# SHORT NOTE

# Root distribution of *Trianthema hereroensis* in the Namib dunes

by

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The morphology of root systems of desert plants seems to be dependent upon habitat conditions. Deeply penetrating roots are common in arid areas and often reach a permanently wet soil or a ground-water supply. Horizontally extending roots are common in sandy habitats and may extend for several meters just below the sand surface (Hills, 1966; Louw and Seely, 1980). In the western Namib dune system, the roots of *Trianthema hereroensis* are horizontal and surface-localised, but further east where ground water is within a few meters of the surface, the roots are vertical. Are these adaptations a search for water?

*T. hereroensis* is endemic to the Namib Desert and is restricted to the western half of the southern Namib dune system, where rainfall is low and advective fogs frequently occur. It is one of two plant species persisting in the Namib dunes for long periods without rain. *T. hereroensis* is capable of imbibing water through its leaves, suggesting that these plants could make effective use of the irregular condensing fogs (Seely, De Vos and Louw, 1977). These workers found that roots of *T. hereroensis* were in direct contact with damp sand at a minimum depth of 2 m at the base of the dunes. They described the roots of these plants as long vertical taproots. Many *T. hereroensis* roots are visible at the sand surface at Rooibank (Plate 1) but this is not the case at Flodden Moor. These observations prompted us to further investigate the root systems of this plant. Some precipitating fogs are capable of wetting the upper sand layers which dry out rapidly when the fog clears. *T. hereroensis* occurs in areas on the Rooibank dunes which take longer to dry out after a condensing fog.

The plants at two study sites, Rooibank and Flodden Moor, were considered. Rooibank is in the western part of the Namib dune system (12 km from the coast) whereas Flodden Moor is further east (35 km from the coast) where the occurrence of fog is less frequent. Precipitation was measured using automatic siphon rain gauges which were maintained by the staff of the Desert Ecological Research Unit.

Twenty plants were randomly chosen across the extent of each study site. The percentage of the total plant material which is healthy was subjectively assessed as the amount of green and healthy plant material relative to the total amount of plant material. The size of each plant was then determined. The mound on which the plant grows is usually elliptically shaped when viewed from above. If a is the major axis dimension and b the minor, then an estimate of the area (defined to be plant size) is given by $\pi ab/4$. The plant size and the percentage of healthy plant material were also assessed for the entire population of *T. hereroensis* plants at each study site. The sand around the roots of the 20 plants selected was cleared away and vertical and horizontal root lengths and directions noted. At Rooibank, most of the roots were surface-localised and their lengths easily measured. Most of the plants at Flodden Moor had only one vertical root. These

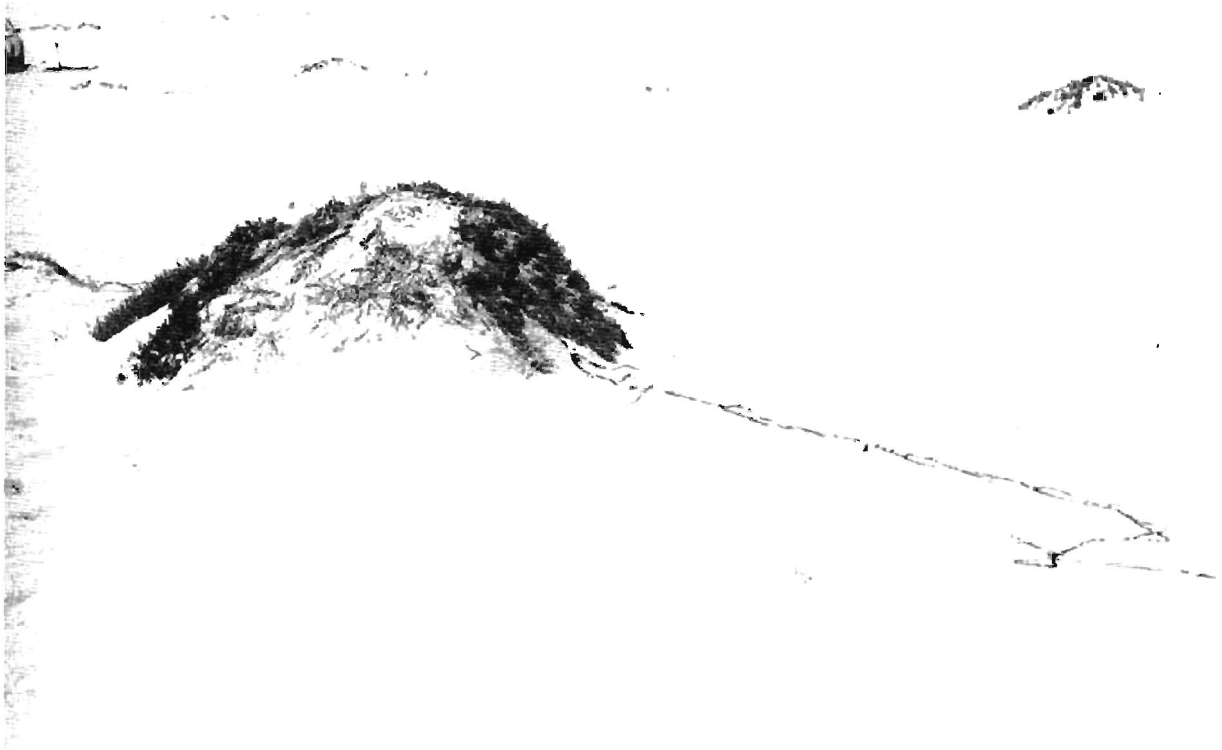

PLATE 1: Surface-localised horizontal *T. hereroensis* roots at Rooibank.

plants were excavated to a depth of approximately 500 mm. Only a few of these plants were further excavated as this meant destroying the plant.

Rooibank has significantly higher total annual precipitation figures (Table 1). The occurrence of precipitation is more frequent at Rooibank than at Flodden Moor. Considering the entire population of *T. hereroensis* plants, on average the plants at Rooibank were less healthy (41%) than those at Flodden Moor (58%). Plant size was found to be greater at Flodden Moor (1,2 m²) than at Rooibank (0,7 m²).

TABLE 1: Annual rainfall and fog (mm) for the two study sites from 1980 to 1982 (DERU, unpublished data), where the number of occurrences is indicated in brackets.

| Year | | Flodden Moor | Rooibank |
|---|---|---|---|
| 1980 | Fog | 60,0 (45) | 112,2 ( 87) |
| | Rainfall | 0,0 ( 0) | 1,6 ( 2) |
| | Total | 60,0 (45) | 113,8 ( 89) |
| 1981 | Fog | 73,1 (63) | 111,8 ( 88) |
| | Rainfall | 2,0 ( 2) | 8,5 ( 2) |
| | Total | 75,1 (65) | 120,3 ( 90) |
| 1982 | Fog | 77,0 (60) | 155,8 (113) |
| | Rainfall | 23,0 (12) | 13,6 ( 4) |
| | Total | 100,0 (72) | 169,4 (117) |
| Mean annual precipitation | | 78,4 | 134,5 |
| Standard deviation | | 20,2 | 30,4 |
| Mean annual number of fog occurrences | | 56 | 96 |
| Standard deviation | | 10 | 15 |

The root data for both sites are presented (Table 2). The plant size and average percentage healthy for these plants are also presented. The plants at Flodden Moor all had long vertical roots and only a few had small horizontal roots within the top 400 mm of the soil. At Rooibank, only three roots were vertical and at least 400 mm long. Generally, the root systems at Rooibank consisted of two or three large horizontal roots within the top 200 mm of the soil. One surface-localised root measured was 6 m in length.

TABLE 2: Root data for Flodden Moor and Rooibank.

| | Flodden Moor | Rooibank |
|---|---|---|
| Number of plants | 20 | 19 |
| Average plant size sampled (m²) | 0,16 | 0,92 |
| Average % healthy | 66 | 36 |
| Standard deviation | 30 | 29 |
| Number of plants with vertical roots | 20 | 3 |
| Average vertical root length (mm) | <400[a] | 400 |
| Number of plants with branch roots | 4 | 15 |
| Average number of branch roots per plant | 1,3 | 2,4 |
| Average length of branch roots (mm) | 180[b] | 1 247[c] |

Notes:

a. One vertical root of 300 mm was found, the other 19 being impossible to measure without destroying the plant.

b. Three horizontal roots were 300 mm long and two were 10 mm long.

c. Length of horizontal roots ranged between 0,1 and 6 m.

Flodden Moor has a lower annual precipitation than Rooibank (Table 1) but plants appear more healthy. This could be due to the combined utilisation of the ground-water supply by the vertical roots and imbibition of condensed fog through the leaves which is then translocated to the roots. The use of both these moisture sources may explain why the plants at Flodden Moor appear more healthy. At Rooibank, the dunes are high and the sandy substrate continuous. Ground-water may be at a greater depth (compared to Flodden Moor) and thus unavailable to *T. hereroensis* plants. These plants would then have to rely entirely on precipitation as a moisture source.

Precipitation amounts are generally small and wet only the upper soil surface. In conjunction with imbibition through leaves, surface-localised roots would be a means of further utilising the frequent but irregular condensing fogs. Whether or not water is actually absorbed by surface-localised roots in contact with the fog-moistened upper layer of the soil, and then translocated to the rest of the plant, is unknown at present.

Rooibank has a significantly greater number of fog occurrences every year. We have noted that *T. hereroensis* occurs in the areas on the Rooibank dunes that take longer to dry out after a fog. We believe that the predominantly surface-localised horizontal roots occurring at Rooibank, as well as the water-seeking vertical roots at Flodden Moor, are adaptations by *T. hereroensis* in its search for water in an arid environment.

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