

SMALL FARM SUBSOILER

midterm presentation

USDA SPONSERED SENIOR DESIGN PROJECT

Jason Lueck, Matt Maples, John McBride,
Brad Mooney, Manuel Pagan

DESIGN REQUIREMENTS

- ▶ Scaled to work on a small farm.
- ▶ Low cost to purchase (under \$3000)
- ▶ Able to penetrate at least 10" (15" preferred)
- ▶ Modify an existing tiller (Troy-Bilt Horse)
- ▶ Surface soil left undisturbed

EXISTING SOLUTIONS

- ▶ Standard walk behind tiller
- ▶ Ditch Witch trenchers
- ▶ Ditch Witch vibrating shank
- ▶ Mid-sized riding and walk behind tractors

PROBLEMS WITH EXISTING SOLUTIONS

► Tillers

- Disturb top soil by tine rotary action
- Limited depth (typically under 10")

PROBLEMS CONT.

- ▶ Ditch Witch Trenchers/Vibrating Shank
 - Excessive cost (\$6500 for trencher, \$8000 for vibrating shank)

PROBLEMS CONT.

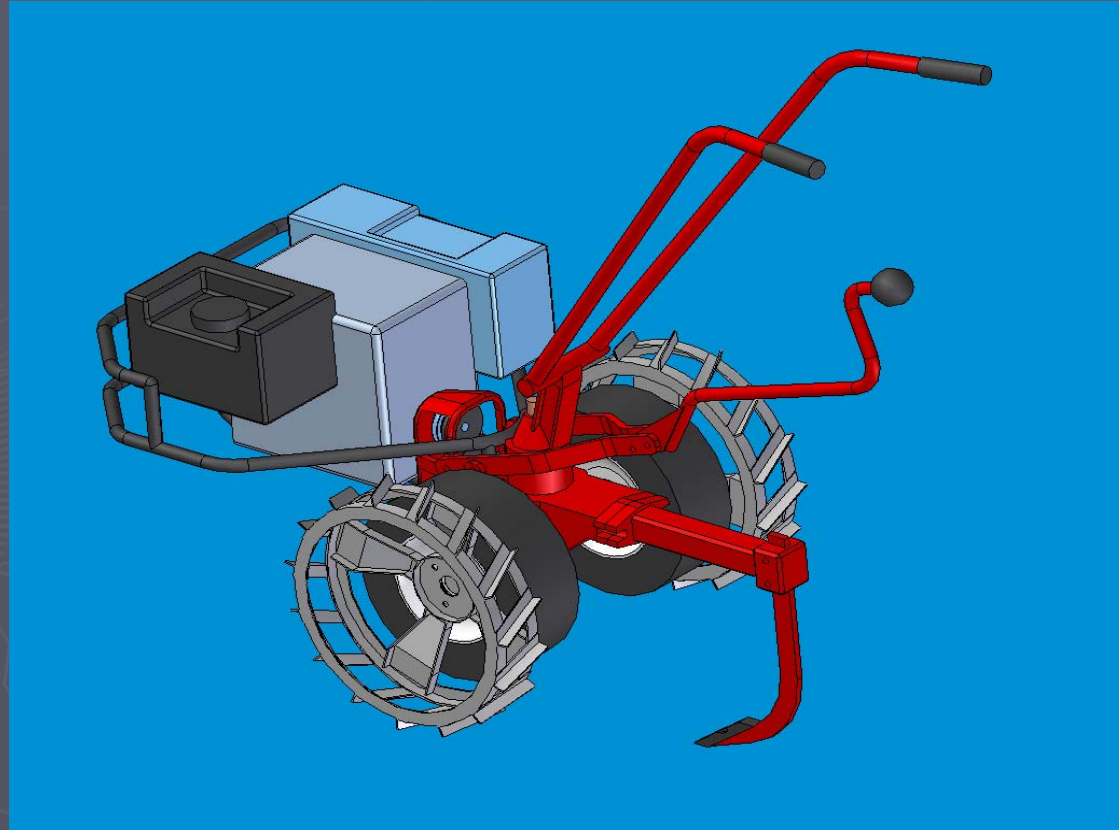
- ▶ Mid-sized tractors/walk behind tractors
 - High cost (typically several thousand dollars)
 - Too large for the smallest farms

POSSIBLE SOLUTIONS

- ▶ Straight shank
- ▶ Rotary chisel
- ▶ Trencher

STRAIGHT SHANK

- ▶ For this design, a straight shank would be attached behind the tiller frame.



SHANK ADVANTAGES

- ▶ This design can be easily attached to the existing tiller frame. The ease of attachment allows for easier modification for the consumers who already own a Troy-Bilt.
- ▶ There are readily available mounting brackets that could be easily modified to fit the tiller frame. This would lead to less new design work.

SHANK ADVANTAGES CONT.

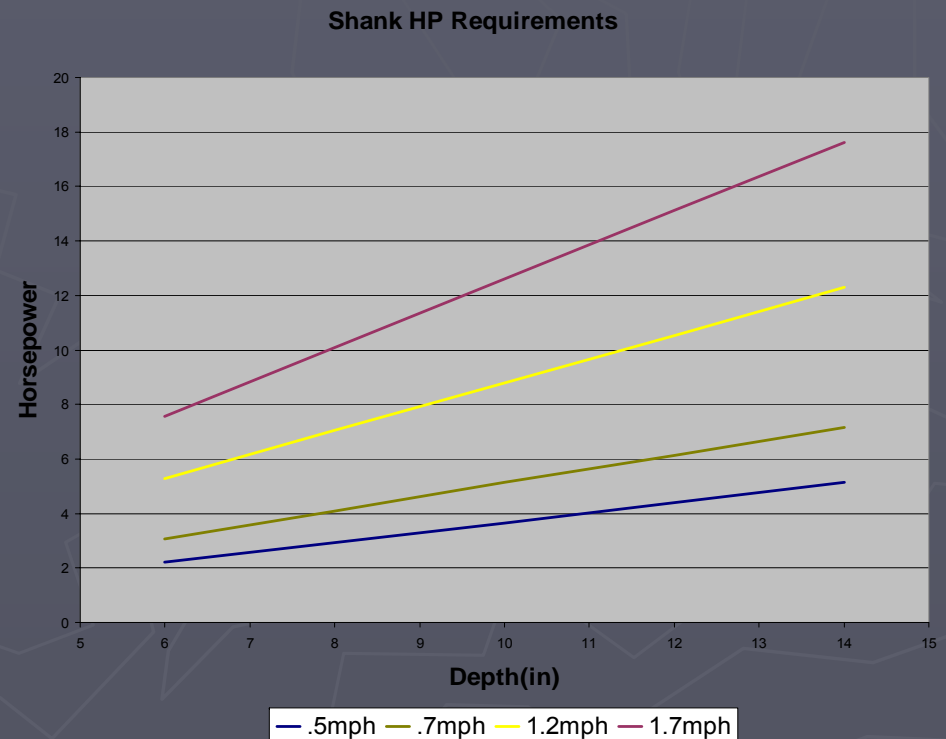
- ▶ The decrease in design work and ready availability of parts will greatly lower cost.
- ▶ The lack of moving parts will decrease maintenance making it more appealing for the customer.
- ▶ The straight shank design is currently used on a larger scale, so the design is already proven.

SHANK ADVANTAGES CONT.

- ▶ The shank can be easily adjusted allowing the operator to move the tiller between storage and the field easy.
- ▶ The depth of operation can be easily adjusted allowing for higher speeds at shallower depths.

SHANK DISADVANTAGES

- ▶ Larger depths require large horsepower increases leading to much higher costs or much slower speeds.
- ▶ To achieve the desired depth, the forward speed will be relatively low (0.7 mph @ 14" depth).

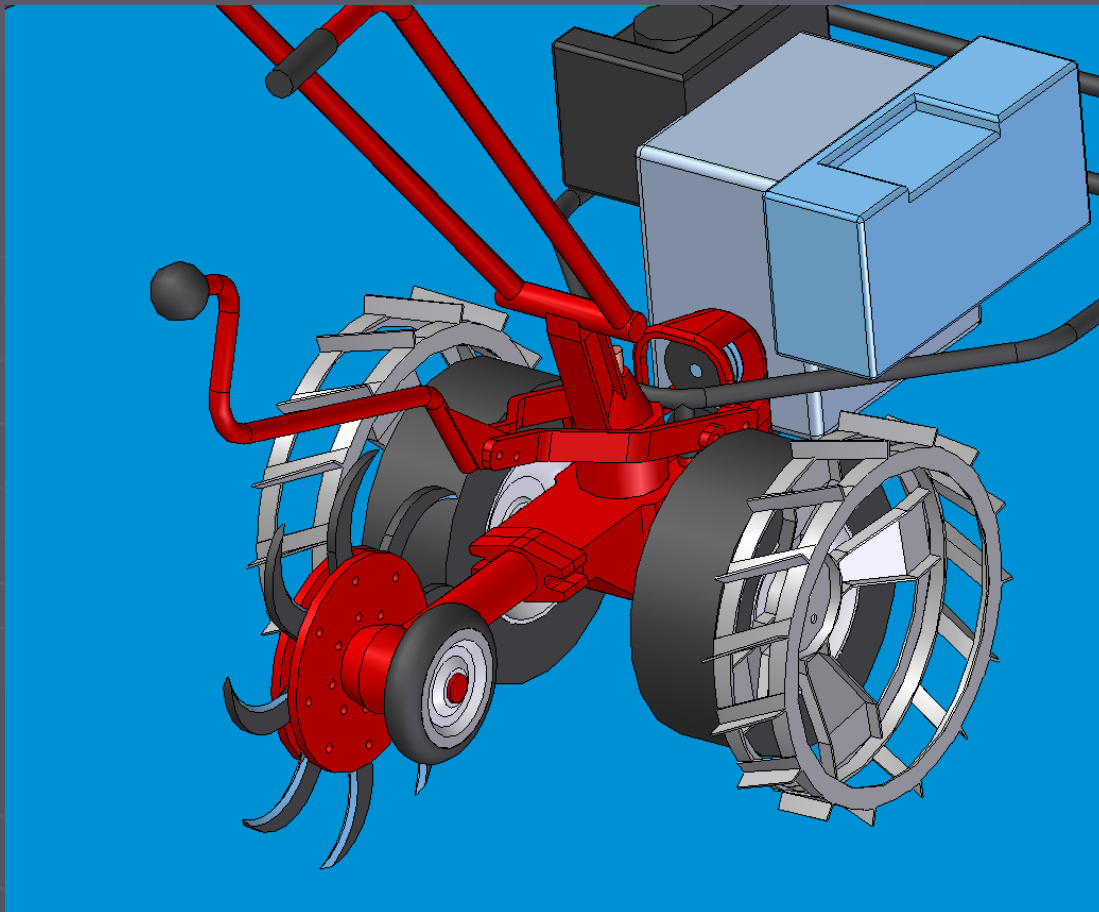


SHANK DISADVANTAGES CONT.

- ▶ The traction of the tiller tires will limit the amount of HP that can actually be used.

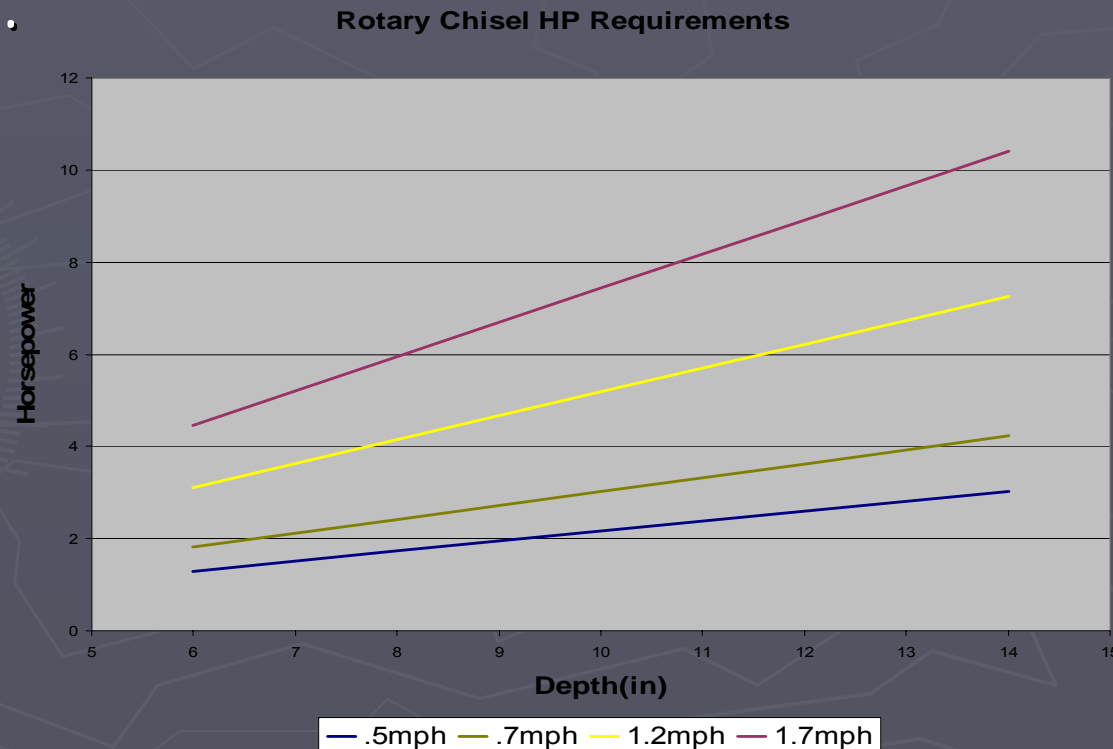
ROTARY CHISEL

- ▶ A rotary blade would be attached to the PTO of the tiller.



CHISEL ADVANTAGES

- ▶ There is roughly a 40% horsepower savings for a rotary shank over a straight shank allowing for greater forward speed and greater depth of digging.



CHISEL ADVANTAGES CONT.

- ▶ The forward chisel rotation causes the tiller to drag itself forward allowing for easier use by the operator.
- ▶ Can cut through underground obstructions easier than the shank.

CHISEL DISADVANTAGES

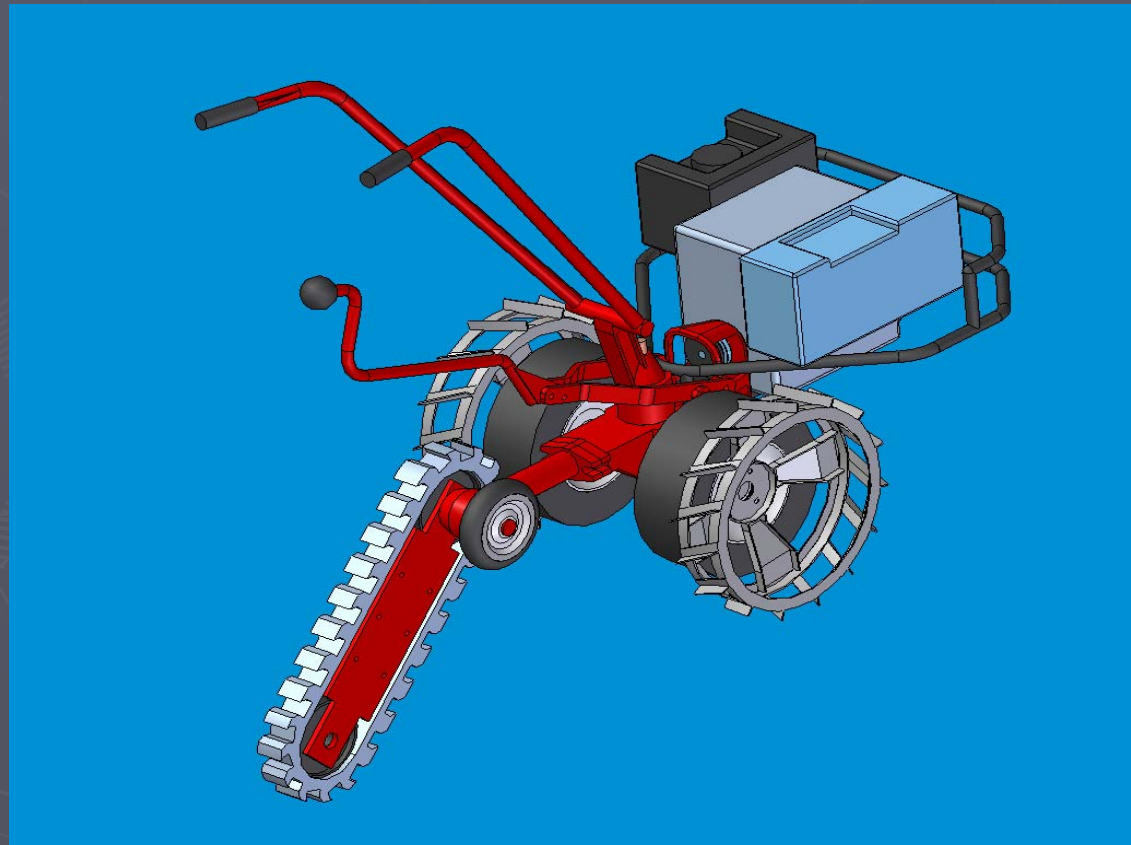
- ▶ To penetrate 15" would require a blade diameter of 36" leading to some major safety concerns.
- ▶ At minimum, a strong guard would have to be built around the blades since there will always be several inches of spinning blades above ground.
- ▶ The handles would have to be moved also.

CHISEL DISADVANTAGES CONT.

- ▶ No existing design would require that all of the parts be designed and built from scratch greatly increasing cost.
- ▶ The clutch would have to be redesigned to allow for "reverse" to become "forward."
- ▶ Since the drive shaft is off-center, the tiller will try to drag itself off of a straight line.
- ▶ Several moving parts will increase maintenance and decrease durability.

TRENCHER

- ▶ A chain type trench digger blade would be attached to the PTO of the tiller frame.



TRENCHER ADVANTAGES

- ▶ The rotary action of the chain allows for lower horsepower requirements than straight shank (comparable to the rotary chisel.)
- ▶ The chain design allows for nearly the entire cutting blade to be below ground during operation making for safer usage than the rotary chisel.

TRENCHER ADVANTAGES CONT.

- ▶ Can cut through underground obstructions much easier than the shank or chisel designs.
- ▶ Lower cutting horsepower requirements allow for higher forward speeds.

TRENCHER DISADVANTAGES

- ▶ There are more moving parts which will lead to lower durability and higher maintenance.
- ▶ The chain guide will be very heavy making adjusting the depth and pulling the arm up for transport very difficult.
- ▶ Having the trenching arm in an upright position will make it hard to transport.

TRENCHER DISADVANTAGES CONT.

- ▶ The parts that are currently available for purchase are very expensive (chains start around \$500).
- ▶ The trencher works by removing the dirt, so it would have to be replaced in the trench.

CONCLUSIONS

- ▶ There are three main design types which could be used to create a subsoiler to meet our design criteria.
- ▶ We feel that the shank design will be the best design.

DESIGN COMPARISONS

	Shank	Chisel	Trencher
Cost	Least Expensive	Expensive	Most Expensive
Ease of Design	Least Design Work	Most Design Work	Some Design Work
Safety	Very Safe	Least Safe	Safe

DESIGN COMPARISON CONT.

	Shank	Chisel	Trencher
Maintenance	Low Maint.	Mid-range Maint.	Most Maint.
Reliability	Most reliable	Reliable	Least Reliable
Efficiency	Least Efficient	Comparable	Comparable