# Improvements

## Depth Control

- Quick clip design for quick and easy adjustment for cone depth
- Heavy duty design of feet supports
- Fiberglass protectant on bottoms of the depth control to prevent tears
- Longer and more durable design of cone
- Improve guide travel system to prevent cylinders and feet from turning
- Cones are easily interchangeable from cylinder to cylinder

Original design of the depth control

## PTO Driven Compressor vs. Hydraulic Driven

- Use of PTO instead of hydraulic motor
- Self contained machine
- PTO pulley ratios are such that the tractor can operate at a low rpm and travel speed
- Allows for quick attach and detach

## Frame

- Complete angle iron frame
- Compact for storage, but still sufficient for housing all components necessary for operation
- Heavy Duty for withstanding field conditions and time
- Heavy enough to push cones into the ground without bouncing the machine

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# Improvement of the Auto-Dibbler

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*Agricultural Systems Management*

*Senior Capstone Project*

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## Problem Statement:

Various crops require different spacing and depth, and current machines are not easily interchanged from one crop species to another. The dibblers that are interchangeable are usually operated and moved manually by human labor. Spacing and depth accuracy is only as good as the person operating the dibbler. An automated prototype has been designed but still not commercially viable.

First design of a Dibbling machine that can be reconfigured rapidly for different planting configurations

Completed design of the Dibbling machine that meets the deliverables of:
- PTO drive
- Improved depth control and adjustments
- Less expensive controller
- More robust actuators

## Objective:

- Design, build, and test a dibbling machine that is commercially viable and cost effective
- Make machine easily transferable from one tractor to another
- Keep horsepower requirements low to attract targeted customers within the horticultural industry
- Improve depth control of dibblers
- Lower cost of electrical controller
- Create "jack stands" to facilitate mounting and dismounting when storing

*image from www.irrigation-mart.com

Previous waterwheel transplanter

## Purpose of an automated dibbling machine

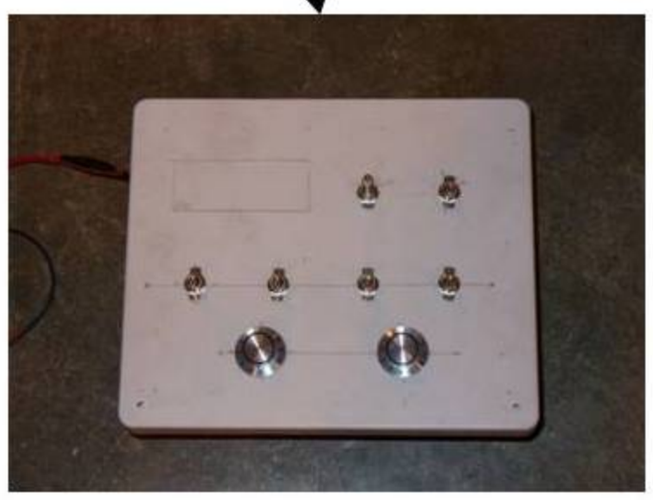
- Provide accurate placement of holes in plastic
- Puncture holes in plastic without tearing the plastic
- Easily changed to any crop configuration within a 30" plastic bed
- Increased acres/day, in turn increase farm productivity

## PLC

- Use a lower cost controller that can perform the same tasks
- Control system that the operator can control depth and spacing from the tractor seat
- New PLC and wiring allows for quick implement detachment from tractor by minimizing wire harnesses disconnection to only one

Old PLC and control panel in two different locations on the tractor and machine

New control panel with PLC and control switches all in one unit

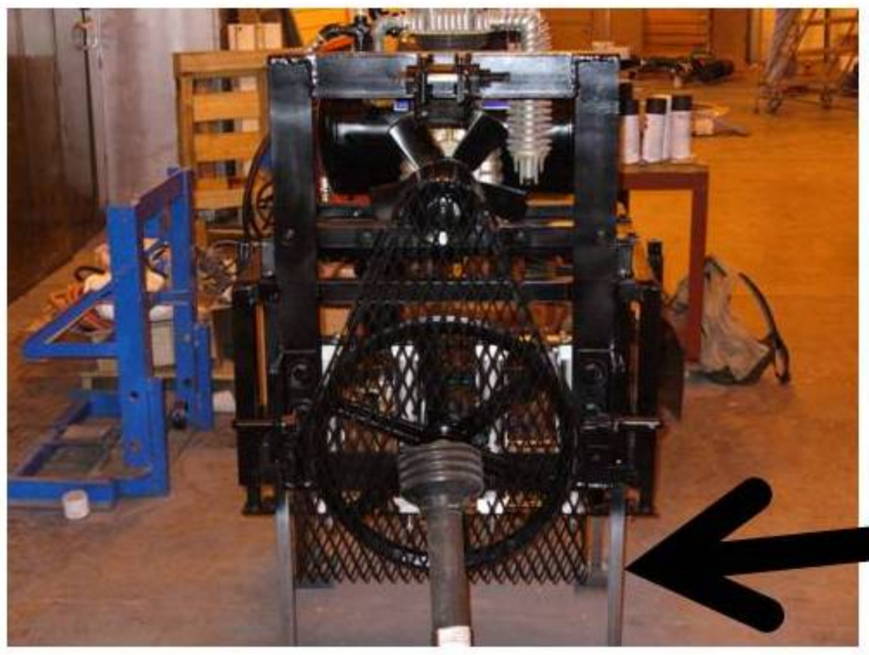


Air consumption model was used to design the air compressor and driveline system. The model was also used to determine:

- Constants for PLC timing and intervals
- Pressures at which the systems operates
- Tractor travel speeds
- Compressor Hp requirements
- Pulley ratios

## Air Consumption Model

| Inputs | | | onions | potatoes | tomatoes | melons slow rpm | tomatoes slow rpm | | |
|---|---|---|---|---|---|---|---|---|---|
| s | travel speed | mph | 0.27 | 0.74 | 3.0 | 3.0 | 1.5 | 0.6 | 0.7 |
| p | air pressure | psig | 80 | 125 | 125 | 125 | 125 | 125 | 125 |
| ncyl | # of cylinders | – | 4 | 2 | 1 | 1 | 1 | 4 | 4 |
| spac | spacing of holes in the row | in | 6 | 12 | 24 | 48 | 24 | 6 | 6 |
| Dc | cylinder dia | in | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Sc | cylinder stoke | in | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Dr | rod diameter | in | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Vc | displacement of compressor | cu in/stroke | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| X | horizontal distance with action | in | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | | | | | | | | |
| INTERMEDIATE CALCULATIONS | | | | | | | | | |
| Vce | cylinder vol on cap end | cubic in | 17.7 | 17.7 | 17.7 | 17.7 | 17.7 | 17.7 | 17.7 =(3.14*(Dc/2)^2)*Sc |
| Vre | cylinder vol on rod end | cu in | 15.7 | 15.7 | 15.7 | 15.7 | 15.7 | 15.7 | 15.7 =Vce-PI()*Dr^2/4*Sc |
| Vt | Total vol needed per stroke | cubic in/cyc | 133 | 67 | 33 | 33 | 33 | 133 | 133 =(Vce+Vre)*ncyl |
| sdu | speed in different units | in/min | 289 | 785 | 3139 | 3139 | 1584 | 634 | 739 =s*5280*12/60 |
| F | frequency of dibbling | cyc/min | 48.2 | 65.4 | 130.8 | 65.4 | 66.0 | 105.6 | 123.2 =sdu/spac |
| Q | air flow needed | cfm | 3.73 | 2.53 | 2.53 | 1.26 | 1.27 | 8.16 | 9.51 =Vt*F/12^3 |
| Qfa | air flow needed, free air | scfm | 24.0 | 24.0 | 24.0 | 12.0 | 12.1 | 77.5 | 90.4 =Q*(p+14.7)/14.7 |
| ncomp | speed of compressor needed | rpm | 1185 | 1185 | 1185 | 592 | 598 | 3826 | 4464 =Qfa*12^3/Vc |
| tcyc | time of the down/up cycle | s | 0.415 | 0.153 | 0.038 | 0.038 | 0.076 | 0.189 | 0.162 =X/sdu*60 |



## Four post dismount system

- Four telescoping feet
- Removable or elevated for operation
- Easily adjusted for multiple tractor hitch heights

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