NOTE

An Improved Cart for Holding 32-cell Trays Used in Mass Rearing Lepidopterous Insects[1]

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J. Entomol. Sci. 34(4):479-483 (October 1999)

Key Words Form-fill-seal machine, mass rearing, *Helicoverpa, Heliothis, Spodoptera.*

Large numbers of lepidopterous insects are required for host plant resistance studies, pesticide studies, or production of microbials or parasitoids. One of the most effective high capacity techniques for mass rearing lepidopterous insects involves use of a form-fill-seal machine. A system using a form-fill-seal machine has been established for mass rearing *Helicoverpa zea* (Boddie), *Heliothis virescens* (F.), and *Spodoptera exigua* (Hübner) (Tillman et al., 1997. Form-Fill-Seal Machine for Mass Rearing Noctoid Insects. Mississippi State Univ. MAFES Tech Bull. 213. 4 pp.). This system, which has a capacity of 416 cells per minute or 24,960 per h, produces 32-cell larval rearing trays from 15.0 mil polyvinyl chloride (PVC) film. The machine can be set to produce "cuts" containing any number of sequential 32-cell trays, which must be placed on a cart for transfer to and holding in the larval rearing room.

A cart called a "rackveyor" (Fig. 1) (Griffin, 1979. U.S. Sci. Educ. Adm., Adv. Agric. Technol., South. Ser., No. 4. 3 pp.) was developed for holding boll weevil larval rearing trays. The rackveyor was later used to hold 2-tray cuts of 32-cell rearing trays for lepidopterous insects. Because the 32-cell trays do not fit in the rackveyor horizontally, the trays are held slanted 8° from the horizontal. The rackveyor is very time consuming to fabricate, and the loading and unloading process is relatively inefficient. Therefore, a cart with an improved design has been developed to support the rearing trays in a vertical position (Fig. 2). The Pink Bollworm Rearing Facility in Phoenix, AZ, also uses a cart that holds trays vertically (R. H. Edwards, pers. comm.); however, the end of the tray was designed specifically to hang from the cart. The new cart was designed to hold the 32-cell trays that have been used in rearing lepidopterous insects since 1972, first at the USDA Southern Grains Insects Research Laboratory in Tifton, GA and then at the USDA Gast Rearing Facility at Mississippi State, MS (Tillman et al., 1997).

[1]Received 02 November 1998; accepted 26 January 1999.

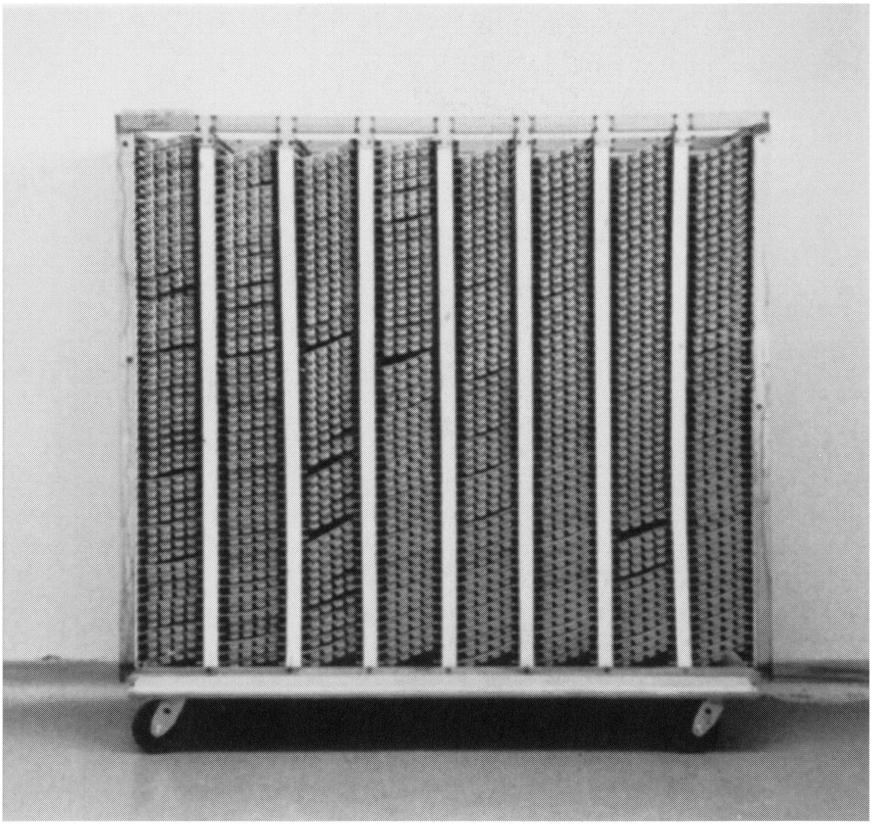

Fig. 1. Rackveyor filled with 2-tray cuts.

The cart design (Fig. 3) calls for construction of the frame from stainless steel angle, stainless steel bar, and four swivel casters. The frame is 162.56 cm long, 174 cm high (not including the casters), and 63.82 cm wide. It is constructed of 3.81 × 3.81 × 0.3175 cm stainless steel angle cut to length and welded. Stainless steel flat bar pieces, 0.4763 × 5.08 cm, are welded to the angle for structural strength. Four sections of 3.81 cm stainless steel angle are welded to the top of the stainless steel frame. The top of the cart consists of 54 sections of 4.45 × 1.91 × 0.381 cm aluminum channel, riveted to the four pieces of support angle. A 12.7 × 12.7 × 0.381 cm square of stainless steel sheet is welded to the corners of the bottom of the frame and the casters are bolted to the sheet and base angles. With this design, each of the 54 channel sections at the top of the cart holds four 6-tray cuts, yielding a total capacity of 1296 trays, compared to the 880 tray capacity of the rackveyor, a 58% improvement in floor space efficiency.

A half-width test model of the cart (Fig. 2) was constructed and tested in comparison to a rackveyor. For stability, the half-width cart was constructed with the casters on the ends, which permitted hanging 7-tray cuts. Rearing trays, from the same

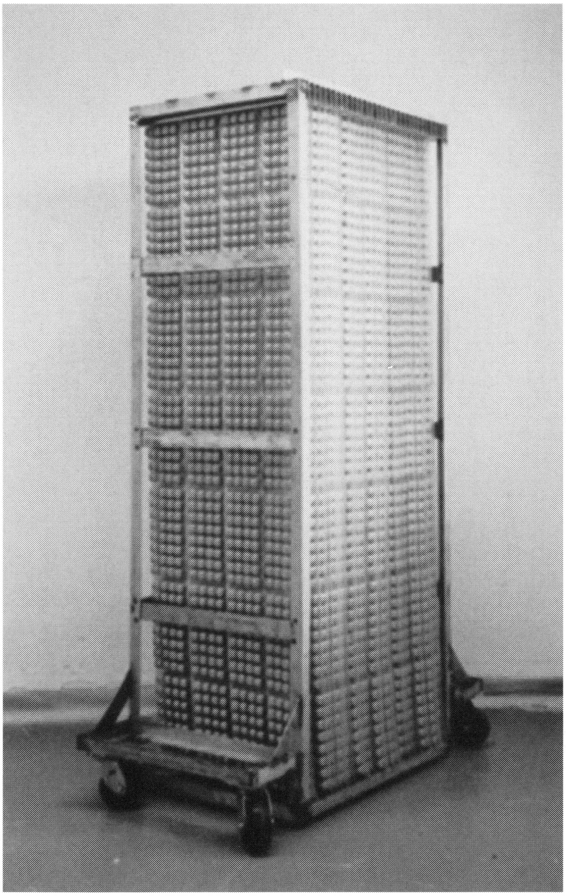

Fig. 2. View of the half-width test model of the new cart filled with 7-tray cuts.

form-fill-seal machine run with *H. virescens,* were loaded onto a rackveyor or the new cart and held in the larval rearing room at approximately 28.94°C and 29.8% RH. After 18 d of development, a sample of trays was removed from the rackveyor and the new cart. The presence or absence of a pupa in each cell was recorded, any pupa that was present was first weighed and then re-sealed in a clean cell. The trays containing the pupae were held in the larval rearing room and checked each day for adult eclosion. Statistical analyses of pupal weight and development time were performed using PROC GLM (SAS Institute Inc., 1983. SAS/STAT User's Guide, Version 6, Fourth Edition, Volumes 1 & 2, Cary, NC) and PROC MIXED (SAS Institute Inc., 1997. SAS/STAT Software: Changes and Enhancements through Release 6.12, Cary, NC).

There are several benefits to the improved design. The new cart holds 1296 rearing trays in 3.38 m^2 of floorspace, which is 58% more efficient than the 880 trays in 3.63 m^2 in the rackveyor. Thus, one of the new carts can replace 1.47 of the rackveyors, reducing the amount of larval rearing room space required for production

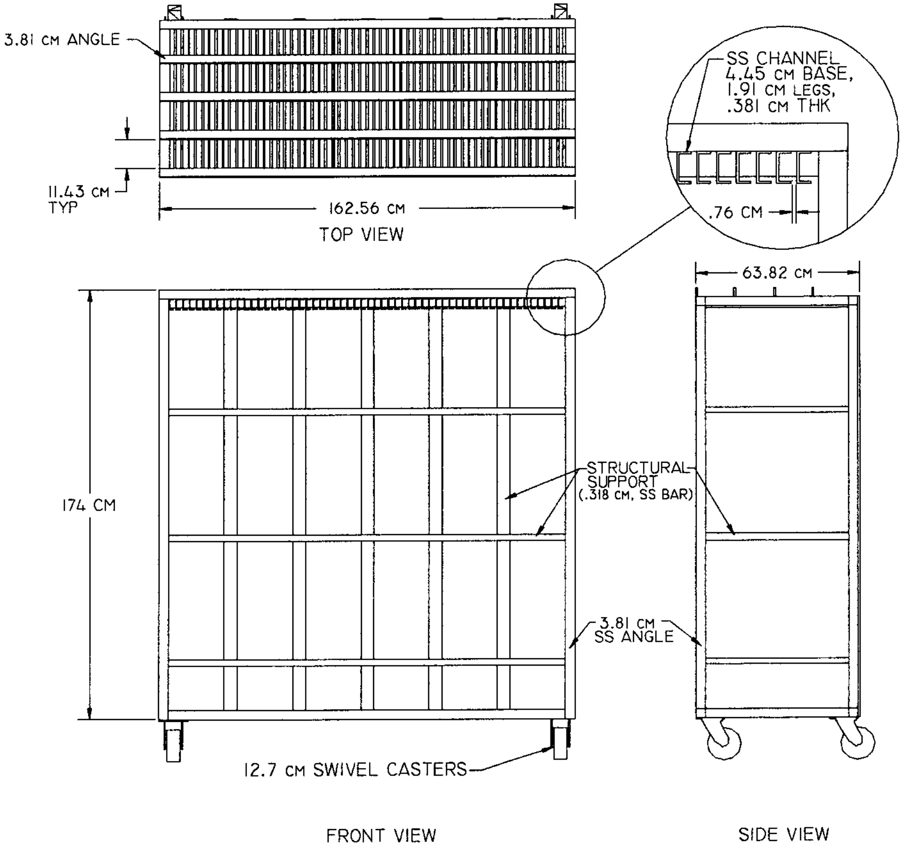

Fig. 3. Specifications for a new full-sized cart with a capacity of 1296 rearing trays.

of a given number of insects. There were no significant differences in pupal weight or development time between the two carts. Mean pupal weight was 0.279 ± 0.055 g on the old cart and 0.282 ± 0.045 g on the new cart. The mean development time on the rackveyor was 23.530 ± 1.471 d, and 23.175 ± 1.625 d on the new cart.

The clearances between trays on the rackveyor is critical to ensure that air can move through the cart to dissipate excess metabolic heat during larval development. Occasionally, there is also a buildup of condensation on trays held in the rackveyor. Because the trays hang vertically on the new cart, the spaces between the cells provide a "chimney" for best dissipation and condensation is free to drip to the floor. The new cart takes 2 man-days to construct while the rackveyor takes 5 man-days, using a purchased base unit. This results in a 60% savings in the cost of labor to fabricate the cart. The materials cost to fabricate the two carts is essentially equivalent.

The new cart is also easier to load because it requires lining up only one edge instead of two edges of the tray. The row of cells on the end of the tray slides easily

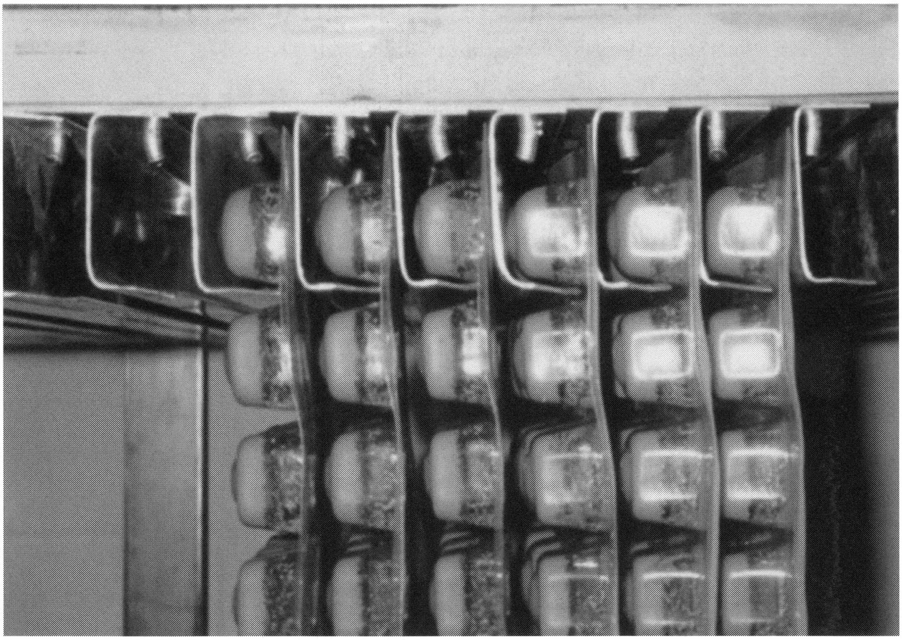

Fig. 4. Close-up of support channels holding trays vertically.

into the supporting channel at the top of the cart (Fig. 4). Hanging the trays from the top of the cart also eliminates the stooping that is required to load the bottom of the rackveyor. In addition, one six-tray cut must be loaded or unloaded as opposed to three two-tray cuts. This reduces handling by two-thirds. Six-tray cuts also facilitate the use of automated pupal harvesting equipment. In addition to all of these advantages, which can significantly increase production efficiency and reduce production costs, another possible benefit to the new cart is that the frass is allowed to fall away from the diet since the cells are hanging vertically. This may aid larval feeding due to greater accessability of the diet.

We thank D. Harsh for assistance in construction of the half-width test cart and D. Boykin for assistance with the statistical analysis. This article has been approved for publication as Journal Article No. J-9418 of the Mississippi Agricultural and Forestry Experiment Station, Mississippi State University.