# A Field-based Handling and Storage Facility for Experimental Pesticides

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**ABSTRACT**

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A pesticide handling and storage facility was constructed at the field laboratory of the Department of Botany and Plant Pathology at Michigan State University. Unique design features, including overhead ducting of storage cabinets, time clock and damper controlled ventilation, and pit disposal of rinse water, were combined to give an efficient operation at a reasonable cost. The facility was superior in eliminating objectionable odors and vapors common to old designs and in reducing exposure of workers to pesticides.

Additional key words: pesticide safety

Researchers engaged in the evaluation of pesticides are increasingly aware of the importance of adequate handling and storage facilities. As new experimental pesticides are formulated, the researcher is faced with the problem of handling and storing chemicals for which the toxicology is incomplete and the environmental impact unknown. To ensure safety of workers, who may include students inexperienced in handling chemicals, and to act in an environmentally sound manner, all pesticide researchers should have a well-designed storage facility.

In 1979, at the field laboratory of the Department of Botany and Plant Pathology on the Michigan State University campus, we designed and built a pesticide storage and handling facility out of inexpensive, locally available materials. We wanted to minimize chemical vapors and odors, limit access to experimental and restricted use chemicals, and provide a safe work area for measuring chemicals for research studies. This paper presents our attempts to resolve these problems for consideration by university, extension, and industry personnel involved in pesticide research and concerned with pesticide storage and safety.

## MATERIALS AND METHODS

A heated, cinder block storage room 7.3 m long × 4.2 m wide × 2.6 m high was modified for pesticide storage and transfer (Fig. 1). The ceiling was taped and plastered, the block walls were sealed with latex block filler and painted, and a metal, fireproof door with appropriate pesticide warning signs was installed. The floor of reinforced concrete pad construction was cleaned and painted to aid in sweeping.

Four rows of cabinets, made from 19-mm-thick exterior plywood, were constructed with the center two rows double and back-to-back. Cabinet wood was primed and painted with two coats of high-quality, interior latex paint to ease pesticide cleanup and prevent absorption of liquids that might be accidentally spilled. The doors were fitted with specially fabricated, locker-type, security rods and handles 6 mm in diameter for padlocking (Fig. 2A). Shelves were sufficiently high (0.4 m) to accommodate standard 19-L cans containing liquid pesticides; aisles were wide enough (0.94 m) to permit easy access with a handcart.

An exhaust system was installed to prevent the buildup of pesticide vapors in the room. Ducts 230 mm deep and 790 mm wide at the top of each cabinet were constructed of 6.2-mm-thick exterior plywood. Ducting around a ventilation fan and a transfer hood was fabricated from surplus, 3-mm aviation metal for added durability and rigidity. Joints and seams were taped and plastered to give a relatively airtight system.

For ventilation, four 32-mm holes were drilled in the ductwork above each cabinet and two in the back edge of each shelf. The exhaust fan pulls air from the corridors into the cabinets through a space along the bottom edge of each door, up through the holes in each shelf, and then into the ducts. All ducts are vented by a two-speed, 0.5 horsepower, 610-mm-diameter fan (W. W. Grainger Inc., Chicago, IL 60648) with a four-wing, cast, nonsparking blade. At 13 mm of static pressure, the fan is rated at 909 $m^3$ of air per minute at high speed and 546 $m^3$/min at low speed. With the ventilation fan at low speed, an open cabinet door has a face velocity of about 6 m/min. This capacity is needed to eliminate puffs of chemical dust when opening doors. A 24-hr time clock automatically starts the fan before working hours during periods of use in the spring and summer. We estimate that the storage room substantially exceeds the 10–15 air changes per hour common in many laboratories.

A surplus, stainless steel, medical transfer hood was added to the room (Fig. 2B). It was stripped of unessential materials, equipped with a scale for

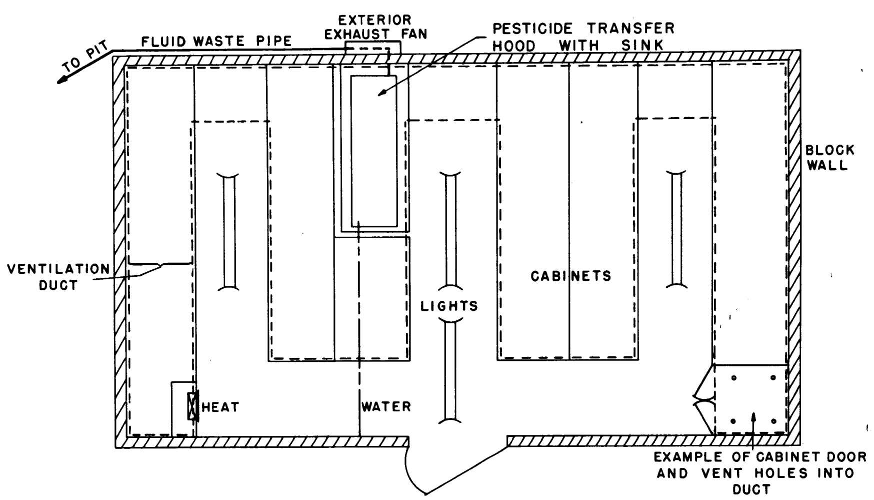


**Fig. 1.** Floor plan for a pesticide storage and transfer room measuring 7.3 m long × 4.2 m wide × 2.6 m high.

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weighing pesticides, and plumbed for water. The work surface was slanted for drainage. The drain was connected to a 104-mm plastic pipe that conducts the fluid wastes underground to a clay-lined pit. A ventilation damper motor (Minneapolis Honeywell Regulator Co., Wabash, IN 46992) was wired to open the vent and exhaust hood automatically when the lights for the hood are switched on. At low speed, the fan gives an average transfer hood face velocity of 20 m/min. At this velocity the vapors and dust particles suspended in the air are exhausted, but the air movement does not interfere with the weighing. Respirators, goggles, disposable vinyl gloves, coveralls, boots, and sawdust for liquid spills are readily available to hood users in a separate, designated cabinet.

Aisles between cabinets are lighted by a four-tube, 1.2-m-long fluorescent fixture; two fixtures are used above the hood. Illumination near the hood is about 1.1 klux and in the aisles about 0.7 klux. The lighting, which was designed to exceed standards for most conventional office areas, was improved by painting the walls, cabinets, and floor with light, bright, oil-base enamel paints.

The chemical rinse pit (Fig. 2C), a modification of one designed by Iowa State University (6), is 4.7 m long × 2.7 m wide × 2.4 m deep. The walls and bottom are clay lined; the center is gravel filled, and it is surrounded by a concrete berm 120 mm wide and 380 mm deep. Field sprayers are rinsed over the pit, and washings from the transfer hood are piped into it. In each case, only small quantities of dilute pesticides are involved. Unused, undiluted pesticides are returned to the manufacturer if they are in the original container, or they are sent to a commercial pesticide disposal firm.

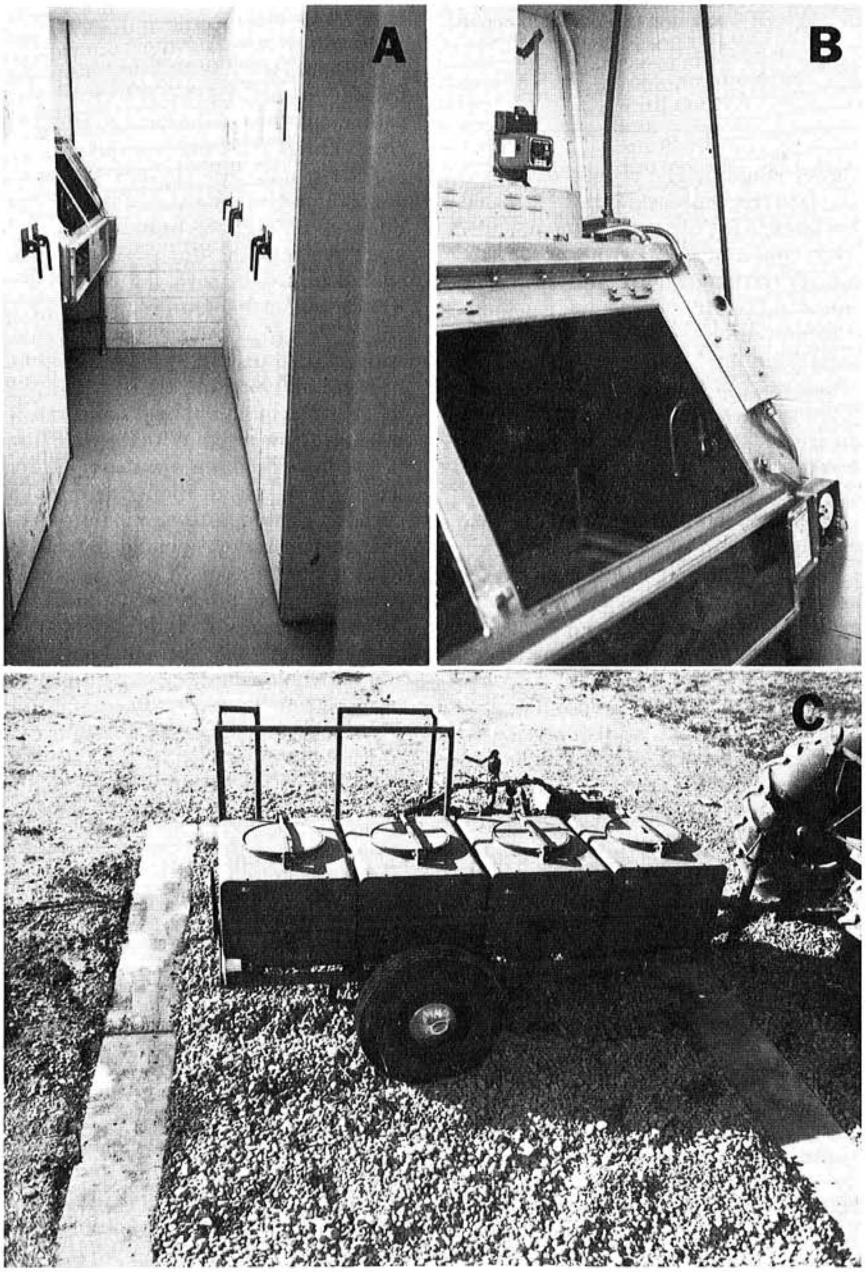


**Fig. 2.** Facility for handling and storing pesticides: **(A)** Center aisle of the storage room, showing cabinet arrangement with locking handles and transfer hood and sink in the far left corner. **(B)** Chemical transfer hood with time clock at lower right (with the cover opened) and damper motor control at upper left for opening and closing the hood vent. **(C)** Gravel-filled, clay-lined, chemical rinse pit measuring 4.7 m long × 2.7 m wide × 2.4 m deep. The concrete berm is 120 mm wide and 380 mm deep.

## RESULTS AND DISCUSSION

A combination of features makes our facility an effective unit for working with pesticides. Painting the storage area with bright, reflective colors and providing lighting at an intensity comparable or superior to that in most laboratories have permitted easy discovery of spills by eliminating dark corners. The facility is heated in inclement weather by a forced-air unit located elsewhere in the building, not only improving worker comfort but preventing liquid formulations from freezing in winter.

Using a time-clock controlled fan with damper controls to maintain a negative pressure on the storage cabinets has eliminated complaints of odors and tainted clothes common to older facilities. A ventilation system with a reserve capacity (high speed) for rapid air evacuation gives a margin of safety in case of emergency spills. The stainless steel hood with the sink has been invaluable as a convenient place to measure small quantities of diverse pesticides from commercial-sized containers accurately without cross-contamination. Flushing spilled chemicals from the hood work surface to the gravel-filled, clay-lined rinse pit has made cleanup easier while limiting the exposure of workers to pesticides. Finally, well-designed latches for the doors permit the locking of cabinets with restricted use pesticides.

In planning this experimental handling and storage system, we tried to anticipate the needs of a typical pesticide researcher and to keep construction costs low. Because surplus or recycled materials were used wherever possible, we were able to attain a shelf capacity of about 75 $m^2$ at a materials cost of about \$29/$m^2$. Seven faculty members now use this facility for storing experimental fungicides and common insecticides and herbicides needed to maintain their experimental plots.

Our rinse pit has been free of any functional problems during 2 yr of use. We recognize that flooding problems could result from large amounts of rainfall and that seepage might occur through the clay walls. The degradation pit was designed solely for limited quantities of diluted pesticides, and it is not intended to receive large amounts of concentrated materials. For commercial and large volume disposal, we suggest that the pit be lined with concrete or hypalon and that it have a rain cover (4).

In selecting ventilation equipment, we chose a propeller-type fan that was cost-effective for moving a predetermined volume of air, even though a centrifugal blower with a high-efficiency dust filter would be more ideal. In making this decision, we carefully considered the facts that most research materials are in gram or milliliter quantities and that any externally vented dusts or vapors will be diluted to trace amounts in the environment, particularly when compared with actual field-trial applications.

Ideally, every pesticide researcher should have storage facilities of a responsible design. We believe that we have such a design and have described the system in hopes of contributing toward a sensible, attainable margin of environmental and worker safety in an area where specific information is lacking. Our design is an effort to combine the best handling, storage, and disposal techniques into a complete system for field research. Components of the system could also be used to improve farm storage and handling of pesticides. This system is a unit that can be further elaborated and refined as technology and regulations evolve. Of course, the design of any new research facility should be in compliance with applicable local, state, and federal guidelines (1,2,3,5).


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