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THE POSI-FLOW PLANTING SYSTEM FOR PLASTIC MULCH

by

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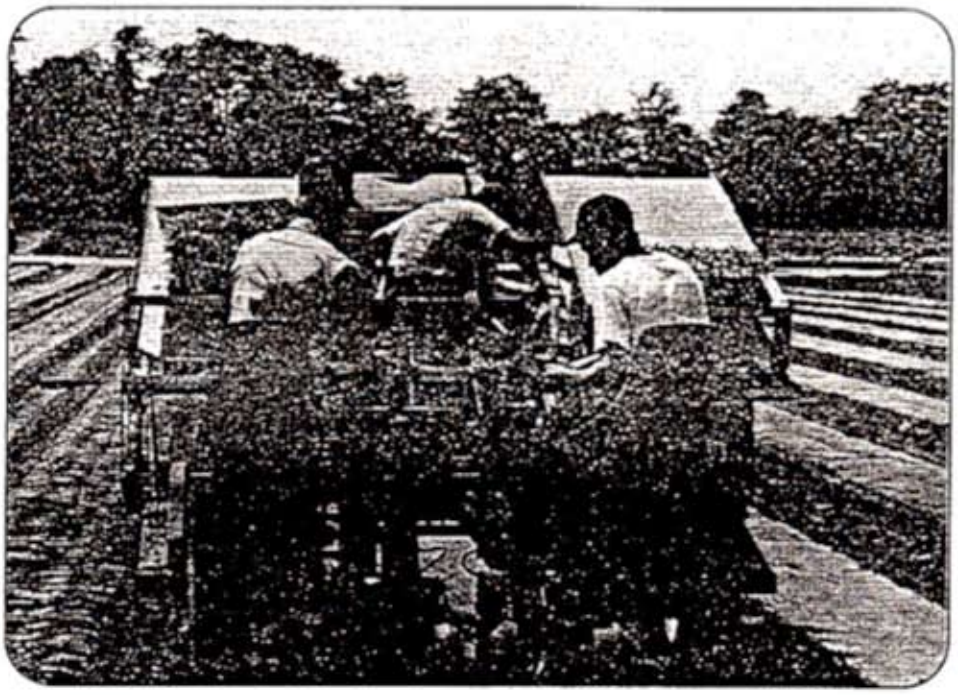
SUMMARY:

Posi-Flow® has been in commercial use for the past four years, and has proven to work in a wide range of growing environments. It has the ability to overcome less than ideal conditions, and shows to be very effective when a second, or even third cropping is desired. With modular accessories such as a propane burner, water injector, and fertilizer injector the Posi-Flow® planting system can be customized to suit the needs of the individual grower. This paper discusses theory of operation, achieved results, advantages over past methods, and system limitations.



Posi-Flow transplanter in use under commercial growing conditions.

I. RE-INVENTING THE WHEEL

Eluding agricultural engineers has been the design of a practical system for transplanting through plastic mulch. To punch and place a seedling through plastic (as opposed to bare ground) requires a completely different approach.

Even in this modern age, the most commonly accepted method is a slow and tedious process that utilizes a wheel-type device; a series of points spaced around the circumference of a steel wheel. These points penetrate the bed, ripping through the plastic, leaving behind an empty plug for laborers to manually insert the seedling into the ground while moving at less than 1/2 mph. This method tends to be inconsistent, and requires additional people (one per row) following behind the unit to pack each plant into the bed, and to fill skipped plugs.

Spade planters (for seed) and cup planters (for seedlings) have been two of the more serious attempts to semi-automate the entire process of transplanting under plastic mulch. Both have had varying degrees of success. However, they also have some very definite drawbacks.

Again, a series of cups mounted around the circumference of a wheel aides in the process of plant setting. Problems occur with the cups because of the large number of moving parts in close proximity to the soil, resulting in a shorter operational life. In-row plant spacing is also difficult to change because the cups are fixed in position around the wheel. Because of the nature of its design, this system also lacks the ability to perform more than one operation without adding complicated mechanical devices before or after the planting wheel.

II. A SINGLE INJECTOR

Figure 2-1: GVB-520 Precision Pneumatic Metered Seed Planter. One row unit.

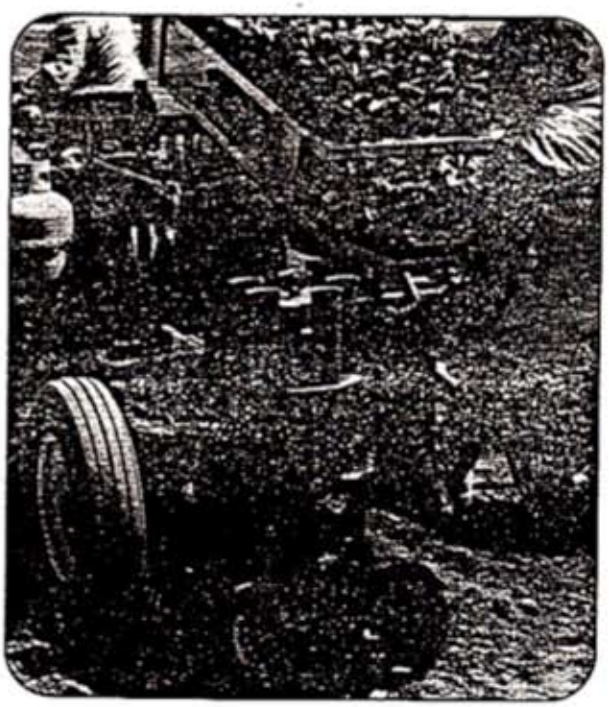


Figure 2-2: RTM-1100 Semi-Automatic Transplanter. One Row Unit

By contrast, the Posi-Flow® system is unique. It is designed around a single injector which does all the planting. It can be configured to work as a seed planter, or transplanter as shown in Figures 2-1 & 2-2. The ground engaging portion of the planting head, a patented injector assembly follows a rotating motion in relationship to the ground. In the rearward portion of the stroke, the injector makes contact with the ground and places the material at the desired depth. After it is released into the ground, the injector reverses its direction and jumps forward for the next penetration, while at the same time being reloaded with a new seed or transplant.

Figure 2-3 shows an inherent feature of this system in its ability to perform multiple tasks in progressive sequences, using the same ground engaging system. During operation, all three of these functions are being performed in the ground-engaging portion of the cycle, at three separate locations. These optional accessories can be added or subtracted without any additional mechanical components.

The Posi-Flow® planting system was designed as a modular system with the ground-engaging mechanism at its center which makes use of accessories to accommodate the many different growing regions. Changing in-row spacing from 8" to 24" is a fairly simple adjustment of off-sets on the cam & crank, and a drive sprocket change. The injector assembly utilizes space age materials which will endure the hardships of high cycle speed and abrasive conditions.

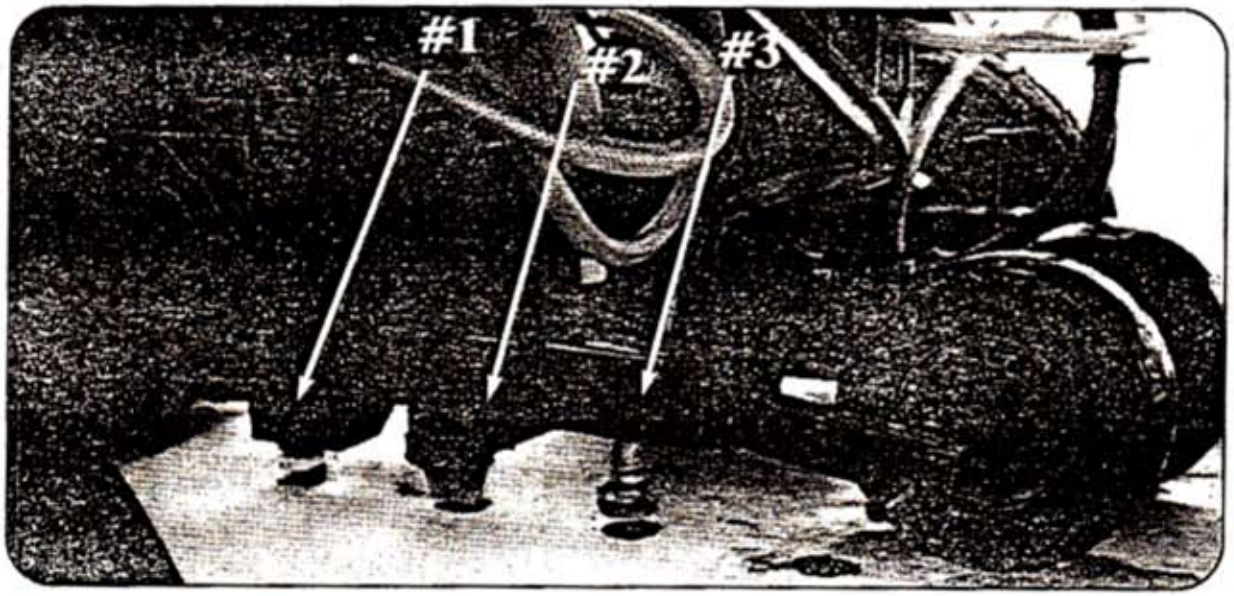


Figure 2-3: Three operations at once.1) The propane fueled burner melts a round hole in the plastic.2) The planting material is then injected into the ground through this hole.3) Water, or liquid fertilizer is then applied to each cell.

III. SEED PLANTING TECHNOLOGY

As illustrated in Figure 3-1, the Posi-Flow® seed planting system consists of six main components. The injector assembly is carried on two rotating axes (cam & crank) which are locked in phase to each other. The lower rotating axis, through the use of the crank assembly, sets the circumferential travel of the injector (plant spacing).The upper rotating axis, through use of a positive motion cam, trains the injector assembly to a parallel motion with the ground. Located inside the injector assembly is the plunger. The plunger follows a linear travel within the injector assembly to facilitate the loading and discharge in each cycle.

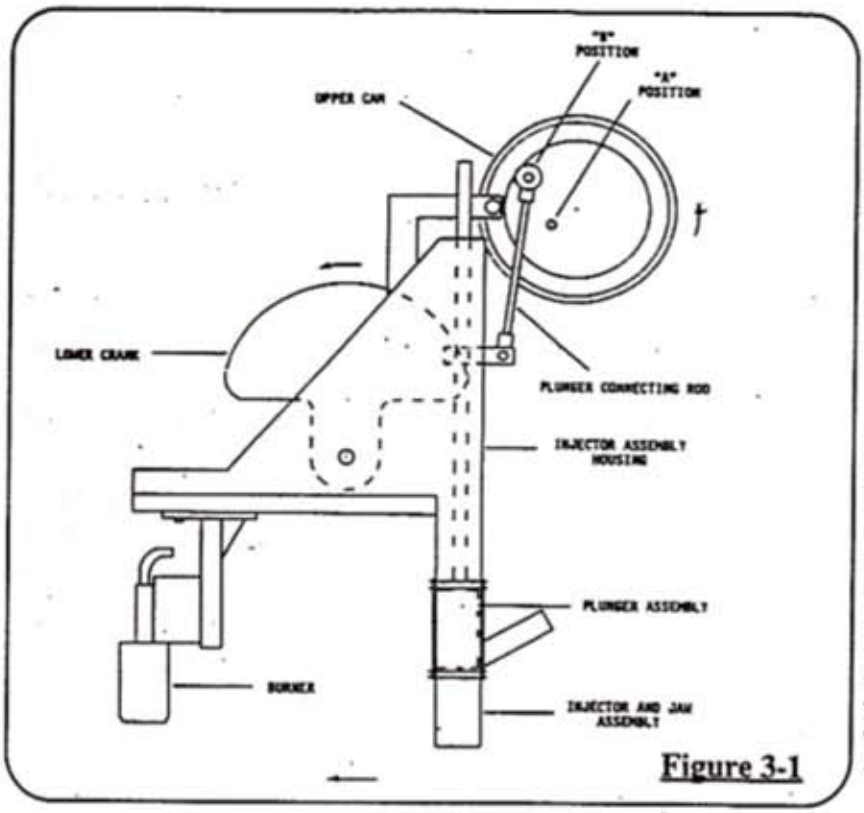


Figure 3-1

To create the linear motion of the plunger, a third axis on the positive motion cam is connected by linkage to the plunger assembly. This causes a linear motion of varying velocity to facilitate the stroking action.

The plunger action is designed to reach bottom dead center approximately 90 degrees after the injector jaws have passed bottom dead center, or just as the jaws are leaving the surface of the bed. This holds down the planting materials which allows for high speed cycling.

Figures 3-2 through 3-5 show the injector assembly in its respective 12, 9, 6, and 3 o'clock positions.

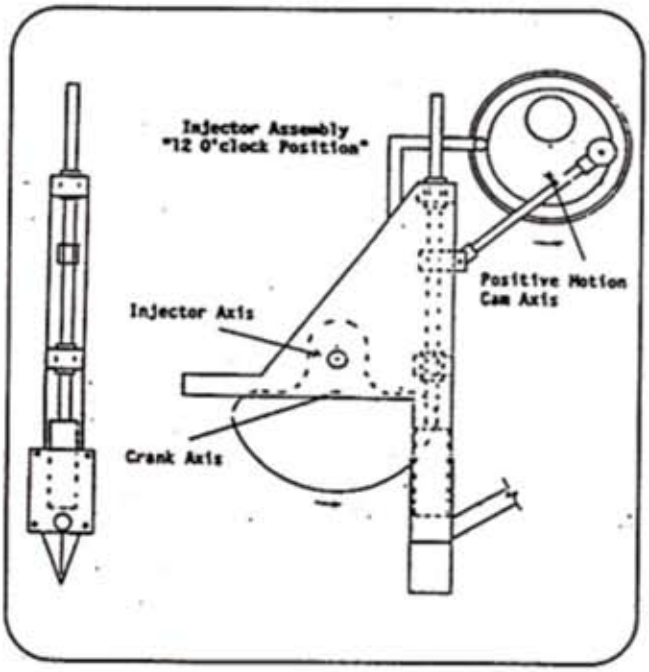


Figure 3-2: 12 O'clock

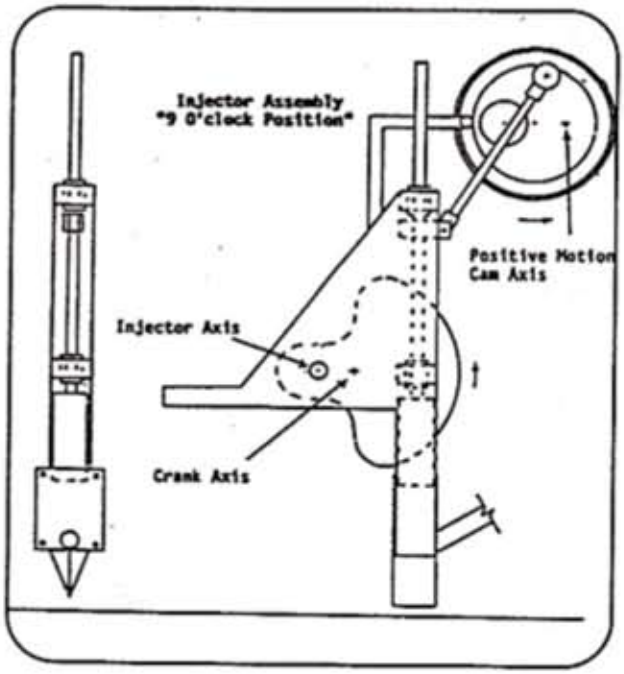


Figure 3-3: 9 O'clock

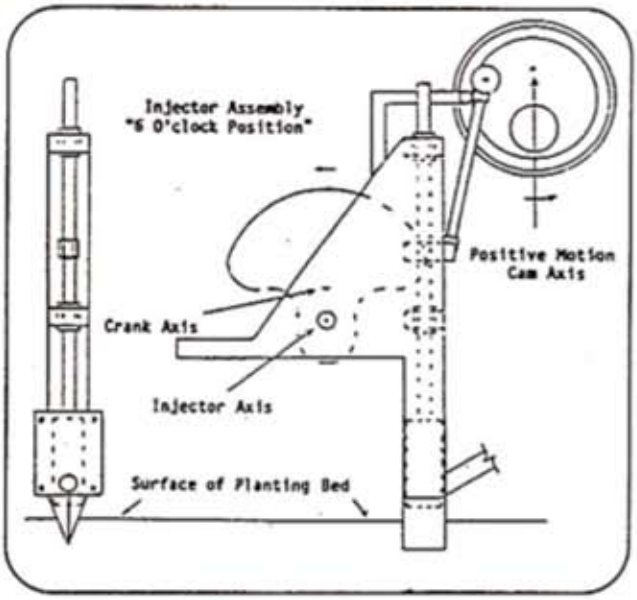


Figure 3-4: 6 O'clock

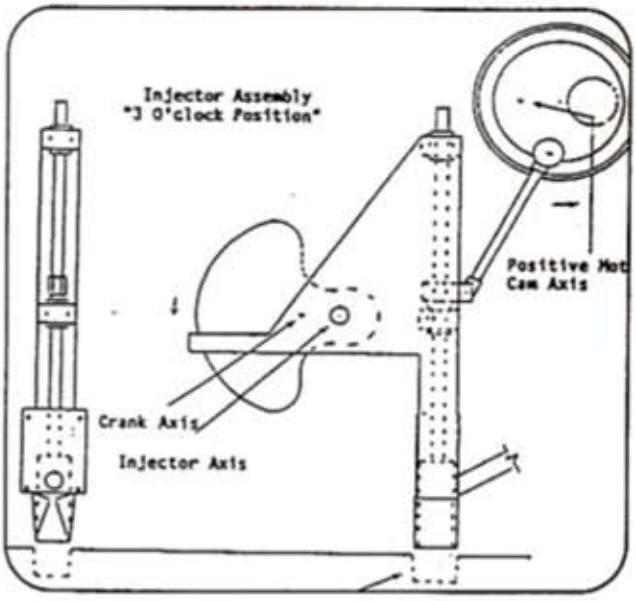


Figure 3-5: 3 O'clock

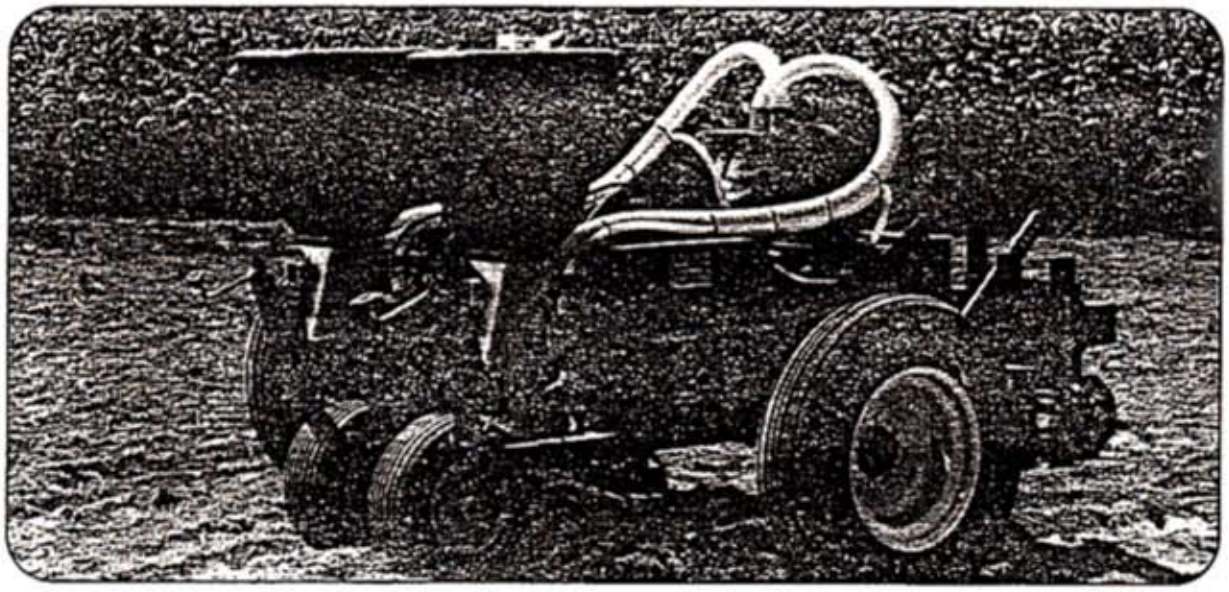


Figure 3-6: The various materials to be dispensed (seed and/or plug mix) are metered from separate hoppers located on the planting unit. The transfer from the hopper to the injector is accomplished by fluidizing these materials by means of pneumatics. A typical example of a unit capable of planting both seed & planting material is as shown.

The transfer tube serves two functions: First, it acts as a conduit for the planting material; second, it compensates for the feeder, which remains stationary in relationship to the planter. The fluidized material from the hopper is received into a holding chamber located on the injector assembly. The linear action of the plunger creates an on/off valve action over the discharge of the holding chamber. The chamber accumulates a steady flow of plug mix until the plunger valve opens to charge the injector. Because the system does not rely on gravity for the transfer of seed and planting material, it is capable of operating at 7,200 cells per hour when planting seed. In reality, the system can function much faster, but bed conditions usually do not allow good seed placement above the rated speed.

IV. Transplanting Technology

As shown below, the Posi-Flow® transplanting system consists of seven main components. In this system the cam, crank, and injector assembly follows the same motions as those of the seed planting version. The plunger's linear shaft motion within the injector assembly is attached to a sliding cup assembly. This creates a vertical elliptical motion of the planting cup assembly which is necessary for the jaws to clear the plant foliage when repositioning for the next cycle. During each cycle seedlings are placed into the bed as contact is made with the ground. After each seedling is placed, a reciprocating packer wheel presses the soil tightly around the transplant.

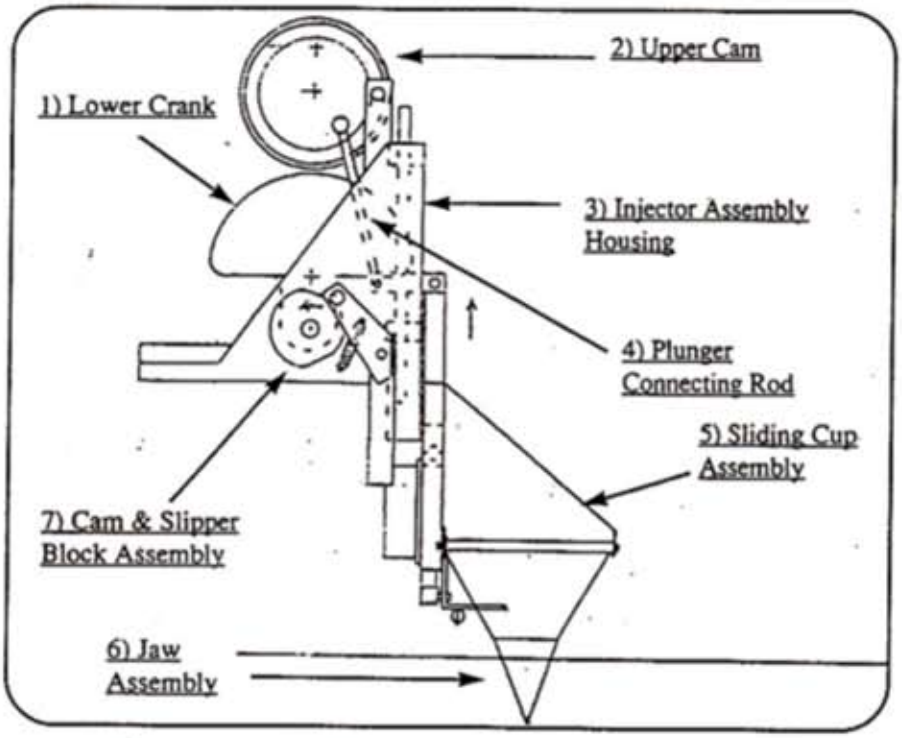


Figure 4-1: 1)Lower Crank 2) Upper Cam 3) Injector Housing 4)Plunger Connecting Rod 5) Sliding Cup Assemble 6) Jaw Assembly 7) Slipper Block Assembly

Two different configurations of the Posi-Flow® transplanting system are available: Figures 4-2 and 4-3 show how the semi-automatic and fully automatic versions make use of the same ground engaging components. In the Semi-Automatic version, a laborer rides the planter and feeds transplants into a rotating carrousel feeder, which drops plants directly into the sliding cup assembly. This system is capable of planting 60 to 90 seedlings per minute, depending on the person feeding the carrousel.

In the fully automatic version, an automatic tray indexer is utilized to drop plants into the sliding cup assembly, rather than the carrousel. This indexer consists of two main assemblies; a plant dislodging bar and a needle belt assembly. The dislodging bar has two functions. Utilizing the drain holes in each tray, it indexes and then dislodges a row of plants onto the needle-belt.This belt, in a vertical relationship to the tray, receives the plant cells from the tray one row at a time.

A stripper device grabs the root zone of the plant, removes it from the needle belt, and places it into a drop tube positioned over the sliding cup assembly. As long as the trays are constructed from a rigid plastic, and have a drain hole, the indexing system is capable of performing the task. Different cells sizes are also possible. This version is capable of two to three cycles per second. Currently the fully automatic version is in the testing stages and is expected to be available for growers in 1993.

(Note: The auto-indexer is interchangeable with the carrousel feeder and would simply be an upgrade to existing semi-automatic planters.)

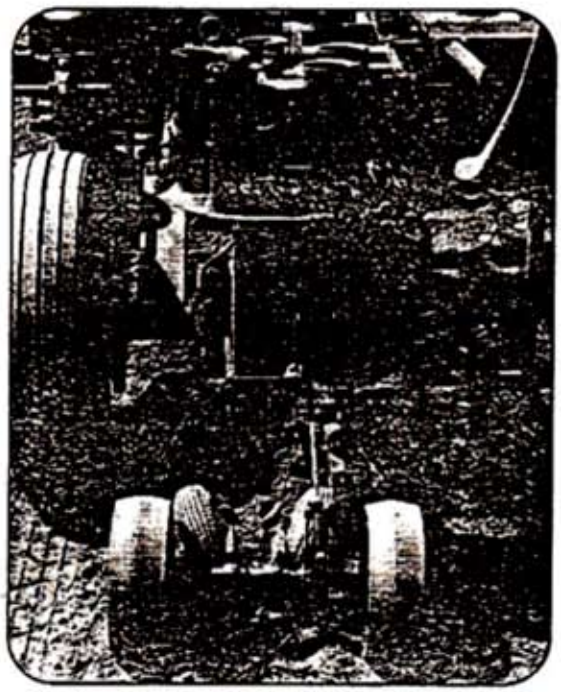


Figure 4-2: Ground engaging system used in semi-automatic transplanter

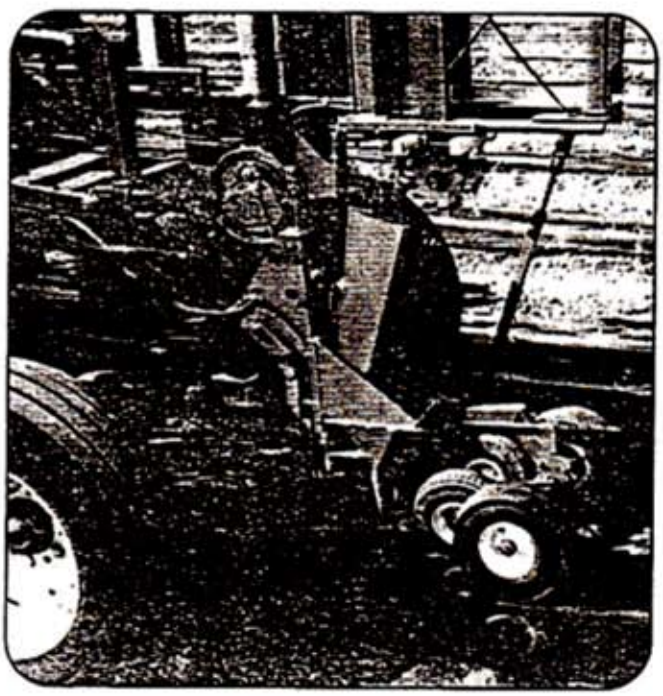


Figure 4-3: Ground engaging system used in fully automatic transplanter.

V. LIMITATIONS

Posi-Flow® has been in commercial use for the past four years, and has proven to work in a wide range of growing environments. It has the ability to overcome less than ideal conditions, and has shown to be very effective when a second, or even third cropping is desired. With modular accessories such as a propane burner, water injector, and fertilizer injector the Posi-Flow® planting system can be customized to suit the needs of the individual. Some growers are reporting 40 to 50 million cycles on their planters, which has helped prove its reliability.

We would like to stress, however, that the system does have certain limitations. The planting system requires a certain level of mechanical aptitude on the part of those responsible for operating the planter in the field. Poor results are most prevalent with poorly trained and constantly changing crews. As with any piece of machinery, the transplanting and seed planting systems require periodic maintenance. If service is neglected, optimum efficiency is reduced, and the end results may not be as anticipated. It should also be noted that the physical planting aspect is just one part (albeit an important one) of the total growing environment.

There are many other variables to consider: Seed germination, Planting in extreme conditions, Poor bed quality, Infestation of insects caused by inadequate spraying programs, Inclement weather,.and Sporadic irrigation to name a few. Precision seed singulation, or the lack of it, is another area that needs to be improved.

VI. TRANSPLANTING ADVANTAGES

Clearly, the industry is in need of an efficient, economical, and results oriented transplanting system to free it from the burden, expense, and inconsistency of manual labor. Although not to the point of a fully automated system, this new design has shown great potential. In its brief history we have seen some very positive results.

The Posi-Flow® transplanting system moves the seedling to the ground in a very consistent manner while the wheel-type planter has a tendency to result in poor stands as the laborer tires from the strenuous effort involved in placing a plant in the bed by hand.

Speed is increased by as much as 50% - 100% over hand planting.

The number of laborers is reduced by half compared to the conventional manual wheel planter.

Modular accessories and the capability of adapting to regional growing conditions makes it a practical alternative in almost all applications.

VII. A TOTAL PLANTING SYSTEM

This planting system was designed specifically for plastic mulch covered beds, and has made the transition from seed planter to transplanter better than anticipated. During field testing of the semi-automatic transplanter on bare ground conditions, it was noted that this system performed much better than many of the commercially available in-row bare ground transplanters.

As illustrated in the last series of photographs, the system has the ability to work in diverse regional conditions. It may also be more expensive, however it offers flexibility and options that up until now growers have never had. It possess a few outstanding characteristics, and fulfills the grower's need to plant on bare ground or on plastic in the same day without making any changes to the planter. Common sense says, use one planter for both operations rather than two separate planters.

The development of the Posi-Flow® planting system brings about a completely new way of utilizing the advantages of plastic mulch. Meeting the growers needs of the future is a requirement for which this system was designed.

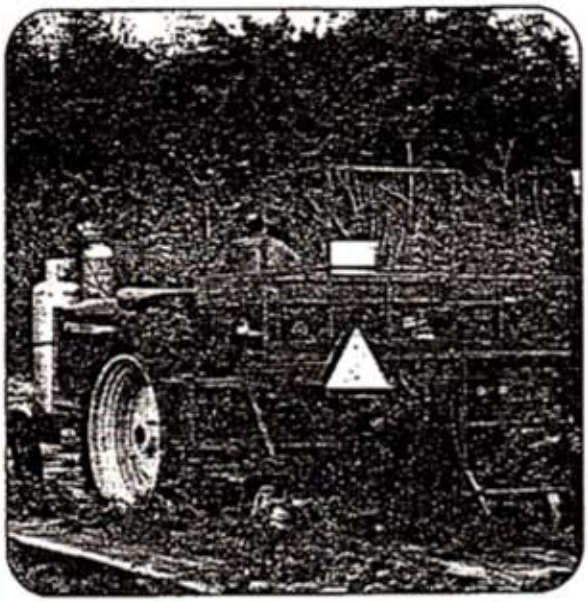


Figure 7-1: Boynton Beach, FL- Direct seeding cucumber over depleted tomato crop.

Figure 7-2 Eden, NY - Direct seeding first crop of zucchini .

Figure 7-3: Clinton, NC - Direct Seeding over depleted strawberry field.

Figure 7-4: Rio Grande City, TX - Direct seeding first crop of melons with plug mix.