BOLL WEEVIL SURVIVAL IN BALED LINT

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Abstract

Re-introduction of the boll weevil into areas from which it was eradicated or substantially suppressed can be costly. It can also complicate the operation of a cotton production system particularly in the case of a producer who farms in both infested and suppressed areas. Many cotton gins also move cotton from a non-eradicated zone into an eradicated or suppressed zone, which could result in reinfestation by hitchhiking weevils. Boll weevil mortality factors related to harvesting, moduling, storage, handling, and ginning are not well known. This experiment was conducted to determine the effect of baling lint (more specifically the lint density) on the ability of boll weevils to survive the process. Pouches to hold test weevils were made from woven cotton bags containing two layers of cotton batting and weevils were placed between the bats. Pouches were placed at four locations in the bale of cotton. A Lummus Swinging Single universal density bale press was used to press the lint to selected test densities. These studies indicated that the location of the pouch in the bale did not significantly affect weevil survival. No weevils survived lint densities above 32.5 lbs/cu ft, while densities between 32.5 and 15 lbs/cut ft had varying survival rates. At densities below 15 lbs/cu ft there was 100% weevil survival. For a 480-pound bale, a platen separation of 24 in or less will ensure complete mortality of any weevils in the lint.

Introduction

Since its invasion in 1892, and its subsequent rapid spread, the boll weevil *(Anthonomus grandis* Boheman*)* has caused economic losses throughout the cotton growing region of the United States. The problem was so severe in some regions that cotton production nearly ceased. Efforts to solve the problem resulted in near eradication of the weevil in the southeastern and far-western cotton production regions, while other regions in Texas are still in various stages of eradication (Smith 1998, El-Lissy and Grefenstette 2001). There are areas in Texas where no eradication program is currently underway and others where it is just beginning, which are adjacent to zones far advanced in the process. Within a ginning community, this could greatly complicate the movement of cotton and cotton production equipment such as harvesters, module builders, and module trucks which cross zone boundaries. Situations where a gin in an advanced eradication zone is located near a border of an infested zone could present a risk by reintroduction of weevils to suppressed zones.

Reinfestation of eradicated zones is a major concern due to costs incurred in reclearing the zone. Natural in-flight dispersions (e.g., Jones et al. 1992, Raulston et al. 1996) and short range migrations from nearby infested zones (Allen et al. 2001) can reinfest eradicated zones. This is a major concern as is the movement of cotton related equipment and cotton products which may harbor hitchhiking weevils. Minimizing sources of weevils is of utmost importance, but there is limited knowledge on the effects of cotton harvesting, storage, handling and ginning on weevil ecology and dispersal. During 2000, a project was formulated to investigate the effect of these aspects of the cotton production system on weevil survival and movement. The immediate objective of this study was to determine the effect of packaging lint in a bale press on boll weevil survival. This information is important because lint is baled and shipped to the textile industry throughout the world where boll weevils are not established. Restrictions and fumigation requirements are often placed on imported U.S. cotton bales because of the perceived threat of hitchhiking boll weevils. Demonstrating that live weevils are not present in baled lint could provide a considerable cost savings to the U.S. cotton industry and be a positive factor for U.S. cotton in world trade.

Materials and Methods

Pouches for containing test weevils in lint bales were made by placing two bats of cotton lint, separated by paper into a 13 by 14 inch woven cotton bag. Immediately prior to testing, ten live weevils were scattered in each pouch between the two bats of cotton. The paper separating the bats was removed, and the open end of the pouch was stapled together and sealed with masking tape. The identity of each pouch was marked and a cotton string was tied to one corner to aid in locating the bag after pressing.

Boll weevils used in this study were at least one week old and were furnished by the rearing facility at the USDA-APHIS Mission Plant Protection Center, Mission, TX.

A Lummus Swinging Single, universal density bale press at the USDA Cotton Ginning Research Laboratory, Lubbock, TX was used to press the lint to the treatment bale densities. The press is a high strength metal box. The top and bottom of the box are called platens. The top platen is stationary and the bottom platen is mounted on the end of a hydraulic cylinder that exerts the force necessary to press lint. The bottom platen retracts downward to allow cotton into the box and then raises to compress the cotton into bales. One side of the press box opens to allow removal of the bale after compression and tying. This type of lint press allows for easy movement of cotton in and out of the press box. A bale of cotton is commonly considered to have 480 lbs of lint but the weight can range from 380 to 550 lbs. Preliminary tests found that a typical bale (480 lbs) of cotton would not be desirable for testing purposes. The treatment with the lowest density would require a 76-inch platen separation when a 480 lb bale was used. This would have been below the floor at the bale press and would not allow for an accurate measurement between the platens. It was also found that there was not a uniform density at all pouch locations when testing the lower densities with 480 lbs of lint. To overcome this problem a constant 19 inch platen separation was used and combinations of 180 lbs and 120 lbs of cotton lint were used to obtain the weights of cotton for the densities tested. As the tests were conducted it was found that the same bale of cotton could not be used for all densities as the lint became packed and did not expand after tests at higher densities. Lots of fresh cotton lint were used in subsequent tests. A range of densities from 10 lbs/cu ft to 40 lbs/cu ft (in 5 lbs/cu ft increments) were tested. Each pressure treatment was replicated 3 times.

The required weight of lint was placed in the bale press and a pouch of weevils was placed in each of four locations Fig.1. Location 1 was approximately one-fourth of the height of the loose lint from the bottom and on the right side nearest the open side of the press. Location 2 was one-half of the height of the loose lint and in the center of the bale press. Location 3 was three-fourths of the height of the loose lint and nearer the closed side of the bale press on the left side. Location 4 was on top of the loose lint next to the top platen. The press door was then closed and the ram energized. The platen was raised to a 19-inch separation, held for 20 seconds and released. The pouches containing weevils were returned to the laboratory where the lint was removed from the cotton bag and the weevils separated from the lint and examined for survival. In each case all weevils were accounted for.

Results and Discussion

Table 1 shows boll weevil survival for the four locations and six pressure densities. There was no significant difference in weevil survival due to location of the pouches. Therefore, data from the four locations (10 weevils/location) were consolidated, giving a weevil survival rate for each bale density. There was 100% survival at bale densities of 10 and 15 lbs/cu ft, while at bale densities between 20 and 30 lbs/cu ft there was a decrease in weevil survival (Fig. 2). At 35 and 40 lbs/cu ft there were no weevils that survived. To more accurately determine the lowest pressure where 100% mortality of the weevils occurs, 31.3, 32.5 and 33.8 lbs/cu ft densities were tested. In these tests 20 weevils per pouch were placed at each of four locations for a total of 240 weevils (3 replications). Results of both data groups are summarized Fig. 3. No weevils survived at densities above 32.5 lbs/cu ft. Thus, to insure that no weevils survive in a bale, a platen separation of 24 inches or less is required to achieve a critical bale densities greater than 32 lbs/cu ft when pressing a 480-lb bale of lint (Anthony et al. 1994).

Acknowledgments

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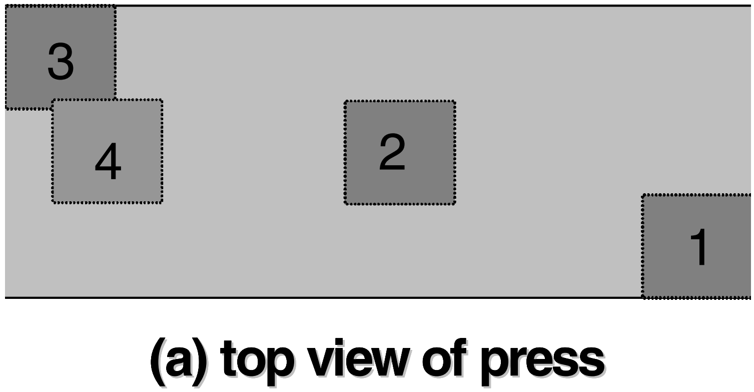
Table 1. Observed boll weevil survival for location 1, location 2, location 3 and location 4 in pressed bales.

		Location			
Density	**Rep**	**1**	**2**	**3**	**4**
-lbs/ft^3-		%			
10	1	100	100	100	100
	2	100	100	100	100
	3	100	100	100	100
	Avg.	100	100	100	100
15	1	100	100	100	100
	2	100	100	100	100
	3	100	100	100	100
	Avg.	100	100	100	100
20	1	100	90	90	70
	2	100	100	100	100
	3	90	100	100	100
	Avg.	96.7	96.7	96.7	90.0
25	1	30	10	20	10
	2	100	100	100	90
	3	90	90	40	30
	Avg.	73.3	66.7	53.3	43.3
30	1	0	0	0	0
	2	0	0	10	10
	3	20	10	10	0
	Avg.	6.7	3.3	6.7	3.3
35	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	Avg.	0	0	0	0
40	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	Avg.	0	0	0	0



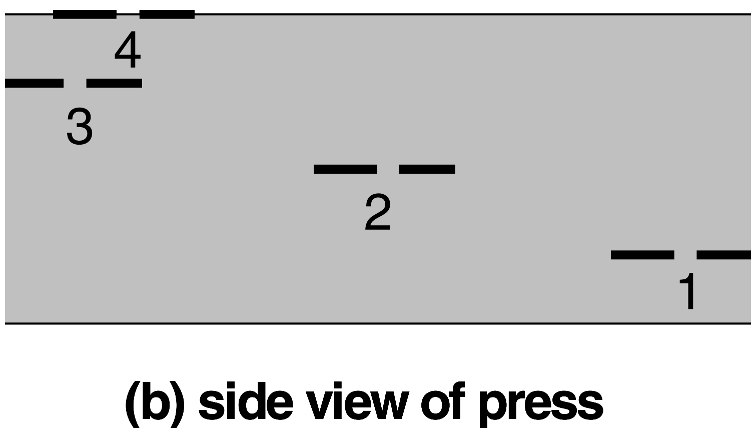


Figure 1. Location of cloth pouches containing boll weevils in bale press from (a) top view of press and (b) side view of press.

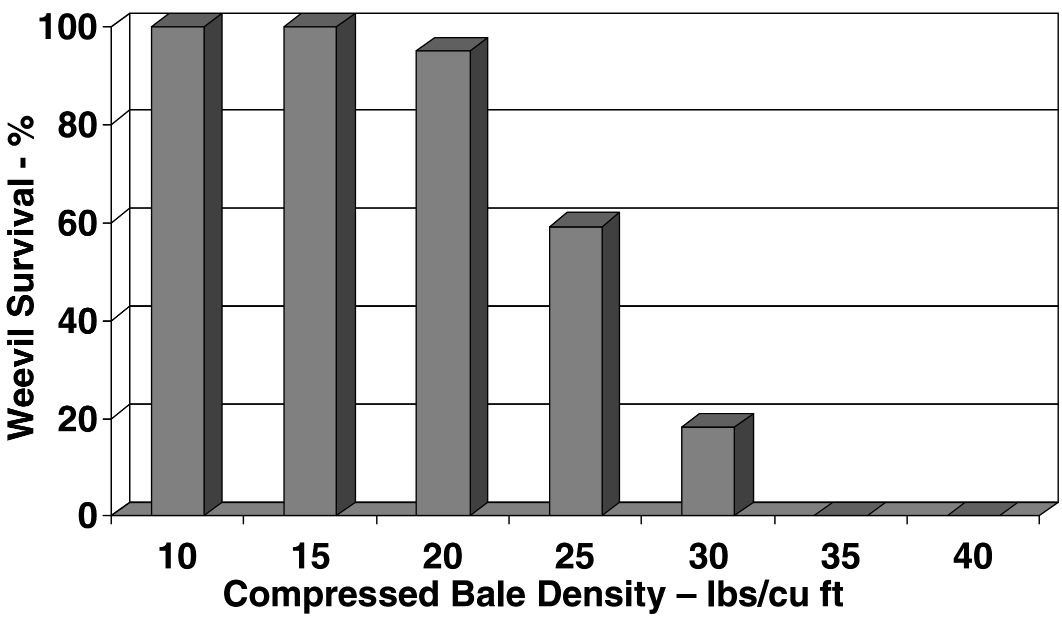


Figure 2. Boll weevil survival for cotton bale tie out densities from 10 lbs/cu ft to 40 lbs/cu ft.

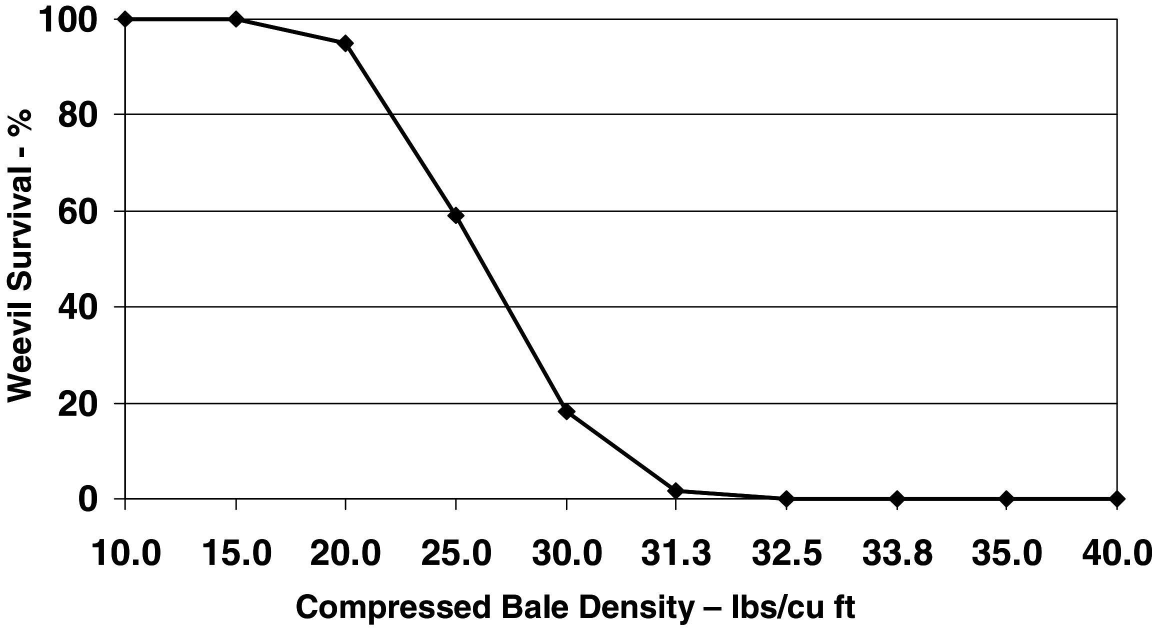


Figure 3. Boll weevil survival versus compressed bale density for all data points tested.