TKP3501
Farm Mechanization

Topic 11: Emerging Technologies in Agricultural Mechanization

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Learning Outcomes

- Be able to capture available technology in the market to be applied in agriculture
- Be able to understand the importance and potential of the technology application in agriculture
Vertical Tillage
Vertical Tillage

- The latest approach to solve the compaction soil later
- Approach:
  - Putting wavy blades straight into the ground these vertical tillage tools remove compaction layers in the seedbed even when running in damp soil.
  - The wavy blades, mounted on 5 or 7.5 inch spacing, lift some soil on top of the residue, which speeds up soil warming and residue decomposition.
- Note: Potential title for student project
Primary Vertical Tillage Depth

Primary tillage depth should be half the shank spacing.
Flutes exit the soil parallel to the ground for a controlled soil release.

Flutes enter the soil perpendicular to the ground for maximum cutting performance while requiring less down pressure.
RTK-GPS Guidance Transplanter For Paddy

VIDEO
How does GPS work?

- GPS receiver determines its position relative to satellite “reference points”
- The GPS unit on the ground figures out its distance (range) to each of several satellites
Application of GPS on:

1. Yield farming
2. Soil variability mapping
3. Water management
4. Variables rate application - fertilizer, herbicides, pesticides
5. Precision farming
Types of GPS used in Malaysia’s agriculture

1. DGPS model AgGPS 132

- Use in rice field
- Trimble attach with VerisEC3100
- The Veris system is an example of such a receiver that measures electrical conductivity and variable rate fertilizer and chemical spreader

- Use transmission frequency of 298.00 kHz and is provided with sub-meter accuracy.

http://mycoordinates.org/precision-agriculture/
Display screen

GPS receiver

Light bar
BENEFITS OF APPLICATION OF GPS:

- Accurate application of chemicals
- Create more environmental friendly
- Produce higher yield by determine the planting distance
- Paddy planting and related activities schedule
- Fertilization schedule
- Yield data collected from harvester
- Reduce cost of labor
Costs range from about $1,500 for a farmer who already owns a GPS.

More than $14,500 for a commercial applicator who wants a system that keeps “as-applied” records as well as provides navigation.

A fully automatic navigation system that steers a tractor, sprayer, or combine—with operator engagement only at field ends—could range from $6,000 to $50,000.

Current swathing aids such as foam-marker systems range from $500 to $3,000. Speed is also an issue in foam systems. The lower-cost foam systems are slower, but they work adequately when application is done with a tractor. Commercial applicators operating at 20 miles per hour need more foam output than some systems can provide.
# COST OF GPS NAVIGATION

<table>
<thead>
<tr>
<th>CATEGORIES</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>FARMER ALREADY OWN GPS</td>
<td>RANGE FROM $ 1,500</td>
</tr>
<tr>
<td>A COMMERCIAL APPLICATOR WHO WANTS A SYSTEM THAT KEEPS “AS-APPLIED” RECORDS AS WELL AS PROVIDES NAVIGATION.</td>
<td>MORE THAN $ 14,500</td>
</tr>
<tr>
<td>A FULLY AUTOMATIC NAVIGATION SYSTEM THAT STEERS A TRACTOR, SPRAYER, OR COMBINE—WITH OPERATOR ENGAGEMENT ONLY AT FIELD ENDS</td>
<td>RANGE FROM $6,000 TO $50,000.</td>
</tr>
<tr>
<td>CURRENT SWATHING AIDS SUCH AS FOAM-MARKER SYSTEMS</td>
<td>RANGE FROM $500 TO $3,000.</td>
</tr>
</tbody>
</table>

Application of ISOBUS on the tractor
Definition ISOBUS

- Integrated tractor standard and implement communication system
- Part of ISOBUS - cables, plugs and sockets, the sensing, control and display software.
ISOBUS SYSTEM
Unmanned Aerial Vehicle Systems (UAS or UAV)

VIDEO
Application of UAV in Agriculture

Mikrokopter and MCA 6 Sensor

- Farm planning and management
- Irrigation line detection, monitoring the leakage and the soil moisture
- Weeds recognition

Reflection of selected weed
Communication between RC, UAV and ground station controller
Oil palm seed production
Approach using semi float system popularly used to raise tobacco seedling and oil palm seedling

This system is a number of innovations and is claimed to overcome disadvantages and limitation of the conventional polybag systems.

In brief about semi float system of oil palm
- Plug trays filled with sphagnum peat moss
- Filled trays are placed in a pool of nutrient solution to a pre-determined depth
- Water and nutrient solution are added as needed
- The trays of seedling are raised under rain shelter with shade netting.
Plug trays filled with sphagnum peat moss

The filled trays are placed in a pool of nutrient solution to a pre-determined depth

Water and nutrient solution are added as needed

The trays of seedlings are raised under rain shelter with shade netting

Semi float system
Cont. methodology

1. sphagnum peat moss filling

- Using tray 28 cm x 54 cm that can accommodate 325 seedlings per $m^2$
- each cell 48 mm x 48 mm (top) and tapered down to depth of 110 mm with capacity 135 ml
2. Trays then placed in a pool of water at 2 cm in depth and topped up again to the same level after 1 to 2 hours when water had been taken up into the peat moss through capillary

*This ultimately reduced labour requirement while conserving water
3. A germinated oil palm seed was planted in each of the cells.
4. When the seedling had reached the two-leaf stage (about 4 weeks after sowing) fertilisation was begun.

- Adding an organic-based fertiliser to the water in the pool according to the recommended rate and frequency while ensuring the electro conductivity reading was within 0.5-0.8 μS for optimum fertilisation effects.
At 11 weeks after sowing, towards the end of the pre-nursery stage, seedling raised under the semi float system had significantly greater plant height, more leaves and longer leaves compared with those in polybag system.
# Result expectation

<table>
<thead>
<tr>
<th>Semifloat</th>
<th>Comparison</th>
<th>Polybag</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ 10,000 cells / man-day</td>
<td>Labour - Media preparation</td>
<td>➢ 500-1000 poly bags/ man-day</td>
</tr>
<tr>
<td>✓ 5000 seeds/man-day</td>
<td>Rate of sowing</td>
<td>➢ 1500-2500 seeds/ per-day</td>
</tr>
<tr>
<td>✓ 325 seedling/m²</td>
<td>Space required</td>
<td>➢ 100 seedling/m²</td>
</tr>
<tr>
<td>✓ Lower</td>
<td>Water consumption</td>
<td>➢ Higher</td>
</tr>
<tr>
<td>✓ Top up twice/week</td>
<td></td>
<td>➢ Watered twice daily</td>
</tr>
</tbody>
</table>

- Polybag: 500-1000 poly bags/man-day
- Rate of sowing: 1500-2500 seeds/per-day
- Space required: 100 seedling/m²
- Water consumption: Higher
- Watered twice daily
### Cont. result

<table>
<thead>
<tr>
<th>✔ Minimal wastage</th>
<th>Fertilizer use</th>
<th>➢ High wastage</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔ Reduced</td>
<td>Cost</td>
<td>➢ Higher</td>
</tr>
<tr>
<td></td>
<td>*not include initial capital expenditure</td>
<td>➢ Due to high labour and wastage</td>
</tr>
<tr>
<td>✔ higher</td>
<td>Rate of transplanting pre-nursery seedlings to larger poly bag</td>
<td>➢ Lower</td>
</tr>
<tr>
<td>✔ Due to easier lifting the medium</td>
<td></td>
<td>➢ Inefficient handling, lifting the medium</td>
</tr>
</tbody>
</table>
## Total cost of production

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conventional Polybag System (RM)</th>
<th>Semi Float System (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polybag</td>
<td>4166</td>
<td>2500</td>
</tr>
<tr>
<td>Media</td>
<td>7500</td>
<td>3255</td>
</tr>
<tr>
<td>Water</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>2070</td>
<td>1755</td>
</tr>
<tr>
<td>Labour</td>
<td>16200</td>
<td>14000</td>
</tr>
<tr>
<td>Transportation</td>
<td>700</td>
<td>300</td>
</tr>
<tr>
<td>Transplant</td>
<td>3000</td>
<td>1500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>34036</strong></td>
<td><strong>23510</strong></td>
</tr>
</tbody>
</table>

- **Cost reduction:**
  \[34036 - 23510 = 10526\]

- So, by using semi float system, the total cost can be saved by 30.9%
Thank you.