Human preference for, and insect damage to, six South African wild fruits

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Throughout history, harvesting of fruit from the wild has played a role in the livelihoods of people in South Africa. For the San, who lived in South Africa for thousands of years, wild fruits were a staple food during parts of the year (Fox & Norwood Young 1983). Among the Bantu people, who entered South Africa about two thousand years ago (Hammond-Tooke 1993), agriculture was the main way in which food was acquired, but they also collected food from the wild. Especially during times of hardship, when cattle herds were decimated or crops were destroyed, they relied on hunting and gathering of fruits and edible plants from the wild for survival (Shapera & Goodwin 1959; Stuart & Malcolm 1986; Bundy 1988). European people settling in South Africa learnt to use and appreciate wild fruits (van Dyk 1988). In the rural areas of the Southern African region, the utilization of wild fruits as a source of food has persisted, especially among black people (Walker 1989; Shackleton 1996; Rossiter, Pellegrin *et al.* 1997). There is increasing interest in the domestication and improvement of selected fruits, and their utilization as orchard crops, marula (*Sclerocarya birrea* subsp. *caffra*) being the prime example (Nerd *et al.*1990; Holtzhausen, Swart & van Rensburg 1990; Nerd & Mizrahi 1993; Geldenhuys 2001; Taylor 2001; Barton 2001). Research into the wild fruits of South Africa has been mainly botanical or anthropological. Little work has been done on pests and diseases (Fox & Norwood Young 1982; van Wyk 1984; Coates Palgrave *et al.* 1985; Scholtz & Holm 1985; Pooley 1993; Barton 2001) and to date insect damage has not been a major concern. For example, Van Averbeke (2002) reported that rural black people, who picked wild fruit for immediate consumption or for processing into beverages using traditional methods, were either unaware of the presence of insects in the fruits, or did not mind their presence as long as damage to the fruit was limited. Fruits that showed clear signs of decay as a result of insect damage or other causes were either not picked or were discarded. The susceptibility of a particular fruit to damage by pests and diseases becomes an important factor when commercial exploitation of the fruit is being considered (De Lange *et al.* 2001). The current study is a preliminary enquiry into insect damage to six different wild fruits found in the northern part of South Africa. First, a survey was used to identify the different types of wild fruit used by black people in the area. Second, the insects attacking the fruit of six of these indigenous tree species were identified.

The study, which was conducted during 1996 and 1997, first involved a survey of knowledge of wild fruits and preferences among black people residing in the northern part of South Africa. The survey investigated which wild fruits they knew, and which of those they liked best for consumption as fresh fruit, or for use in various processed forms, such as non-alcoholic and mildly-alcoholic beverages and desserts. In order to do this a comprehensive list of the wild fruits growing in the triangle delimited by the towns of Pretoria, Polokwane (Pietersburg) and Rustenburg was compiled, using Van Wyk (1984), Coates Palgrave *et al.* (1985); Van Gogh & Anderson (1988) and Pooley (1993) as sources. From this list of 40 trees the senior author and three black residents, who had all obtained formal botanical training, selected 11 species for further investigation, using consumption among local people as the criterion. Colour photographs of these 11 fruits were used in the survey involving face-to-face interviews. During the interviews, respondents were shown the 11 photographs and asked to separate the fruits they knew from those they did not. Thereafter, they were requested to rank the fruits they knew in order of personal preference. For each respondent, the fruit most preferred was given a score of 11, the second a score of 10, and so on. Fruits not known to the respondent were allocated a zero score. Sampling occurred in the urban settlements of Soshanguve (25°30′S 28°04′E) (n = 16) and Mamelodi (25°42′S 28°20′E) (n = 15) in the north of Gauteng Province, and in the rural settlements of Sebayeng (23°43′S 29°43′E) (n = 15) and

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Makotopong (23°51'S 29°37'E) (n = 15) near Polokwane in Limpopo Province. Selection of respondents was by means of convenience sampling (Leedy 1993). Convenience sampling, also called accidental sampling (Strydom & De Vos 1998) or incidental sampling (Welman & Kruger 2001), is a non-probability sampling method that selects any sampling unit crossing the path of the investigator until the desired number of units has been sampled. It does not allow for generalization of the study population and is used mainly to obtain preliminary information on the phenomenon under investigation. A total of 61 adults (aged 15 years and older) participated in the survey (34 males and 27 females). At all four sites respondents were interviewed during the day (10:00–14:00) at a taxi rank, while they were waiting for a taxi. The different scores allocated to each fruit by the 61 respondents were summed and used to rank the fruits. The ranking obtained was used to select six different wild fruits for evaluation during the second phase of our study, which assessed the susceptibility to damage by insects.

The fruit trees selected for further study were *Englerophytum magalismontanum, Vangueria infausta, Lannea discolor, Strychnos pungens, Mimusops zeiheri* and *Ximenia caffra.* The study area was the Recreation Farm of Tshwane University of Technology, called Toppieshoek (27°51'E 25°46'S), in Broederstroom.

The sampling area consisted of the eastern and western slopes of a narrow north-facing valley. The soil cover on the slopes was shallow, and rocky outcrops occurred in several places. The study area is situated along the transition between the rocky highveld grassland and the mixed bushveld vegetation types (Low & Rebelo 1998). The trees that were sampled formed part of a wider variety of indigenous trees scattered throughout the landscape. Three specimens of each tree species were selected during a transect walk through the valley. The main criterion used in the selection of trees was accessibility, and the sampling procedure is best described as convenience sampling. Selected specimens were colour-coded by spraying paint on tree trunks 50 cm above the soil surface. The fruit of these trees was sampled every two weeks over a period of six months, from October 1996 to April 1997. For sampling the tree canopy was divided into four quadrants of 90° using a compass and each quadrant was subdivided in a top and a bottom half, yielding eight sections. One representative fruit was collected from each of these eight sections, yielding a maximum of eight fruits per tree, depending on availability. This was done to account for differences in rate of development resulting from different exposure to sunlight. During each collection a total of 20 fruits of a particular species was sampled. A stepladder was used to sample fruits from the top half of the canopy of tall trees. For each species and collection date the 20 fruits were placed in a single plastic bag, sealed, labelled and transferred to a cool bag. A five-category code was used to describe the stage of development of the fruit. Growth stage 1 referred to flowers, 2 to small green fruit, 3 to large green fruit, 4 to fruit in the process of ripening as indicated by colour change and included full ripeness, and 5 to fruit that was overripe and in various stages of decay.

In the laboratory, the fruits from each species and each collection date were transferred to separate insect rearing cages (Uys & Urban 1996). The date of collection of each fruit sample was recorded on the cages. The cages were kept in a controlled-climate room at a temperature of 27 ± 3 °C) and R.H of 55 ± 5 %). The fruits were kept in the cages for a period of three months. The cages were examined every second day to record emerged insects. Insects emerging from a single rearing cage were all placed in one pre-cleaned, labelled glass vial, sealed with a cotton stopper. Insects were identified at the Transvaal Museum (Northern Flagship Institution) or the Biosystematics Division of the Plant Protection Research Institute, both in Pretoria, South Africa.

Knowledge of the 11 wild fruit species among respondents was widespread. Only three of the 61 respondents did not know all 11 fruits. Considering that the mean age of respondents was 29 years, the results suggested that knowledge of wild fruit persists among the population residing in the northern part of South Africa. An indication of the overall preference of respondents for the 11 fruits incorporated in the survey is presented in Table 1.

There was great diversity of preference among respondents (Fig. 1). For example, 40 of the 61 respondents ranked marula among the three most preferred fruits, but there were also some who did not like it. Conversely, there were 18 respondents who liked live-long least, but there were also 10 who ranked it among their three most preferred fruits. Reasons for the diversity in preference among respondents were not investigated, but

Table 1. Overall ranking of wild fruit in order of preference by a sample of black people residing in the northern part of South Africa (*n* = 61).

Scientific name of wild fruit tree	Common English name	Sum of scores	Rank
Sclerocarya birrea spp. *caffra*	Marula	497	1
Englerophytum magalismontanum	Milkplum	477	2
Strychnos pungens	Black monkey orange	424	3
Syzigium cordatum	Waterberry	392	4
Trichilia emetica	Natal mahogany	367	5
Carissa bispinosa	Num-num	353	6
Ximenia caffra	Sour plum	332	7
Myrsine Africana	Myrtle	320	8
Dovyalis zeyheri	Wild apricot	288	9
Vangueria infausta	Wild medlar	287	10
Lannea discolor	Live-long	266	11

differences in degree of exposure to the different fruits may be one.

Qualitative and quantitative information on the various insect species reared from the fruit of the six tree species collected at different stages of growth are presented in Table 2. Four insect species emerged from the fruit of *E. magalismontanum.* The three Diptera specimens, two of *Ceratitis* (*Pterandus*) *rosa* and one of *Ceratitis* (*Ceratitis*) *rosa,* emerged from fruit sampled on January 2, 1997, when it had reached growth stage 4. The 27 specimens of the Lepidoptera emerged from fruit that had reached growth stages 4 and 5. This fruit was sampled during the period December 1996 and January 1997 on the different sampling dates. The Lepidoptera recovered included 18 specimens of *Bahiria ximenianata* and nine of *Nola poliotis.* Larval host records of the two moths found in *E. magalismontanum* exist at the Transvaal Museum. The records report on the presence of the larvae on *E. magalismontanum* and on *X. caffra,* which is also indigenous to South Africa. The inscriptions on the labels read *"Nola poliotis*: male: Bedford Ridge, Jhb, 8.iii.1940 (A.L. Capener), bred from larva feeding on 'stamvrugte'" (*stamvrugte* is the common Afrikaans name for *E. magalismontanum)* and *'Bahiria ximenianata*: male: Pretoria, 2.iii. 1917 (A.J.T. Janse), from fruits of *Ximenia caffra,* retained'. Relative to fruit that was free of insect damage, attack by members of both the Lepidoptera and Diptera increased the rate of decay of the fruit of *E. magalismontanum.*

Ten specimens of *Archernis flavidalis* (Lepidoptera: Pyralidae) were collected from the fruit of *V. infausta* (Table 2). Three specimens emerged from fruit sampled during growth stage 2 (20 November 1996), two were collected during stage 3 (4 December 1996 and 18 December 1996) and five appeared from fruit sampled during growth stage 4 (16 January 1997). A tiny wasp, *Megastigmus* sp., emerged from young fruit of *V. infausta* sampled during growth stage 2 (20 November 1996). This wasp is known to infest the seed inside the fruit (Scholtz & Holm 1985). Relative to fruits

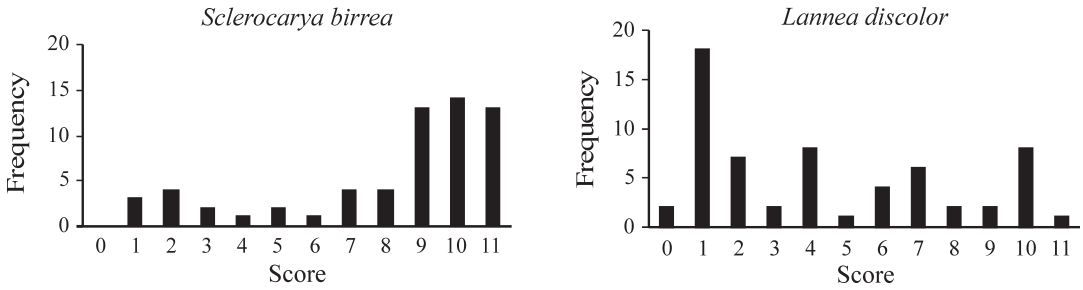

Fig. 1. Frequency distribution of scores indicating personal preference allocated by respondents to marula (*Sclerocarya birrea*) and live-long (*Lannea discolor*), with a score of 11 allocated when the fruit was the most preferred among a list of 11 species, a score of 1 when it was least liked, and a score of 0 when the respondent did not know the fruit (*n* = 61).

Table 2. Insects reared from six types of wild fruit collected at Toppieshoek, Broederstroom, South Africa.

Tree species	Insect order	Insect family	Insect species	Number of insects emerged during certain growth stages of fruit.*				
				2	3	4	5	Total
E. magalismontanum	Lepidoptera	Pyralidae	*Bahiria ximeniata*	0	0	9	9	18
	Lepidoptera	Noctuidae	*Nola poliotis*	0	0	3	6	9
	Diptera	Tephritidae	*Ceratitis* (*Pterandus*) *rosa*	0	0	2	0	2
	Diptera	Tephritidae	*Ceratitis* (*Ceratitis*) *capitata*	0	0	1	0	1
V. infausta	Lepidoptera	Pyralidae	*Archernis flavidalis*	3	2	5	0	10
	Hymenoptera	Torymidae	*Megastigmus* sp.	1	0	0	0	1
L. discolour	Hymenoptera	Torymidae	*Megastigmus* sp.	0	0	1	0	1
S. pungens	Diptera	Tephritidae	*Ceratitis* (*Ceratitis*) *capitata*	0	0	68	176	244
X. caffra	Lepidoptera	Pyralidae	*Archernis flavidalis*	0	2	2	0	4
	Lepidoptera	Gelechiidae	*Anarsia spicata*	0	0	1	0	1
M. zeiheri	Hymenoptera	Eurytomidae	*Bruchophagus* sp.	0	0	1	0	1

*Growth stage 1 = the stage of flowering and initial fruit development; 2 = small green fruit; 3 = large green fruit; 4 = fruit that was ripening as indicated by colour change: 5 = fruit that was overripe and in various stages of decay.

that were not attacked, those infected by *Archernis flavidalis* decayed rapidly, rendering them unsuitable for human consumption within a matter of days. No visible damage to the fruit from which the wasp emerged was evident.

A single specimen of *Megastigmus* also emerged from a fruit of *L. discolor* that was collected during growth stage 4 (16 January 1997). As in the case of *V. infausta* the wasp did not cause any visible damage to the fruit. No other insects were found in any of the fruit samples that were collected.

Fruit flies (*C. capitata*) were the only insect species that emerged from the fruit of *Strychnos pungens*. They attacked the fruit during growth stages 4 and 5 (Table 2). Seven specimens emerged from fruit collected on 13 February 1997, 61 from fruit sampled on 27 February 1997, and 176 from fruit sampled on 13 March 1997, indicating that the severity of infestation increased as the fruit progressed from ripe to over-ripe. All fruit had decayed completely by the time the fruit fly adults emerged.

Two specimens of *Archernis flavidalis* were collected from the fruit of *X. caffra* sampled during growth stages 3 (6 November 1996) and two from fruit sampled during growth stage 4 (4 December 1996). A single specimen of *Anarsia spicata,* (Lepidoptera: Gelechiidae), emerged from a fruit sampled at the end of growth stage 4 (16 January 1997). Feeding by the caterpillars of *Archernis flavidalis* and *Anarsia spicata* rapidly destroyed the fruit they had infested.

A single specimen of a eurytomid wasp, *Bruchophagus* sp., was found in a fruit of *M. zeiheri* collected during growth stage 4 (4 December 1996), but no visible damage to the fruit was observed.

The results of a survey indicated that knowledge of wild fruit species persists among urban and rural black people residing in the north of South Africa. Preference for particular fruit species varied among respondents, but generally marula (*Sclerocarya birrea),* milk plum (*E. magalismontanum)* and black monkey orange (*Strychnos pungens*) were the three most preferred. The preliminary study of insect damage showed fruits to differ in terms of the types of insects that caused damage, the stage of development during which the insects entered the fruit and the severity of the attacks. Indications were that the fruit of *M. zeiheri* and *L. discolor* were least susceptible to insect damage and that of *E. magalismontanum* and *Strychnos pungens* the most. With few exceptions, fruit that was attacked by insects decayed more rapidly than fruit that was not, indicating that damage to fruit by insects is likely to become a concern when commercialisation of susceptible wild fruit species is being considered. Generally, insects attacked the various fruits during ripening or once ripe, although there were also a few cases where insects attacked the fruit at an earlier stage of development. Picking fruit at the start of the ripening process and allowing this process to continue in an environment that is free of insects may be one way of minimizing insect damage to selected wild fruits.

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