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

![Graph showing singulation performance over dates from 27-Jun-12 to 22-Jul-12. The graph compares OS-calc, Blanks, and Doubles with data points indicating performance trends.](image)
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http://nue.okstate.edu/Hand_Planter.htm