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South African Journal of Botany 77 (2011) 425–429
SOUTH AFRICAN JOURNAL OF BOTANY
www.elsevier.com/locate/sajb

Gender expression and inflorescence structure of *Pappea capensis* Eckl. and Zeyh. (Sapindaceae)

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Received 4 May 2010; received in revised form 25 October 2010; accepted 28 October 2010

Abstract

Gender and the structure of the inflorescence and flowers of *Pappea capensis* (Sapindaceae) are investigated in a locality around Pretoria (22–27°S and 25–32°E). The trees flower over a long period (December to April) and are basically monoecious, starting with male flowers followed by female flowers towards the end of the flowering period, although some trees may be predominantly male and some predominantly female. The inflorescence is a reduced thyrse with small flowers. Male flowers have five ephemeral petals, eight stamens and a rudimental pistil. Female flowers comprise a 3-lobed ovary, a single style and stigma and eight staminodes.

Keywords: Dichasia; Inflorescence structure; Monoecy; *Pappea*; Sapindaceae; Thyrse

1. Introduction

Pappea capensis (Sapindaceae) is a small tree or shrub, indigenous to Africa with a wide distribution from the southern Cape in South Africa to Ethiopia in the north. The seed of *Pappea capensis* contains about 74% edible oil (Coates Palgrave, 1977; Landsell, 1920; Venter and Venter, 2007) that can be used for various purposes and might also be a source for bio-diesel. No information about seed production is available and there is still disagreement about the sexuality of the trees as well as the structure and type of the inflorescence. Most authors of books on indigenous trees of Southern Africa concur that the trees are dioecious (Coates Palgrave, 1977; Landsell, 1920; Palmer et al., 1972; Van Rooyen, 1984; Van Wyk and Van Wyk, 1997; Van Wyk, 1984; Venter and Venter, 2007; White, 1962). However, Fivaz and Robbertse (1993) and Davies and Verdcourt (1998) supplied evidence showing that the trees are monoecious, first producing male flowers and later producing female flowers, either on the same inflorescence or on separate inflorescences. Fivaz and Robbertse (1993) also referred to other monoecious members of Sapindaceae with male and female flowers on the same inflorescence.

Some authors describe the inflorescence as a catkin-like raceme (Coates Palgrave, 1977) without distinguishing between male and female inflorescences. Landsell (1920) and Palmer et al. (1972) describe the inflorescence as a panicle up to 15 cm, while Van Wyk and Van Wyk (1997) describe it as "drooping spikes." Davies and Verdcourt (1998) described the male inflorescence as a "lax or a dense thyrse" while most authors regard the female inflorescence as a raceme (Coates Palgrave, 1977; Landsell, 1920; Palmer et al., 1972). According to Van Wyk (1984) "Male and bisexual flowers are borne on separate trees; petals of bisexual ones (3) white and the hairy ovaries buff-green, in spikes up to 6 cm long."

According to Richards (1990), monoecious plants tend have an unstable sex expression as seen in Cucurbitaceae (melons and squashes), where high temperatures and long days stimulate the production of mostly male flowers, whereas under opposite conditions (low temperatures and short days) the plants tend to produce more female flowers. Male flowers are also produced over a longer period in a relatively proximal position on the plant, whereas female flowers tend to be produce later in the season over a shorter period in a more distal position on the plant. Furthermore, younger monoecious trees are inclined to be

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doi:10.1016/j.sajb.2010.10.011

mostly or wholly male while older trees have more resources and tend to be mostly or wholly female (Richards, 1990).

From the above brief overview, it is clear that the descriptions of the sexuality, inflorescences and flowers of *P. capensis* found in books on Southern African trees are either incomplete or even erroneous. With the exception of Fivaz and Robbertse (1993), no proper study has ever been done on gender expression or inflorescence structure in *P. capensis*. We accordingly studied these aspects in plants locality around Pretoria (22–27°S and 25–32°E).

2. Materials and methods

Observations over a period of 3 years were made on two trees in a tree collection on the experimental farm of the University of Pretoria (UP) (25°45' S, 28°16' E). Twenty more trees growing in the wild in a locality 30 km north of Pretoria were marked during December 2009 and visited at monthly intervals. Material was also collected during field trips to other parts of the wider study area (22–27°S and 25–32°E). Herbarium specimens from the National Herbarium of Pretoria, the Schweickerdt Herbarium at the University of Pretoria, and the Compton Herbarium in Cape Town were also consulted. Specimens collected during field trips and from the marked trees have been deposited in the Schweickerdt Herbarium at the University of Pretoria.

No special technique was applied to score sex expression of trees. Trees that were observed in the male phase were each bearing hundreds to thousands inflorescences, each bearing male flowers only, while inflorescences on trees in the female phase, borne only female flowers or female flowers with remains of some dead male flowers amongst the female flowers.

Most herbarium specimens found in the different herbaria were collected with male flowers and very few with female flowers. The descriptions in this paper are therefore mainly based on material collected and observations made during field excursions and visits to the marked trees.

3. Results and discussion

3.1. Inflorescence

Trees in and around Pretoria usually start flowering in December/January and may continue to flower until April. Inflorescences are produced singly in the axils of the first-formed leaves of the new flush of both short and long shoots, and consist of an erect main axis up to 12 cm long, containing reduced dichasia in the axils of the bracts along the main axes (Fig. 1). According to White (1962), the inflorescences can be up to 21 cm, but no such inflorescences were found in this study. Based on the sex expression of the flowers, three inflorescence types are found (Fig. 2), namely, male, female and mixed inflorescences, but the basic structure conforms to a reduced, indeterminate thyrse (Sensu Weberling, 1992). Especially in young inflorescences, the hypopodia of the dichasia are extremely reduced or lacking and the dichasia are then sessile (Fig. 1). The development of a dichasium starts with the terminal, first order flower with two

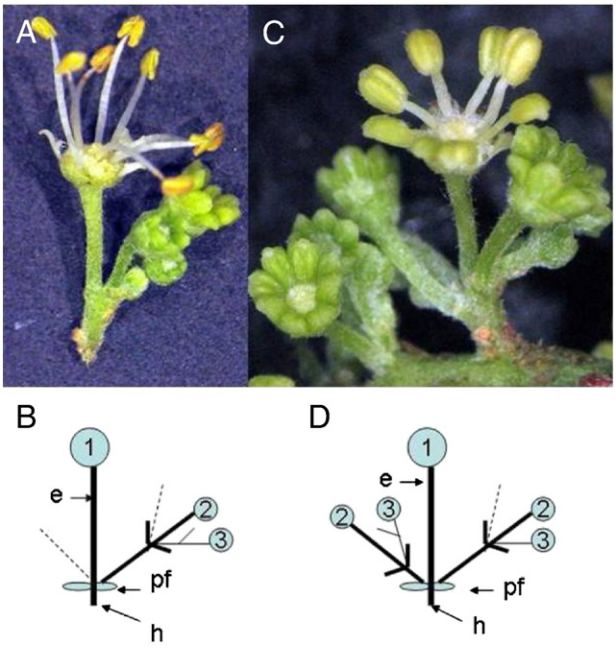

Fig. 1. Dichasia and young inflorescence of *Pappea capensis*. Real (A) and diagram (B) of reduced dichasium showing reduced hypopodium (h), epipodium or pedicel (e) of first order flower (1), prophylls (pf) and second and third order flowers (2 and 3). Real (C) and diagram (D) of young dichasium (right) and reduced dichasium (left).

bracts (prophylls) at the base of the pedicel (epipodium), close to the bract on the main axis (Figs. 1A and 4A). A second order bud, also with two prophylls at its base, then develops in the axil of one, or both first order flower prophylls. The process is repeated

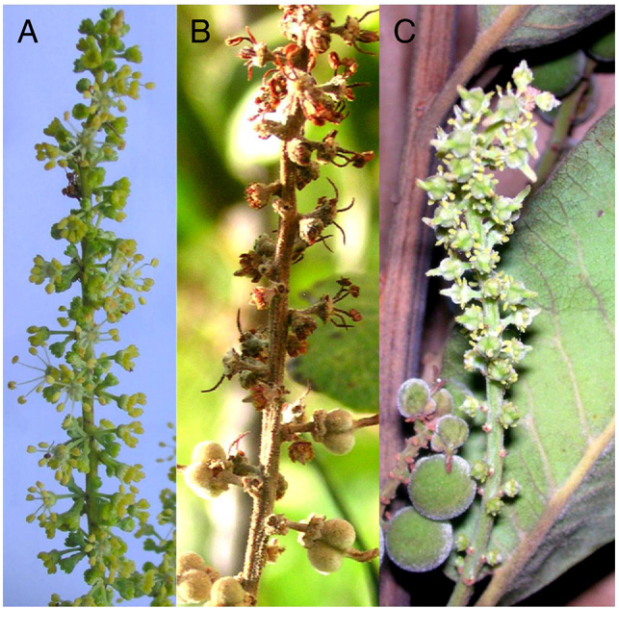

Fig 2. Three inflorescence types found on *P. capensis* trees at different times of the flowering period. A, inflorescence producing male flowers. B, inflorescence with male flowers followed by female flowers. C, inflorescence with female flowers .Young fruit on separate inflorescence bottom, left.