R. A. KEPNER AND W. E. HOWARD

Mechanical

Gopher-bait Applicator

for pastures and open fields

Preliminary field trials with a mechanical bait applicator indicate definite possibilities for a new method of controlling pocket gophers.

The objective in developing a field treatment with a mechanical bait applicator was to eliminate most of the gophers in an infested field by a quick, once-over operation. When gophers become abundant, especially in alfalfa, irrigated pastures and some rangelands, trapping and poisoning by hand are time-consuming, costly, and often not successful.

The mechanical gopher-bait applicator makes an artificial burrow at depths of 7″–11″ below the soil surface and meters poisoned grain into the burrow. By making artificial burrows across a field at regular intervals of from 15′ to 30′ and at the proper depth, enough of the natural burrows will be intercepted to give access to the poisoned bait. The gopher's aggressiveness and natural curiosity prompt him to investigate the new burrow.

The mechanical bait applicator has been field tested only six times in five counties of California, using several different mixtures of poisoned grain at application rates ranging from 1¼ pounds to over four pounds per 1,000′ of burrow.

In most cases where the artificial burrow spacing was 20′–60′, counts of remaining active burrow systems indicated kills of 50%–75%. In one heavily infested 10-acre field in Tulare County, the mechanical treatment resulted in almost complete control for six months, then a gradual reinfestation from surrounding areas began.

Experiments in Colorado with a similar machine gave 85%–100% control of the Colorado plains gopher and mountain gopher.

The California bait applicator has a burrow-forming shank; a rolling coulter, to cut surface trash and shallow roots ahead of the shank; a bait-metering device; a presswheel, to drive the metering unit and push the top layers of disturbed soil partially back into place; and a support frame. The bait is delivered to the burrow through a tube built into the rear portion of the burrow-forming shank.

The applicator is designed for mounting on a 2–3 plow tractor with a conventional three-point hitch. The two lower links of the hitch must converge horizontally toward the front of the tractor and be free to swing laterally within the limits of the restraining chains. This permits the shank to follow the tractor on moderate turns without excessive side thrust.

The penetrating ability of the shank is influenced by the type and pitch of the shank and point, the relative heights of the attachment pins for the hitch links,

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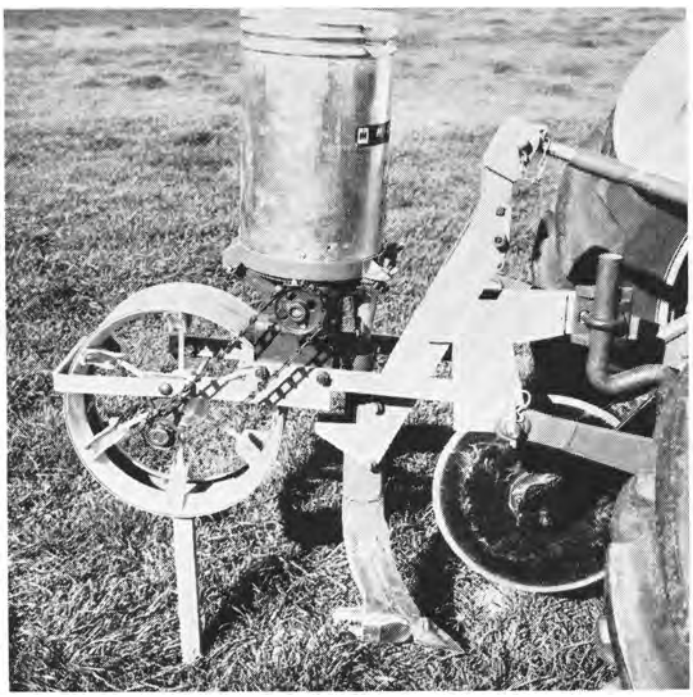
***Left.* The mechanical gopher-bait applicator. The presswheel is blocked up to show normal height relations for a burrow depth of about 10″. *Right.* A dug-away view showing the rolling coulter, the burrow former, and the burrow of about 2¼″ in diameter. Wheat bait is visible behind the shank.**



MEASUREMENT

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desired pressures are observed using a mercury U-tube and a meter stick calibrated in millimeters.

The pressure-membrane unit—the high pressure system—was constructed so control valves would allow the operator complete freedom to direct air from any pair of regulators to any or all of the pressure-membrane units at three separate pressure ranges.

Air pressure for both units of the pressure panel is supplied by a two-stage compressor with a capacity of 300 pounds per square inch working pressure. A maximum pressure of 30 pounds per square inch is required for the porous-plate unit and a maximum pressure of 217 pounds per square inch—equivalent to 15 bars—is required for the cellulose membrane unit.

A graph plotted from typical soil-moisture suction curves for four different soils demonstrated the effect of particle size on the soil moisture characteristics. The greater the number of small particles such as in clay loam, the greater the quantity of water that can be stored and be available for plant growth.

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the coulter diameter and sharpness, the weight of the unit, and soil conditions.

In development tests, the greatest improvement in soil penetration resulted from lowering the rear attachment point of the upper link to make this link about parallel with the lower links. This adjustment reduces the upward pull on the shank. Raising the lower-link attachment pins on the tool frame also improved penetration, but the amount that these hitch points can be raised is limited by the amount of ground clearance needed when the tool is fully raised.

Rolling coulters must be forced into the ground. In tests in an old pasture with moist soil and fairly heavy sod, the total downward force required for 5″ penetration was 380 pounds for an 18″ coulter but only 220 pounds for a 16″ coulter. The 16″ size is adequate for the mechanical gopher.

Objectives in the development of the burrow-forming shank included penetrating ability, obtaining a clean burrow, effective closure of the slot above the burrow, shedding trash, and minimizing soil heaving and surface disturbance. Replaceable spear points used on three of the tested shanks gave good penetrating ability with less soil heaving and surface disturbance than other points tried.

The current model shank is curved forward so roots collected below the coulter level tend to slide upward to the surface and usually fall off during operation or when the tool is raised. This shank has an over-all body thickness of 5/8″ and was built up by adding a bait passage and burrow-forming side pieces to a commercially available spear-point cultivator shank. A deflector at the lower end of the bait tube discharges the poisoned bait rearward about 3/4″ above the bottom of the burrow, thus leaving the bait on top of any cave-in dirt.

The bait-metering device on the applicator shown in the lower left photograph is the conventional plate-type seed hopper with corn base. The 16″ presswheel and the drive components are from a McCormick No. 184 tool-bar-type planter. A flat rim was clamped around the presswheel. A 5/16″ seed plate with 12 round-hole cells 5/8″ in diameter is suitable for applying grain baits at rates of 2–4 pounds of grain per 1,000′ of burrow. Application rates can be adjusted by changing the speed ratio between the presswheel and the plate.

To obtain good burrows the soil must be moist but not sticky—in good plowing condition—and must be reasonably firm. The operating depth should be adjusted so the artificial burrows will intercept a maximum number of gopher burrows. Careful alignment of the coulter blade with the shank minimizes disturbance of surface soil.

Although a shear bolt protects against damage if the shank hits an obstruction, forward speeds should not exceed 3½–4 miles per hour and should be slower where there is an obstruction hazard. At 3½ miles per hour and with burrows 20′ apart, 6–7 acres per hour can be treated.

Total construction and assembly time in a well equipped shop should be 25–30 hours. The costs for all construction materials and purchased parts or assemblies, including an adjustable upper link for the three-point hitch, the presswheel, seed hopper and drive assembly, and the rolling coulter, total approximately $130.

Although the preliminary field trials indicate definite possibilities for the mechanical bait applicator in the control of pocket gophers, many more tests are needed to determine the most acceptable bait, the best amount to use, and the most efficient spacing of the artificial burrows under various field and gopher-population conditions in California.

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Additional field trials with mechanical bait applicators are planned by many California County Farm Advisors.

Detailed construction plans for a mechanical gopher-bait applicator and operating instructions may be obtained without cost from the Department of Agricultural Engineering, University of California, Davis.

The mechanical baiting experiments in Colorado are reported in Special Scientific Report: Wildlife No. 47, 1960, *by A. L. Ward and R. M. Hansen, U. S. Department of Interior, Fish and Wildlife Service, Washington 25, D. C.*

FALLOUT DEBRIS

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duced to about one fifth the amount of strontium90 taken up by plants from acidic soils. Added calcium did not significantly reduce strontium90 uptake from neutral soils of high calcium status or from alkaline-calcareous soils. Crops grown on soils of high calcium status take up only about one tenth the amounts of strontium90 taken up from soils of low calcium status.

The addition of stable strontium amendments to soils at levels compatible for normal plant growth did not effectively reduce strontium90 uptake. There was reduced crop uptake of strontium90, ruthenium106, and cerium144 when high concentrations of bicarbonate were present, as is usual in alkaline and calcareous soils.

The extent to which strontium90 accumulates in the human body through the soil-plant-animal-human food chain apparently depends on the dietary calcium accumulation, because calcium tends to dilute the strontium90 concentrations.

Cesium137

Cesium and potassium also showed complementary ion relationships. Crop uptake of cesium137 increased as the potassium level in the soil was reduced by cropping. The addition of potassium amendments reduced plant uptake of cesium137 from soils low in exchange-