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Auger-Applicator for Applying Small Amounts of Granular Pesticides[1]

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ABSTRACT The design and construction of an auger-applicator for applying small quantities of granular pesticides for control of red imported fire ants is described. The basic metering device is a modified ship auger bit that fits inside a stainless-steel tube and is driven by a variable-speed electric motor. The applicator can be mounted on a tractor, jeep, or truck and will apply a variety of granular formulations at low application rates in the range from 0.84 to 5.6 kg/ha (0.75 to 5 lb/acre) very accurately.

In our research with several insect species, including imported fire ants, mosquitoes, and ticks, there often was a need for equipment to apply granular insecticides at very low rates, e.g., <5.6 kg/ha (<5 lb/acre). We have searched for commercially available systems to adapt to our needs, but although several types of commercial equipment are available, such as Gandy, Cyclone, Horn Seed Sower, and Skibbe, most are either hand operated or their metering devices are not sensitive enough to consistently apply very low application rates. A review of the published literature on application equipment designed for research purposes has not been helpful either. Lovely et al. (1956) conducted tests with several metering mechanisms for applying granular insecticides for control of the European corn borer. One of these devices used an auger feed mounted in the bottom of a conventional dust hopper; however, the application rate used was 22.4 kg/ha (20 lb/acre). Danielson and Chambers (1957) described a herbicide applicator that used an auger in the bottom of a trough-type hopper which dispersed clay granules in 182.88-cm (6-ft)-wide bands at 44.8+ kg/ha (40+ lb/acre). This unit could be adjusted only by changing the size of the sprockets, and therefore, application rate depended on the ratio of the sprocket on the drive wheel to the one on the auger. Abrahamson et al. (1973) used a modified Gandy insecticide dispenser to apply granular systemic insecticides in the soil in cottonwood nurseries and plantations, but again, the application rates ranged from 5.6 to 134.4 kg/ha (5 to 120 lb/acre).

Because of our need for low application rates in evaluating granular toxic baits against the red imported fire ant, *Solenopsis invicta* Buren, and lack of success in modifying commercial equipment, we designed and report here an applicator to meet these specific needs. The auger applicator can be mounted on a tractor, jeep, or truck and will apply a variety of granular formulations at low application rates in the range from 0.84 to 5.6 kg/ha (0.75 to 5 lb/acre) accurately.

Description of Granular Applicator

The applicator (Fig. 1) is (A) an auger conveyor or metering device consisting of a modified ship auger bit 43.18 cm long and 2.86 cm in diameter (ca. 17 in. long, 1⅛ in. in diameter) ship auger bit placed inside a stainless-steel tube. Some modifications of the original auger bit were necessary. First, because it was tapered, it had to be ground to a uniform diameter on a lathe. Second, to give the correct rotation to move the granules forward (counterclockwise), the original shaft was cut off and a new, longer shaft was welded on the opposite end. In operation, the auger conveyor is rotated and regulated by (B) a ⅓-hp (ca. 249-W) 115 VAC electric motor and variable speed gear drive. This power source was used in our prototype because of the extremely accurate rates required in our research. (C) A 0.021-m^3 (6-gal) funnel type hopper (FMC Corp., Atlanta, Ga.) is situated above

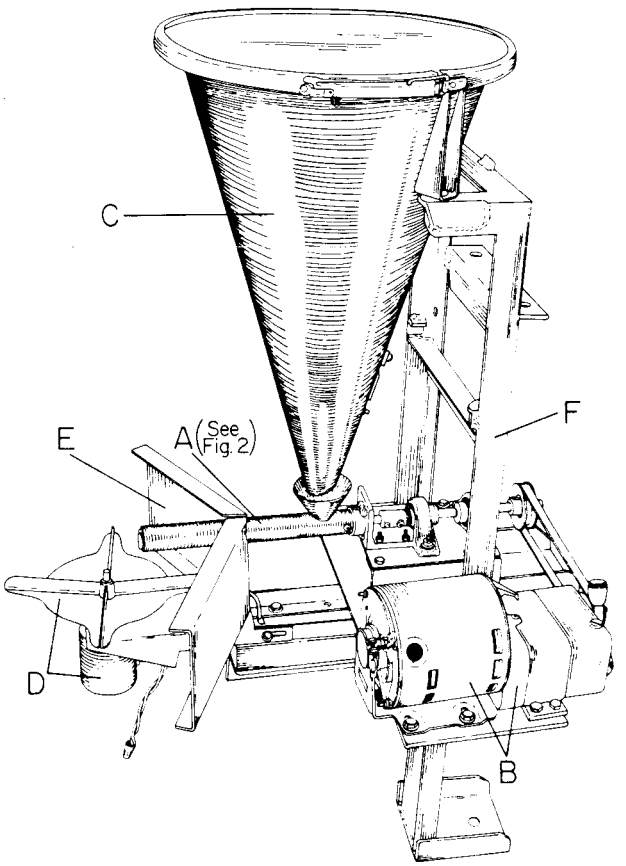

FIG. 1.—Granular applicator used for applying bait toxicants to control red imported fire ants: (A) auger conveyor; (B) ⅓-hp electric motor and gear drive; (C) hopper; (D) electric motor and spreader; (E) bait deflector; (F) support frame.

[1]This paper reflects the results of research only. Mention of a commercial or proprietary product does not constitute a recommendation or endorsement by the USDA. Received for publication 11 December 1981.

a smaller funnel that is welded to, and empties into, the auger conveyor tube. The granular material flows out of the hopper and into the smaller funnel by gravity feed. (Separation of the hopper and auger tube facilitates cleaning and servicing of the apparatus.) The auger conveys and meters the granules out of the end of the steel tube where they fall on (D) a stainless-steel spreading spinner (Cyclone model M3B 4OOR electric spreader, the Cyclone Seeder Co., Inc., Urbana, Ind.), which disperses the granular material in a fanlike pattern from 2.44 to 9.14 m (8- to 30-ft swath) behind the moving vehicle. (E) An aluminum deflector 2.86 cm (ca. 1.3 in.) in diameter prevents the bait from being thrown on the back of the vehicle. (F) The supporting frame consists of 0.159-cm (ca. 0.06-in.) angle iron and steel plates 0.64 cm (0.25 in.) thick.

Figure 2 shows the auger conveyor in an exploded view; it consists of (A) the stainless-steel housing tube, 2.86 cm (ca. 1.3 in.) ID, containing the auger, 2.86 cm (ca. 1.3 in.) OD. The clearance between the housing tube and auger is 0.00127 cm (0.0005 in.). (C) The two 0.64-cm (0.25-in.) steel plates offer support for the auger housing tube and (D) 2 ball bearing pillow blocks with 1.27-cm (0.5-in.) bores. These in turn support (E) the extended 1.27-cm (0.5-in.) steel auger shaft which has (F) a 6.35-cm (2.5-in.) pulley attached to its distal end. A drive belt (no. 2250) connects this pully to the power source (gear drive of the electric motor). The motor (model no. M3) and gear drive (model no. JK 3) were purchased from Zero Max Co., Minneapolis, Minn. The speed adjustment handle located on the gear drive yields a speed range of 0 to 400 rpm and is used to adjust the speed of the auger and thus to calibrate the output (flow) of material.

The overall size of the entire unit is 60.9 cm (24 in.) wide, 121.92 cm (48 in.) high, and 76.2 cm (30 in.) thick. In operation, the unit, weighing 31.75 kg (70 lb), is mounted on the back of a tractor. A gasoline-powered generator is mounted on the front of the tractor to furnish the 115 VAC needed to power the ⅓-hp electric motor. The 12 VDC motor for the cyclone spreader is activated by the tractor's electrical system.

Another unit was built which was slightly smaller in size, 50.8 by 55.88 by 66.04 cm high (20 by 22 by 26 in. high), more compact, and weighed 22.68 kg (50 lb). This unit was very similar to the model shown in Fig. 2, except that it uses a 12 VDC electric motor as the power source and a variable rheostat for adjusting motor speed and the flow rate. It is energized by the 12 VDC electrical systems used on tractors, trucks, and jeeps. It also uses a larger auger conveyor 3.81 cm (1.5 in.) in diameter and thus is able to apply higher application rates.

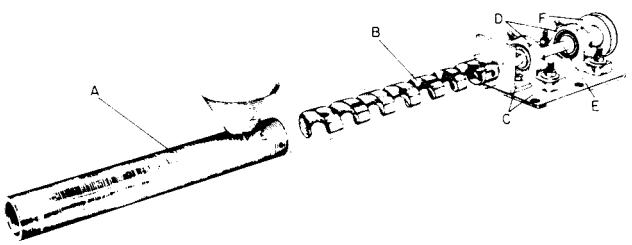

FIG. 2.—Auger conveyor for metering granular baits: (A) auger housing tube with funnel; (B) auger; (C) support plates; (D) pillow block bearings; (E) shaft; (F) pulley.

Operational Results and Discussion

Numerous field tests have been conducted using the granular applicator (Williams and Lofgren 1981, Lofgren and Williams 1982). The following granular carriers have been tested or applied: pregel defatted and pregel degermed corn grits (Lauhoff Grain Co., Danville, Ill.); several corn cob grits products (The Andersons, Maumee, Ohio); puffed corn (The Quaker Oats Co., Chicago, Ill.); and citrus pulp. Table 1 shows differences between expected and actual application rates in a number of field tests with the pregel defatted corn grit carrier. The small SD, 0.03 to 0.07, illustrates the accuracy obtained with this applicator.

A greater working range and, thus, diversity of the applicator can be obtained with the auger unit by adjusting the speed of the tractor, the swath width, and the output (rpm) of the auger. Also, the auger conveyor can be removed easily for cleaning, servicing, and, if necessary, replacement with a larger-diameter auger unit for higher application rates. We believe it could be adapted for use in a variety of research and applied situations which require accurate, low rates of application of granular materials. We have not tested any of the clay granules that are used in many pesticide formulations; however, we believe they could be applied, although some modifications may be required to compensate for their greater abrasiveness. Also, we have not conducted extensive studies of the uniformity of lateral distribution of the granules, since we have worked only with baits for which the worker ants forage. This factor would have to be evaluated if uniformity of dispersal is critical.

Alternate power sources can be used with some slight modification. A small, two-cycle gasoline engine attached to a gear drive could furnish sufficient power to operate the equipment. Also, power takeoffs on tractors and some jeeps could be used as long as a gear reduction box or system of pulleys was available for different speed adjustments. Calibration could then be accomplished by

Table 1.—Weight differences between expected and actual application rates of pregel defatted corn grit carrier toxic baits containing 30% soybean oil

Application rates kg/ha (lbs/acre)		SD	No. of tests[a]
Expected	Actual (mean)		
0.84 (0.75)	0.86 (0.77)	0.03	4
1.12 (1.0)	1.29 (1.15)	0.07	5
1.68 (1.5)	1.80 (1.61)	0.08	5
2.24 (2.0)	2.33 (2.08)	0.06	7
2.80 (2.5)	2.74 (2.45)	0.04	4
5.80 (5.0)	5.63 (5.03)	0.06	4

[a]Tests consisted of evaluations of several toxicants against natural populations of red imported fire ants in north Florida and south Georgia.

setting the speed of the auger and adjusting the speed of the vehicle or swath width.

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