Machinery for Soil Drainage

comparative analyses made of production volumes of various earthmoving machinery used for preparing land for drainage

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**Production rates**—affecting hourly costs—of earthmoving equipment vary with a given piece of work and the type of machine used.

A machine handled by a skilled operator can operate continuously—if there are no delays—for a period of four hours. However, delays or breakdowns can reduce actual productive time, on a seasonal or annual basis, to about 35% or 20 minutes in every hour. The working season varies with geographic location, but should average about 250 working days per season.

To determine a per hour cost figure for excavation machinery the owner must allot 30% for the capital investment, interest, insurance and taxes on the machine; 10% for transport of the machine to the work site; 15% for repairs, maintenance and fuel, oil and grease; 40% for labor costs; and 5% for general management overhead.

**Trenchers**

Two types of trenchers—wheel, and ladder—are used in excavating for underground tile construction. Wheel trenchers have a maximum digging depth of 5½' and ladder trenchers have a maximum digging depth of 9' or more, depending on the boom length. Averaged figures show that wheel trenchers—because of simple, rugged design—have almost twice the digging speed of ladder trenchers.

Trenchers, when excavating only, have a production rate far in excess of the speed of a normal tile or pipe laying crew. Where the work is being integrated with tile laying—to use the minimum length of opened ditch—production rates are restricted severely. Limited experience with drain tile laying crews shows that for average California soil conditions production rates of a wheel trencher—for laid and backfilled tile—should be 2,000' at a 3½-5' depth in an eight-hour day. A ladder trencher should do 1,000' at a depth of 6'-9' in eight hours. These figures represent actual outputs, including short moves for location, and servicing of the machines, but without major breakdowns, or delays due to obstructions or hard digging. A typical tile-laying crew consists of the trencher operator, two tile layers, one handyman, one bulldozer operator for backfilling and one field supervisor.

**Shovels and Backhoes**

Two types of machine shovels are used for general earth excavation. Each type has exact control of the bucket, but one—the ordinary machine shovel—can not excavate far below its track level and works on the ditch banks from the bottom of the ditch. The second type is the backhoe—a machine shovel with reverse action—which can excavate below its track level and work on the ditch banks from above. Production rates of both types of excavators are dependent on bucket size and should be the same with the same size of bucket.

The eight-hour production volume—in cubic yards for both types of shovels—should be 227 with a 3½-yard shovel, 440 with a ¾-yard shovel and 547 with a 1-yard shovel in moist loam or sandy clay. In sand and gravel the rates should be 214, 414, and 533. In good, common earth, the ¾-yard bucket should do 187, the ¾-yard, 360 and the 1-yard bucket, 466. In hard or tough—or both—clay (dragline excavating a drainage ditch)

**Draglines**

The dragline—another type of excavator—has a cable-controlled bucket and works best in loose material. The dragline can work above or below track level and is a good machine for trimming. Like the power shovels, production rates are controlled by the size of the bucket.

At the 35% efficiency level the eight-hour production volume for a dragline during primary excavation in moist loam or sandy clay should be 187 cubic yards with a ¾-yard bucket, 346 with a ¾-yard bucket and 467 with a 1-yard bucket. In sand and gravel, rates should be 173, 334, and 414 for the three sizes of shovels. In good, common earth the buckets should move 147, 250, and 360 cubic yards. Again the rates would drop in hard or tough clay to 93 cubic yards, 240, and 293. In wet and sticky clay, the ¾-yard bucket should move 53 cubic yards; the ¾-yard, 147; and the 1-yard bucket, 200 cubic yards.

**Bulldozers**

Bulldozers are short distance earth-moving tractors equipped with push or pull types of blades. The blades vary in shape and size, so production varies also. The use of bulldozers for multipurpose work in general construction limits the measurement of their earthmoving capacity because they usually work in shuttle service for a maximum efficient load-carry of about 200'. Their versatility—especially in the hands of a highly skilled operator—is fabulous. On some jobs a pull-type of bulldozer blade is carried by lengthened arms on the front of the tractors. The lengthened

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lateral buds grew sooner and more rapidly than those close to the tip. In some cases the apical bud was inhibited for several weeks after the lateral buds started growth.

Stem terminals of certain plants may abscise with even moderate concentrations of MH but such abscission is not serious. The young terminal leaves of some plants have poor color and may be unsightly if they remain on the plant for the period of the inhibition. Young terminals of Pyracantha and other plants that do not abscise may not develop good green color until after the MH effect has been dissipated.

Nondamaging concentrations of MH did not appear to suppress the development of blossoms of those plants investigated but some distortion of leaves and blossoms has been reported on chrysanthemum.

Several resprays have not shown adverse effects on lemons, ivy and Star Jasmine.

The Chinese Juniper—Juniperus chinensis variety mas or variety joemina—normally produces a small amount of needle-like juvenile type foliage on some parts of the plant, but after being sprayed with 0.20% MH as MH-30 it produced the juvenile type foliage on all parts of the plant. That effect lasted for more than a year before the mature, scale-like foliage has been reported on chrysanthemum.

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