

# Design and Development of a Stick Planter for the Developing World

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# Corn Production Around the World

- 160 million ha grown world wide
  - 9 to 10 Mg/ha in the industrialized world
- 34 million ha in the developing world
- 21 million ha planted by hand
  - average corn yield 0.7 to 2.5 Mg/ha
  - key food supply



# Hand Planting

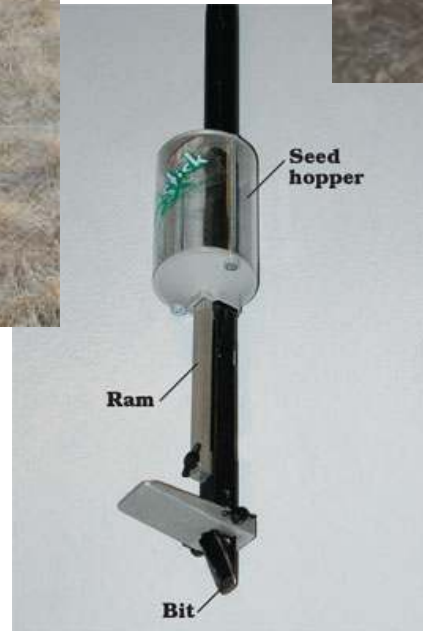
- hill-planting method
  - farmers use a stick to poke holes into the ground roughly 35 to 45 cm apart
  - drop by hand 3 to 4 seeds into each hole
- direct skin contact with fungicide treated seeds
  - skin irritations, unknown long-term effects



# Alternative Seeding Concepts



# Stick Planters



# Objectives & Potential Impact

- design and build a simple and reliable stick planter for corn production in the developing world
- plant single seeds 14 to 17 cm apart, 3 to 4 cm deep
  - spacing and depth control
- eliminate the need to touch seeds
- achieve 10 to 15% yield increase
  - value of production increase in the order \$2.2 billion annually

# Design Requirements

- Performance
  - singulate seeds from a mixture of seeds of all different shapes and sizes (rounds, flat, small, large)
  - 2% blanks and 10% multiples are considered acceptable
  - Enable dispensing of 1.5g of urea (side dressing)
- Operational and economics
  - holding capacity for about 3000 to 5000 seeds (ca. 1 kg)
  - last 10 years, at least 1 million seeds
  - provide means to dispense 1.5 g of urea granulate for side dressing
- Ergonomics
  - actuation force should not exceed 35 N
  - total mass with a full hopper should be less than 2.5 kg

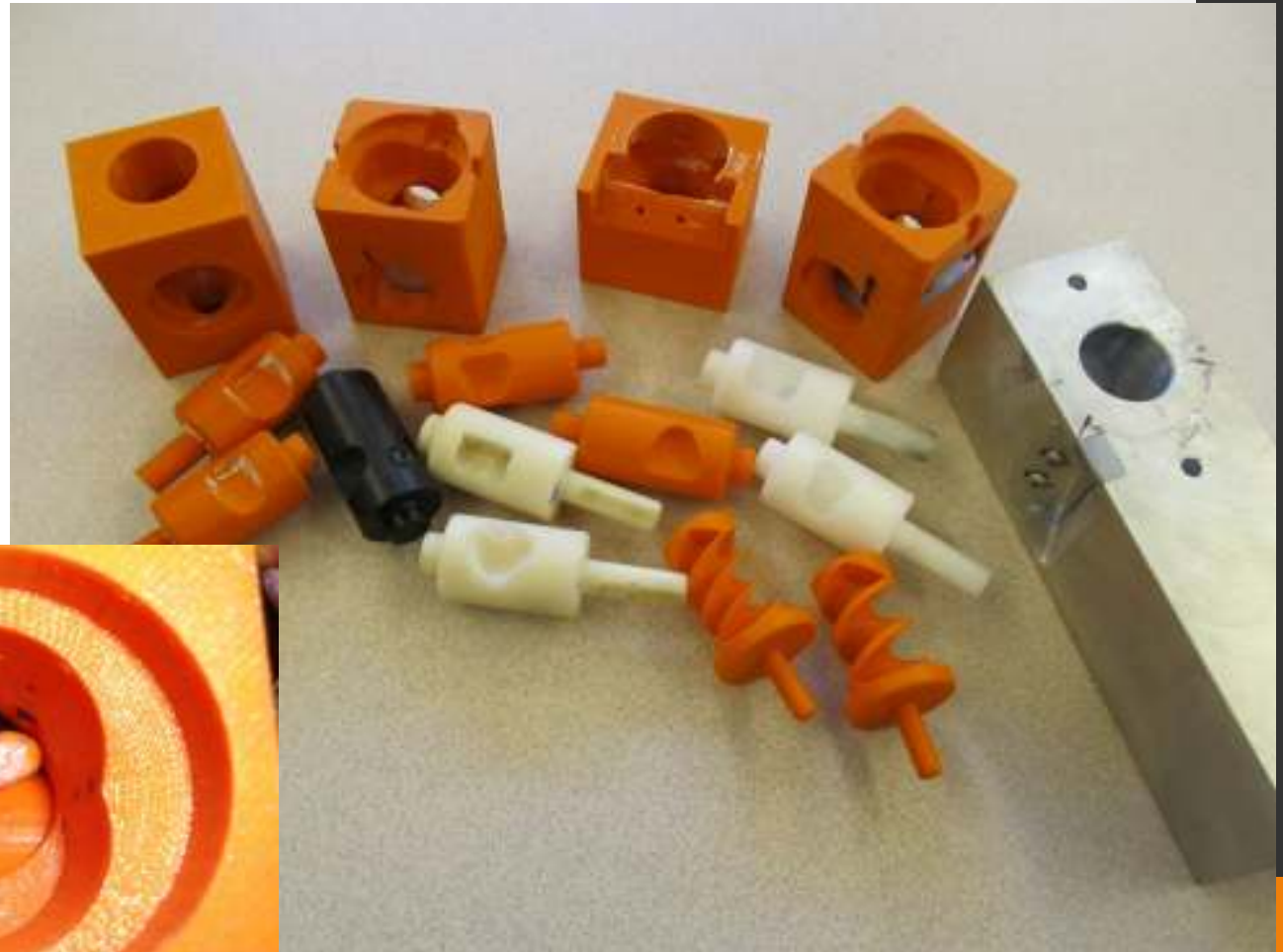
# Design Concept



- PVC pipe as hopper
- Al-square tube as slider
- reciprocating action, rotates a horizontal singulation drum
  - 180° off set → cutout for urea dispensing
  - seed/fertilizer release on up-stroke
- extension springs provide restoring force
- steel shovel



# Singulator Design



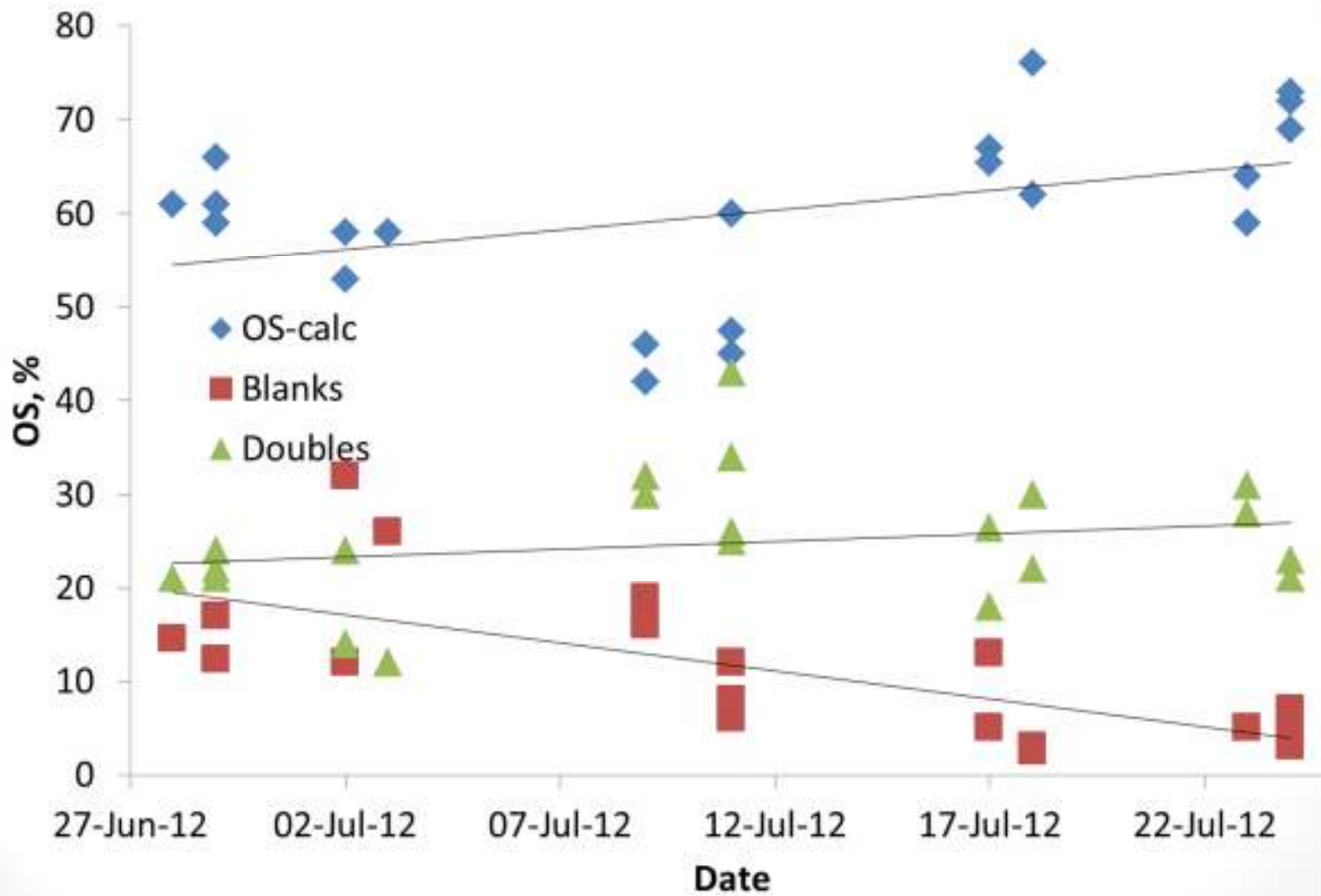
# Field Testing



# Test Results

- empty mass 1.5kg, holds 0.9kg of seeds, weight feels comfortable
- actuation force by operators required to be much higher (80 to 100 N)
- shovel needs redesign...
- around 12'000 actuations to date, several rounds of modifications

# Singulation Performance



# Acknowledgements

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[http://nue.okstate.edu/Hand\\_Planter.htm](http://nue.okstate.edu/Hand_Planter.htm)