INTRODUCTION
Shea tree (Vitellaria paradoxa) is a drought-tolerant oleaginous tree indigenous to savannah regions of sub-Saharan Africa. The shea fruit is consumed as a staple during the beginning of the rainy season while the butter extracted from the kernel is used to manufacture confectionery and as a base for medicines and lotions in the pharmaceutical industries (Masters et al. 2004). Despite its huge economic benefits, the tree still remains wild. The germination of V. paradoxa is described as cryptogeal (Jackson, 1968) but the morpho-anatomical features of the seed that account for that germination type remain unreported. Thus, we used topographical tetrazolium (TTZ) test to determine the exact location of the embryonic axis and describe the morpho-anatomical features of the cotyledonal tube (pseudoradicle). The effect of seed size on germination was also evaluated.

RESULTS AND DISCUSSION

Identification and location of the embryo in V. paradoxa seed
All the fresh seeds in the tetrazolium chloride (TTC) solution stained deep red towards the proximal end, indicating the location of the embryonic axis (Figure 2A & B). A longitudinal section through a stained seed showed two differentially stained regions: a lighter portion suggesting the presence of the radicle and a deeper section indicating the presence of the plumule.

Role of the cotyledonal tube in seedling development

Germination and developmental stages of shea seedlings
- The germination is cryptohypogeal (plumule-burying): the cotyledonal petioles distend into a 3–6 cm hollow tube and the plumule descends through the tube to develop into a rudimentary shoot which grows upwards (Figure 4).

Table 1. Effect of seed size on the stages of shea seedling development

<table>
<thead>
<tr>
<th>Seed size</th>
<th>Days to Germination (MGT)</th>
<th>Cotyledonal tube elongation (CTE)</th>
<th>Bulging (SA)</th>
<th>Shoot appearance (SE)</th>
<th>Shoot elongation (EST)</th>
<th>Establishment (EST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>11.52c</td>
<td>21.52b</td>
<td>27.86c</td>
<td>37.99c</td>
<td>37.03</td>
<td>75.02b</td>
</tr>
<tr>
<td>Medium</td>
<td>9.15b</td>
<td>15.89ab</td>
<td>25.69b</td>
<td>33.31b</td>
<td>32.16</td>
<td>65.47a</td>
</tr>
<tr>
<td>Large</td>
<td>6.98a</td>
<td>11.55a</td>
<td>20.76a</td>
<td>25.36a</td>
<td>35.34</td>
<td>60.70a</td>
</tr>
<tr>
<td>LSD0.05</td>
<td>1.95</td>
<td>5.78</td>
<td>1.85</td>
<td>3.49</td>
<td>-</td>
<td>5.57</td>
</tr>
</tbody>
</table>

MGT: Mean germination time; CTE: Cotyledonal tube elongation; SA: Shoot appearance; SE: Shoot elongation; EST: Establishment and *SE = Emergence – SA.

CONCLUSIONS
- The embryonic axis of V. paradoxa seed is located at the proximal end.
- The cotyledons are fused at the proximal end but are free at the distal end.
- The proximal syncotyl makes the seeds exhibit cryptohypogeal germination.
- A cotyledonal tube comprises sheath, laticiferous vessels and central hollow tube.
- Seed size has a significant effect on seedling development with either small or medium-sized seeds producing vigorous seedlings.

REFERENCES