gainesville, FL 32604*

Abstract

Comparisons were made of the yield of soybeans from three North Carolina fields infested with the red imported fire ant, *Solenopsis invicta* Buren, at an average of 56.9 mature mounds/acre, as opposed to three fields infested at a rate of only 0.06 mature mounds/acre. Though the differences were small statistically (ca. 0.73 bushel/acre), they were highly significant. The price of soybeans is rarely static, but on the basis of the price on December 17, 1976 (\$6.88/bushel), a loss of \$5.02/acre could be expected from the infested fields. This loss is directly attributable to custom combine operators raising their combine header-bar to avoid the tumulus of mounds of the fire ant.

Introduction

Numerous surveys have been made in an effort to determine losses attributable to the red imported fire ant, *Solenopsis invicta* Buren. Economic data gleaned from these surveys was based on subjective losses reported by the farmers polled. Wilson and Eads (1949) surveyed two counties in Alabama to determine the severity of crop and livestock damage in that area. The final tabulations, however, contained little or no definitive information to support their conclusions.

The most recent survey of the effect of fire ants on agriculture was conducted by Hunt (1975) in the four most heavily infested counties in North Carolina. His study, again based on a poll of the farmers and with few supporting data, showed an average loss of

\$322.91 per farm with an average size of 229 acres. Ninety-seven percent (125) of the 129 farmers polled reported infestations of fire ants on land they managed for agricultural production. Most respondents reported tobacco as their major source of income, with 9.3 percent reporting soybeans as their major crop. However, Hunt reported that the major loss appeared to have occurred in soybeans. The 86 respondents in Brunswick and Columbus counties reported an average loss of \$279.69 per farmer for a total loss of \$24,053.34.

The presence of the imported fire ant in soybean fields was once thought to be rare because of the heavy shading of these fields. However, Whitcomb et al. (1972) reported finding heavy infestations in soybean fields in northwest Florida. The infestations became progressively lighter as the survey continued east and south through the soybean-producing areas of the state. Most of these areas, however, had been infested for progressively shorter periods of time than those in northwest Florida.

A survey in 1976 found mound densities in 14 randomly selected fields (549 total acres) in Sumter County, Georgia ranged from 8 to 138.6/acre, with an average density of 78.36 mature mounds/acre (unpublished data).

A study to quantify some of the losses caused by fire ants so that we could more accurately define their impact on agriculture was reported by Adams et al. (1976). This study was undertaken in Lowndes County, Georgia, and revealed that incomplete harvest of soybeans in areas infested with an average of 44.0 mounds/acre resulted in a loss of ca. \$2.50 per acre. The losses here were a direct result of the custom combine operators raising the header-bar of their com-

¹ Mention of a proprietary product in this paper does not constitute an endorsement of this product by the USDA.

PURCHASED BY THE
U. S. DEPARTMENT OF AGRICULTURE
FOR OFFICIAL USE

bines to avoid damage from cutting through the tumulus of the fire ant mounds.

Further studies were initiated in North Carolina in late 1976 in an effort to quantify the exact loss per acre as reported by Hunt that could be attributed to the presence of the red imported fire ant in soybean fields.

Survey and Plot Selection

Post-harvest surveys were made to locate fields supporting the lowest and highest rates of fire ant infestations. Mound counts were taken in Columbus County, North Carolina, in 10 circular $\frac{1}{2}$ acre plots in each of three fields measuring 30, 40, and 75 acres, respectively. Only one mature mound was found in these 30 randomly selected survey plots. Three fields in Brunswick County, North Carolina measuring 10, 22, and 35 acres each were surveyed in the same manner. Mound density in these fields ranged from 44.0 to 74.4, for an average of 56.9 mature mounds per acre. The study sites were separated by ca. 30 miles, and represented extremes of fire ant infestation. It should be stated that a mature mound is subjectively classified as a mound of at least moderate size but having an abundance of workers and brood within the mound, and alates during mating season.

Sampling and Harvest Technique

Fifty subplots of soybeans, each measuring 0.01 acre (6.3×69.1 ft), were selected for post-harvest soybean stubble collection from each of the two areas. Two fields in each area contained 17 subplots each, and the third contained 16 subplots. Each subplot included 69.1 linear ft in each of two adjacent rows. The stubble remaining in the designated subplots after combining by normal farm practices was harvested at ground level with a modified Jari[®] sickle mower equipped with a miniature feeder reel and two catch bins to retain the collected stubble. All stubble samples were bagged in burlap, numbered sequentially, and returned to the laboratory for processing. The soybeans remaining on the stubble of each sample were shelled, cleaned with a sheller-cleaner for small samples, and weighed, and the data

were tabulated. Sequentially paired samples were compared individually and collectively.

Results and Discussions

All fields sampled had been planted in mid-May, thus giving sufficient time for full-season stalk development prior to bloom set.

The three uninfested fields were combined by different operators. Our observations, however, revealed that all did an excellent job as indicated by the size of our samples. Since there were no ant mounds present in the fields, nearly all soybeans were cut at 2–4 inches above the soil surface in the initial combine operations.

The three infested fields were combined by the same operator. He indicated that prior to combining he surveyed the fields and preset his header-bar to avoid as many mounds as possible. Thus, most plants in these fields were cut at 12–15 inches above the bed. Discussions with other combine operators in the area indicated that this technique for combining soybeans in areas infested by fire ants is quite common.

Samples of soybeans collected from stubble in the uninfested fields averaged 13.65 g soybeans/sample (1.2–88.5 g). Samples of soybeans collected from the stubble in the infested fields averaged 212.33 g/sample (7.7–968.6 g). The mean difference, 198.68 g, represented the amount of beans lost per 0.01 acre. Thus, the loss per acre was 19,868 g, or 0.73 bushel. Though there was some overlap in the ranges of the two sets of samples, the *t*-test showed the differences between the two to be highly significant.

The average yields of soybeans for the uninfested and the infested fields were 32.67 and 22.50 bu/acre, respectively. We assume that this difference in yield is attributable to the variation in growing conditions in the two counties, over which we have no control. There was an average loss of 3.24 percent of the beans from the infested fields. The loss was only 0.15 percent in the uninfested fields, or a net loss of 3.09 percent. Resultant monetary loss due to the presence of the mounds of the red imported fire ant was ca. \$4.68 per acre (Table I). Assuming an infestation rate of 56.9 mounds/acre, variations

Table I

Yield and loss of soybeans during harvest in three fields infested or uninfested with the red imported fire ant

	\bar{X} of three fields bushels/acre		Yield loss (%)	Value (\$)/acre ^b		Loss (\$) due to fire ants
	Harvested	Unharvested ^a		Harvested	Unharvested ^a	
Infested	22.50	0.73	3.24	154.73	5.02	4.68
Uninfested	32.67	.05	0.15	224.67	0.34	

^a Beans remaining on stubble.

^b Based on the average of six quotes appearing in the *Southeast Farm Press* 3(12/15/76):50; Clarksdale, Miss. (\$6.88 per bushel).

in yield:loss would be as follows: 25 bu/acre:\$5.31; 30 bu/acre:\$6.37; 35 bu/acre:\$7.44; etc.

Three combine operators were interviewed during the course of this study in an effort to determine the extent of damage to the combine as a result of ingestion of the tumulus of the fire ant mounds. Each maintained accurate records of parts replacement and labor costs for repair of his machinery. All agreed that the average operational life of both the knives of the sickle-bar and the concave rollers is four years when the combine is operated under optimum field conditions. The knives of the sickle-bar are the most commonly replaced item when the combine is operated in fields infested with fire ants. Three total replacements are usually required per season at a cost of \$20.00/set. Labor for installation averages four man-hours/set at \$2.20/hour, plus down-time for the combine. The second most commonly replaced item was the concave rollers of the combine, which suffer excessive wear from the ingestion of the tumulus of the fire ant mound. Under these adverse conditions, two sets of concave rollers must be replaced each

season at a cost of \$40.00/set. Replacement time averages four man-hours/set plus similar down-time. Monetary cost of combine repair amounts to \$184.00 per season per combine. These increased maintenance costs explain why combine operators intentionally sacrifice a portion of the yield in soybean fields infested with the red imported fire ant.

LITERATURE CITED

- ADAMS, C. T., J. K. PLUMLEY, C. S. LOFGREN, AND W. A. BANKS. 1976. Economic importance of the red imported fire ant, *Solenopsis invicta* Buren. I. Preliminary investigations of impact on soybean harvest. *J. Ga. Entomol. Soc.* 11:166-169.
- HUNT, T. N. 1975. Survey of agricultural losses due to the imported fire ant as estimated by North Carolina farmers. N.C. Cooperative Economic Insect Survey and Detection Annual Report, N.C. Agric. Ext. Serv., N.C. State Univ., Raleigh.
- WHITCOMB, W. H., H. A. DENMARK, A. P. BHATKAR, AND G. L. GREEN. 1972. Preliminary studies on the ants of Florida soybean fields. *Fla. Entomol.* 55:129-142.
- WILSON, E. O., AND J. H. EADS. 1949. A report on the imported fire ant *Solenopsis saevissima* var. *richteri* Forel in Alabama. Special Report to the Alabama Department of Conservation (mimeographed).

Received November 15, 1977