The incidence of leaning palms is unavoidable for oil palm planted on peat, even with mechanical compaction of the peat and applying the ‘hole-in-hole’ planting technique. Palms leaning in a disorderly manner have apparently become a serious limiting factor in oil palm performance on peat (Mohd Tayeb et al., 1996). Leaning poses difficulties in field operations and maintenance (Figure 1). Leaning palms have resulted in reductions in fresh fruit bunch (FFB) production, ranging from 9% to 26% compared to upright palms (Hasnol et al., 2007). However, palms that lean progressively with age have little impact on the arrangement of the canopy, and this type of leaning does not seriously affect the FFB yield and field operations.

FIELD TRIAL

A trial on unidirectional leaning of young palms achieved by mechanical force was carried out in 2000 at MPOB Research Station, Sessang, Sarawak. The area was classified as deep peat with a depth between 350 and 400 cm. Mechanical compaction of the harvesting paths and the planting rows was carried out during land preparation. Twelve-month-old DxP materials were planted at a density of 160 palms ha⁻¹ using the normal hole planting technique.

A 2 ha area consisting of 320 palms was used as the treatment plot. The work flow is shown in Figure 2. The steps involved were:

Step 1: When the palms reached 30 months old, they were forcibly pushed using an excavator to lean at 45° in one direction.

Step 2: Soil mounding of palms was conducted.

Step 3: The soil was compacted or levelled and cleared of any stumps or lumber along the harvesting paths.

Step 4: Pruning of damaged fronds was carried out.

In the same planting block, 2 ha of palms with normal planting practices were used as the control plot. Four years of FFB yields were recorded, starting from 36 months after planting. The progress of leaning by the palms was recorded at six-month intervals.
INCIDENCE OF LEANING PALMS

The progressive unidirectional leaning palms caused by mechanical force is shown in Figure 3. Mechanically forced palms leaned progressively and there was no occurrence of severe leaning or toppling over and uprooting of palms. In the control plot, palm leaning occurred in a disordered manner with severe leaning and toppling over starting at seven years after planting.

Unidirectional leaning of young palms by mechanical force helped to alleviate haphazard leaning, and subsequently minimized FFB yield losses during harvesting. This technique also provided good in-field accessibility, thus helping to increase the efficiency of field operations such as harvesting and fruit evacuation (Figure 4).

FFB YIELD PERFORMANCE

The effect of mechanically forced unidirectional leaning of young palms on early FFB yield is summarized in Table 1. Bunch yields for the first two years of harvesting in the treatment plot were significantly lower compared to the control plot. Yields of the treatment plot improved from year three onwards when they were significantly higher than those of the control plot. The cumulative FFB yield of the treatment plot, although higher than that of the control plot, showed a difference that was not significant. This result suggests that the treatment had a small adverse effect on early FFB yields. In later years, the technique is expected to give higher FFB yields due to the more uniform leaning direction and growth recovery of the palms.

Work Productivity and Costing

Table 2. Estimated Cost of the Forced Unidirectional Leaning Technique in Two Conditions of Harvesting Path

CONCLUSION

The technique of mechanically forced unidirectional leaning of young palms has good potential for minimizing the negative impact of leaning palms, such as lowering FFB yield and hampering field operations. It is recommended that this technique be adopted for oil palm planted on peat.
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Table 1. Effect of Unidirectional Leaning of Young Oil Palms by Mechanical Force on FFB Yield and Yield Components

<table>
<thead>
<tr>
<th>Yield component</th>
<th>Treatment</th>
<th>Year of harvest</th>
<th>Cumulative mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFB (t ha⁻¹)</td>
<td>Unidirectional</td>
<td>13.9 ± 1.0</td>
<td>14.3 ± 1.6</td>
</tr>
<tr>
<td>Control</td>
<td>16.1 ± 1.4</td>
<td>18.9 ± 2.3</td>
<td>22.3 ± 2.3</td>
</tr>
<tr>
<td>LSD</td>
<td>0.64**</td>
<td>1.70**</td>
<td>2.67**</td>
</tr>
<tr>
<td>Bunch weight (kg)</td>
<td>Unidirectional</td>
<td>4.6 ± 0.2</td>
<td>6.6 ± 0.3</td>
</tr>
<tr>
<td>Control</td>
<td>5.1 ± 0.2</td>
<td>7.6 ± 0.2</td>
<td>9.7 ± 0.4</td>
</tr>
<tr>
<td>LSD</td>
<td>0.13**</td>
<td>0.30**</td>
<td>0.67**</td>
</tr>
<tr>
<td>Bunch production (No. palm⁻¹)</td>
<td>Unidirectional</td>
<td>19.0 ± 1.4</td>
<td>13.5 ± 1.1</td>
</tr>
<tr>
<td>Control</td>
<td>19.7 ± 1.9</td>
<td>15.3 ± 1.9</td>
<td>14.4 ± 1.7</td>
</tr>
<tr>
<td>LSD</td>
<td>0.83**</td>
<td>1.20**</td>
<td>1.33**</td>
</tr>
</tbody>
</table>

Notes: Values are mean ± standard deviations, where n = 12.
** Significant at p = 0.01.
* Significant at p = 0.05.
ns Non-significant.

CONCLUSION

Work Productivity and Costing

Table 2. Estimated Cost of the Forced Unidirectional Leaning Technique in Two Conditions of Harvesting Path

<table>
<thead>
<tr>
<th>Condition of harvesting path</th>
<th>Excavator work force</th>
<th>Estimated cost (RM ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of palms day⁻¹</td>
<td>Excavator moved along harvesting path without timber mat.</td>
<td></td>
</tr>
<tr>
<td>Poor accessibility¹</td>
<td>160 – 240</td>
<td>1.0 – 1.5</td>
</tr>
<tr>
<td>Good accessibility²</td>
<td>320 – 400</td>
<td>2.0 – 2.5</td>
</tr>
</tbody>
</table>

Notes: ¹ Based on excavator rental rate of RM 400 day⁻¹.
² Excavator moved along harvesting path with timber mat.

Benefits of the Forced Unidirectional Leaning

1. Minimizes FFB yield losses through:
   - avoidance of palm and yield losses due to incidences of uprooted palms, palms leaning towards each other, and palms leaning towards field drains and harvesting paths;
   - induction of early and progressive palm leaning that has a less negative effect on yield production; and
   - shortening the period of recovery from palm leaning (less than three years).

2. Increases the efficiency of harvesting operations through:
   - providing good in-field accessibility; and
   - having a more uniform palm height that minimizes the problem of having to use two harvesting tools (chisel and sickle) in the same area.

Recommendation

The technique of mechanically forced unidirectional leaning of young palms has good potential for minimizing the negative impact of leaning palms, such as lowering FFB yield and hampering field operations. It is recommended that this technique be adopted for oil palm planted on peat.
REFERENCES
