

# Botanical research in South Africa: A questionnaire assessment of opinions of South African botanists

C.L. Bredenkamp<sup>a\*</sup> and G.F. Smith<sup>b</sup>

The South African National Biodiversity Institute conducted a questionnaire-based enquiry in 2004 into perceptions of the current state of botany in South Africa. Terms of reference were numbers of botanical papers being accepted for publication, both locally and abroad, and an evaluation of replies of South African botanists to specific questions that were put to them. The overall conclusion is that government remains the main source of funding, but this source is diminishing in importance, and institutions need to become financially more self-reliant to survive. Economics make collaborative research programmes essential. The advancing group age of practising botanists, together with an inadequate rate of training and mentoring of young incumbents are cited as sources of concern. South African publications need to achieve international standards of excellence. Reasons indicated for the status quo in botany are given as low salaries of botanists, poor job security, and inadequate research funding.

## Introduction

South Africa accounts for about 0.5% of global open-published research. The mean age of our research contributors is advancing.<sup>1</sup> These trends prevail within South African botany, motivating this investigation under the auspices of the South African National Biodiversity Institute (SANBI) as to the state of this discipline in South Africa. A questionnaire was compiled in 2004 and was sent to practising botanists. This paper analyses the information returned, including respondents' comments on work-place experience. Two hundred and fifty-nine questionnaires were sent electronically to practising botanists in the private sector, government and other institutions listed in the footnote.<sup>a</sup> Sixty-seven copies were completed and returned (36% response).

## Results and discussion

Table 1 lists the raw numerical data and is viewable online. Graphical depiction of results is presented in Figs A-F, which,

with Table 1, are viewable online at [www.sajs.co.za](http://www.sajs.co.za)

### Part 1. Institutional funding

Figure A indicates that national government is regarded as the most important source of funding of the assessed institutions that employ botanists. Few botanists are autonomous, self-employed or in private business. Only 6% of respondents are totally independent of government, their funding for research coming exclusively from non-statutory sources. Two-thirds of the respondents regard inadequate funding as a significant impediment to progress in botanical research (Table 1, Part 1.5).

These funding figures comprise the relevant institution's own research budget, funding from national research institutions, income from contract research and from the Technology and Human Resources for Industry Programme (THRIP). Contract income has exceeded an institution's own research budget in at least three instances. SANBI's income statement, in the annual report for 2004/5,<sup>2</sup> lists a Medium Term Expenditure Framework government grant of R82.772 million and an amount of R98.085 million from other grants, sponsorships and donations. These cases illustrate that government-funded institutions are expected to become more self-reliant, the official research budget requiring other supplementary sources of funding.

<sup>a</sup>South African National Biodiversity Institute, Private Bag X101, Pretoria 0001, South Africa.

<sup>b</sup>South African National Biodiversity Institute, Pretoria, and Acocks Chair, H.G.W.J. Schweickerdt Herbarium, Department of Botany, University of Pretoria, Pretoria 0002, South Africa.

\*Author for correspondence.  
E-mail: [bredenkamp@sanbi.org](mailto:bredenkamp@sanbi.org)

### Part 2. Institutional research and capacity

Figure B categorizes botanical research, executed individually, corporately, or in collaborative programmes:

- 79% of the respondents have been independent in a specific sub-discipline. This situation is typical at universities, where students have individual projects.
- 43% of respondents commonly work together on a corporate project undertaken by the institution that employs them.
- Programme A—51% of respondents have been active in research, where botanists of the *same* sub-discipline worked on individual projects, e.g. ecologists working on an ecosystem, or taxonomists or systematists working on plant families.
- Programme B—61% of the respondents have been active in research, where scientists of *different* disciplines researched individual projects in a group programme, e.g. environmental impact studies or internationally funded projects, such as the Cape Action for People and the Environment (CAPE), the Subtropical Thicket Ecosystem Planning (STEP), and the Succulent Karoo Ecosystem Programme (SKEP). Conducting research in a cooperative programme has the advantage of easier access to funding for a group. This approach has become relatively popular. Larger institutions tend to set up a number of programmes, with the requisite infrastructure and staff, and universities generally form specialist and independent institutes within their departments.

### The identity and relationship of co-workers in research

(Table 1; Part 2.2)

- 57% are postgraduate students, mentored by university teachers;
- 67% work in collaboration with botanists within their own institute;
- 60% collaborate with peer botanists from other national institutions;
- 52% indicate that they collaborate internationally.

Jewitt and Görgens<sup>3</sup> and Katz and Martin<sup>4</sup> describe the adverse factors affecting interdisciplinary projects. Most relevant in the field of botany are the escalating costs of fundamental science research, a need for scientific interaction and networking, increasing need for specialization, the complexities of negotiation of interdisciplinary structures, all of which can be affected by political factors.

Blankley *et al.*<sup>5</sup> reports on the research and technological development and cooperation between South Africa and

the European Union. Key areas of interest to botanists have been identified under the headings *Environment and climate*, and *Rational use of natural resources*.<sup>6</sup>

The Southern African Botanical Network (SABONET) programme, under the auspices of SANBI, has aimed at strengthening levels of botanical expertise, expanding and improving herbarium and botanical garden collections, and fostering closer collaborative links between botanists in southern Africa. The project has attracted a strong core of professional botanists, including taxonomists, horticulturists and plant diversity specialists within 10 selected countries in the sub-continent (Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe) and was finalized in 2005. This programme serves as a good example of a funding opportunity that has been created by international collaboration.

#### *Scientific expertise and equipment*

Respondents expressed the following views on availability of scientific expertise and equipment at South African institutions (Table 1, Part 2.3):

- 46% find the expertise and equipment to be adequate;
- 76% report that departments shared equipment;
- 40% indicate that very expensive equipment, such as electron microscopes, with support costs, are being shared between institutions.

Less than half of respondents find expertise and equipment to be adequate, raising concern about capacity. World-class research (and world-class publications therefrom) in all sub-disciplines of botany must have the support of adequate infrastructure and modern technology.<sup>7</sup>

#### *The rising average age of employed botanists*

The survey addresses the group-average age of botanists employed in South Africa. Practising botanists have a predominant age range in their institutions of 41–50 years, which is indicative of an unsustainable rate of appointment of younger people (Table 1, Part 2.4). This will, in time, lead to diminishing numbers of practising botanists.

The advancing average age of practising scientists in South Africa has been widely reported.<sup>1</sup> As long ago as 1993, a survey<sup>8</sup> by the Foundation for Research Development [FRD; now part of the National Research Foundation (NRF)] showed that botany, agriculture and nature conservation were among the natural science disci-

plines where the highest number of students had secured jobs after graduation. A small percentage of respondents in institutions indicate an average age of botanists of as young as 20–30 years, attributing this to:

- A necessity for students to study in disciplines that favour better employment opportunities;
- the movement of students from taxonomy and ecology to molecular biology; and
- lack of posts and/or funding for permanent appointment of young botanists.

#### *Registered postgraduate botany students in higher education institutions*

The results indicate a high ratio of postgraduates per staff member, some lecturers supervising 11–20 or more individuals (Table 1, Part 2.5).

Nine departmental heads, mostly at universities, indicated that there were more than 20 postgraduate students in their department, the highest being 83. This is a contra-indication of the view that the number of postgraduate students in botany is declining.

#### *Numbers of postgraduate botany students in each institution*

This information covers institutions other than universities, with staff members supervising postgraduate programmes. Four respondents had more than 20 postgraduate students, showing a commitment to academic training, personal development and career competence.

A 1992 FRD survey<sup>9</sup> gives a statistic of three postgraduate students per academic staff member. Our data show as many as 10, and in some cases over 20 per staff member. Vacancies, with no suitable applicants, are a contributing cause. The situation could arise from the lack of job opportunities in botany, with the consequence that students remain at university and continue with postgraduate studies. More responsibility is placed on university teaching staff, abetted by the NRF funding system, where their leadership in the field and the number of students recorded with them will determine funding allocation.<sup>10</sup> In the environmental sciences, Walmsley and Walmsley<sup>8</sup> identify postgraduate training through research as the best way in which a country can enlarge the pool of available skills.

#### **Part 3. Institutions and publications**

##### *Access to, and publication in, South African journals*

Ninety-one per cent of respondents have readership access to peer-reviewed South African journals. Seventy-five per

cent have access to key international/foreign botanical journals (Table 1; Parts 3.1 and 3.3). Two out of three respondents publish in South African journals. An analysis of the frequency of publication in South African journals indicates that 21% of the respondents publish regularly, and 19% publish intermittently. Forty-two per cent of respondents seldom publish in South African journals, while 3% do not publish in local journals at all. Thirty per cent of the respondents publish papers of largely national relevance in South African journals (Table 1; Part 3.2).

Pouris and Richter,<sup>11</sup> in their assessment of journals published by the now-defunct Bureau for Scientific Publications, concluded that South African journals were in the main introspective, dealt with regional topics, and were written by local authors. Their reach was thus limited in terms of subscription and indexing. As most respondents publish in South African journals (66%), they should be aware of the ASSAf report<sup>12</sup> on research publishing, stating that South African publications need to attain an international quality, and that local journals need to strive for ISI accreditation standard.

#### *Publication in international/foreign journals*

About half of respondents publish in foreign journals more regularly than in local publications (Table 1, Part 3.4).

#### *Field of publication*

Figure C shows that 49% of respondents publish in botanical taxonomy and 49% in ecology. Twenty-one per cent publish in physiology and 15% in biotechnology (Table 1, Part 3.5).

A survey of articles in five South African botanical journals between 1988 and 2002 by Bredenkamp and Smith (in press) shows that articles largely relate to taxonomy, followed by ecology, then physiology and lastly in biotechnology. This survey points to a relatively high percentage of botanists who are publishing in biotechnology, which implies that these biotechnology papers are appearing in foreign journals.

#### *Number of papers per age group of publishing botanists*

Figure D shows the number of papers per age group of publishing botanists for the two years prior to the questionnaire (2002 and 2003). These data confirm that older botanists dominate publication in South Africa, with much less originating from those younger than 40. Publication profile relates to employment profile

(Table 1, Part 3.6). The situation is a cause for concern, as the scientific responsibilities of senior botanists tend to discourage them from mentoring younger staff members, creating a generation gap that will impact negatively on publication productivity in the future.

#### *Age groups of publishing botanists*

Analysis of the age groups indicates that most publishing botanists fall in the age groups 41–50 and 51–60, in agreement with the data for the average age of employed botanists (Table 1; Parts 2.4 and 3.7).

#### *Reasons why South Africa has a lack of young publishers in botany*

Figure E indicates the respondents' choices as to the options that best reflect the reasons for a lack of young publishers in botany in South Africa (Table 1, Part 3.8). Lack of 'Constant mentoring of new incumbents' scored highest, followed by 'insufficient training of botany students' with 'incumbents unaware of their responsibility to publish' at the lowest score. Unawareness among young botanists that publishing is essential for a research career in botany could be a factor, for which teaching institutions may well have to accept some responsibility. Learning to think independently, as well as a problem of serious illiteracy in science-writing are weak areas in science education that require to be addressed with priority by institutions of learning. Good publications are predicated by quality research. Unpublished research is as good as never having done the work at all.

Other points made by respondents include:

- Recent graduates have inadequate time to write up publications after taking up employment.
- Research output can be third-party property in closed contract-research reports, with an open-publication restraint on the content.
- Publication may be restrained, pending the award of intellectual property rights on information.

#### *Foreign publications versus those in South African journals*

Almost half of the respondents prefer publication abroad to local publication (Table 1, Part 3.9).

The notion that international publication is superior to local publications is reflected in the statutory funding and rating processes in our country.<sup>11</sup> Behaviour is thus moulded by the reward system.

#### **Part 4. Impediments perceived to exist in botanical research in South Africa**

Scores, in descending order, are 'salaries of botanists', 'research funding', 'expense of scientific equipment' and 'job security'. 'Interpretation and presentation of research results' and 'Publication in the peer review system too demanding' scored the least, but nevertheless merit further inquiry (Fig. F).

#### *Funding of research*

Limited availability of research funding has been identified by 61% of the respondents as the most important constraint (Table 1, Part 4.1). Twenty-four per cent chose accountability (responsibility), while 53% regard reporting as a further constraint on research funding, and this could be linked to the problems of competence in report-writing. Most government institutions are dependent solely on government grants for research, and they need funding partners, research contracts, or research collaboration to secure supplementary project funding. The availability of funding through these partnerships is not widely publicized, and botanists need to educate themselves about available finances and the accepted methods of submitting applications for them. Blankley *et al.*<sup>5</sup> regard the lack of funding as the most important factor, with the identification of research partners as the second most significant barrier to research collaboration.

#### *Cost of scientific equipment*

Fifty-seven per cent of the respondents identified 'expensive equipment' as an important constraint to botanical research in South Africa (Table 1, Part 4.2). This agrees with the conclusions of a recent study commissioned by NACI,<sup>13</sup> which identifies the lack of equipment and facilities as an obstacle to research in this country. Existing equipment is often unsuitable or obsolete. Replacement is almost inevitably from foreign manufacturers, with the concomitant expenses associated with purchases of this kind.

#### *Interpretation, presentation and publication of research results*

Thirty-nine per cent chose 'Interpretation and presentation of research results' as a prime issue. Twenty-two percent opted for 'Publication in the peer review system too demanding', and perceive this as a serious impediment to South African research. Inexperienced botanists can be discouraged by the peer-review system, opting for publication in journals without peer review, evading pressure to raise their standard, to the detriment of their

publication track record (Table 1, Parts 4.3 and 4.4). A now-dated FRD survey of 1996 on South Africa's research culture<sup>14</sup> indicates that postgraduates are confident in their ability to design and write up their research projects, a view not shared by senior academic supervisors, and not effectively communicated by them to postgraduates.

#### *Salaries*

Seventy per cent regard their salaries as inadequate, relative to the private sector (Table 1, Part 4.5). Sixty-nine per cent regard their salaries as inadequate, without any comparisons. Fifty-seven per cent of respondents regard financial benefits as inadequate. Thirty-nine per cent believe that salaries are unfavourably structured for tax benefits.

A career in botany requires effort, energy and passion. From the opinions of the respondents (available in the official report at SANBI) it is evident that the civil service salaries earned by botanists are a source of dissatisfaction. Low salaries and financial constraints prompt many botanists to set up their own consultancies. Private consultation has the advantage of wider experience outside the confines of a formal institution of employment. This wider perspective is invaluable in an academic environment for preparing students for self-sufficiency after graduation. South Africa has been in a state of transformation since 1994 and employment equity is now mandatory. Limited employment vacancies prompt unemployed graduates to become self-employed through consultancies that will constrain them in terms of science research and publication.

Over half of the respondents regard salaries as having inadequate financial fringe benefits. Improved salary packages could allow for claiming tax benefits. Thirty-nine per cent of respondents consider their salaries as improperly structured for tax benefits. Pouris<sup>15</sup> has advocated a tax incentive scheme appropriate for South Africa, and has outlined the social benefits that would arise therefrom.

#### *Job security*

Comments from respondents reflect strong sentiments about job security. Forty-nine per cent regard the contract appointment system as a negative influence, followed by compulsory early retirement (29% response) and retrenchment (21% response) (Table 1, Part 4.6).

Contract employment is appropriate to specific shorter-term tasks that do not require permanent labour commitments. The advantages are that unemployed

graduates can work temporarily, and widen their experience. The disadvantage is insecurity, impacting negatively on job satisfaction and commitment, aggravated by concern that new employment has to be found at the closure of an existing contract. Compulsory early retirement is seen as a consequence of equal opportunity employment policy, creating 'space' for the appointment of applicants from previously disadvantaged groups. The rising average age of our scientific community,<sup>1</sup> together with the slow process of mentoring young incumbents, has created a dearth of younger skilled scientists. We quote the question: 'does it make sense to force many productive academics to retire at 60, as some institutions do, even though the succeeding generations may not be here to fill their shoes'<sup>16</sup>

Retrenchment is seen by those who suffer it as an inappropriate way of addressing problems with employee inequity. A low percentage of respondents regard retrenchment as a negative factor for botanists. Our inference is that retrenchment policies impact minimally on employed botanists.

### Conclusions

- National government remains the most important source of funding of institutions that employ botanists, and expects the institutions that they fund to become more self-reliant by securing additional finance from other sources for their research budget.
- Although most botanists in South Africa work independently, group research programmes have become necessary to address larger projects that have prescribed budget and time frames.
- There is a need for improvement in inter-institutional research collaboration in South Africa, in conformity with global trends.
- There is concern about the inadequate

state of expertise and equipment. Well-equipped laboratories and the best expertise can only be secured by appropriate financial support, in most cases from government.

- The increasing group-average age of practising botanists and the slow process of training and mentoring young incumbents are causes for concern.
- The ratio of the number of postgraduate students per staff member in botany has significantly increased since 1992, loading more responsibility on academic staff at universities.
- South African publications need to match international best standards, and more South African scientific journals need to earn ISI accreditation. However, funding policy favours foreign publication over local journal publication, which militates against ISI listing of non-accredited South African journals.
- Foreign journals are perceived to be of superior standard to South African journals.
- Botanical articles are published predominantly in taxonomy and ecology, and least so in physiology. A relatively high percentage of botanists publish abroad in biotechnology, creating an under-reflection of this discipline in South African botanical journals.
- A core of older botanists predominate in science publication in South Africa. Respondents attribute this situation to the work-load of constant mentoring of new incumbents, insufficient training of students and the unawareness of new incumbents of their responsibility to publish.
- Publication profile is linked to employment profile.
- Detracting factors in botany are the low salaries of botanists, job insecurity, difficulties in obtaining research funding, and the expense of procuring the necessary scientific equipment.

We thank H. Steyn for assistance with data analysis and Richard Clark for his constructive role during the editing of this paper. The respondents are thanked for their assistance with this project.

1. Anon. (2002). *South African Science and Technology: Key facts and figures 2002*. National Advisory Council on Innovation and Department of Arts, Culture, Science and Technology, Pretoria.
2. Anon. (2005). *Annual Report 2004–2005*, pp. 1–69. South African National Biodiversity Institute, Pretoria.
3. Jewitt G.P.W and Görgens A.H.M. (2000). Facilitation of interdisciplinary collaboration in research: lessons from a Kruger National Park Rivers Research Programme project. *S. Afr. J. Sci.* **96**, 410–414.
4. Katz J.S. and Martin B.R. (1997). What is research collaboration? *Research Policy* **26**, 8–9.
5. Blankley W., Van Vliet B., Basson N. and Du Toit D. (1998). Wake-up call to South African S&T: research and technological development co-operation between South Africa and the European Union. *S. Afr. J. Sci.* **94**, 521–530.
6. Blankley W. (2003). Launch of the European Union's Sixth Framework Programme for Research: opportunities for South Africa. *S. Afr. J. Sci.* **99**, 3–6.
7. Pillay D., Glaser G., Hassan M.H.A. and Rosswall T. (2002). Capacity-building in science and technology. *S. Afr. J. Sci.* **98**, 334–335.
8. Walmsley J. and Walmsley R.D. (1993). Some flaws in postgraduate training for the environmental sciences. *S. Afr. J. Sci.* **89**, 471–472.
9. Walmsley R.D. (1992). Aspects of botanical teaching and research at South African universities. *S. Afr. J. Sci.* **88**, 242–243.
10. Lickindorf E. (1998). The NRF: what's in store for researchers? *S. Afr. J. Sci.* **94**, 514–516.
11. Pouris A. and Richter L. (2000). Investigation into state-funded research journals in South Africa. *S. Afr. J. Sci.* **96**, 98–104.
12. Gevers W., Hammes M., Mati X., Mouton J., Page-Shipp R. and Pouris A. (eds) (2006). *Report on a Strategic Approach to Research Publishing in South Africa*. Academy of Science in South Africa, Pretoria.
13. Editorial Assignments at the Vaal Cybercentre (2003). *Innovation: making research work for us*. National Advisory Council on Innovation, Pretoria.
14. Anon. (1996). More vital statistics on the state of science. *S. Afr. J. Sci.* **92**, 266.
15. Pouris A. (2003). Towards a South African R&D tax incentives scheme: fiscal policies and social benefits. *S. Afr. J. Sci.* **99**, 195–199.
16. Anon. (2002). Bringing home the bacon. *S. Afr. J. Sci.* **98**, 314.

This article is accompanied by supplementary material online at [www.sajs.co.za](http://www.sajs.co.za)

## Supplementary material to:

Bredenkamp C.L. and Smith G.F. (2008). Botanical research in South Africa: A questionnaire assessment of opinions of South African botanists. *S. Afr. J. Sci.* **104**, 97–100.

**Table 1.** Results from assessment questionnaire to botanists.

---

### PART 1. FUNDING AT YOUR INSTITUTION

---

1–4. Research funding (Fig. A) (also see Results and discussion)

1. Is funding for research generated from the government grant to your institution?
2. Does funding for research exclusively come from private resources?
3. Is research mainly funded by commercial corporations and companies?
4. Is research completely internationally funded?
5. Inadequate research funding

Percentage response	
Uncertain	3
NO	30
YES	67

---

### PART 2. RESEARCH AND CAPACITY AT YOUR INSTITUTION

---

1. Execution of research as indicated by respondents (Fig. B)
2. Who are the co-workers in your research? (Table shows percentage response)

	Study leader	Postgraduate students	Same institution	National institutions	Foreign institutions
Uncertain	9	9	8	7	11
NO	34	34	25	33	37
YES	57	57	67	60	52

3. Scientific expertise and equipment (Table shows percentage response)

	Adequate	Shared by departments	Shared by institutions
Uncertain	11	6	14
NO	43	18	46
YES	46	76	40

4. Average age of botanists employed

Age group	Percentage of respondents
20–30	9
31–40	33
41–50	42
51–60	15
61–75	1

5. Numbers of registered postgraduate botany students (Table shows number of respondents)

Number of students	Personal supervision	In department	In institution	Not specified
>20	1	9	4	
11–20	3	8	5	
1–10	23	8	4	
0	4	2	–	13

---

### PART 3. PUBLICATIONS AT YOUR INSTITUTION

---

- 1 and 3. Readership access to peer-reviewed South African and foreign journals? (Table shows percentage response)

	South African journals	Foreign journals
Uncertain	3	10
NO	6	15
YES	91	75

2. Publication in peer-reviewed South African journals (Table shows percentage response)

	In SA journals	Regularly	Often	Seldom	Never	Relevant to SA
Uncertain	27	55	54	40	67	48
NO	7	24	27	18	30	22
YES	66	21	19	42	3	30

4. Publication in peer-reviewed foreign journals (Table shows percentage response)

	Foreign journals	Regularly	Often	Seldom	Never	International relevance
Uncertain	42	43	51	54	70	57
NO	6	17	28	19	28	24
YES	52	40	21	27	2	19

5. Field of publication (Fig. C)

6. Number of papers per age group of publishing botanists (Fig. D)

7. Age groups of publishing botanists (See Results and discussion)

Age group	Percentage response
20–30	4
31–40	22
41–50	36
51–60	33
61–75	5

8. Possible reasons why South Africa has a lack of young publishers in botany (Fig. E)

9. Are foreign publications superior to those in South African journals?

	Percentage response
Uncertain	15
NO	37
YES	48

#### PART 4. REASONS FOR THE PERCEIVED IMPEDIMENT TO EXIST IN BOTANICAL RESEARCH IN SOUTH AFRICA (Fig. F)

1. Funding of research (Table shows percentage response)

Certainty	Availability	Accountability	Reporting
NO	19	34	25
YES	20	42	22
	61	24	53

2–4. Fig. F (also see Results and discussion)

2. Cost of scientific equipment

3. Inadequate training in the interpretation, presentation and publication of research results

4. Publication in the peer-review system too demanding

5. Salaries of botanists (Table shows percentage response)

	Inadequate	Comparison with private sector	Few financial benefits	Tax benefits
Uncertain	19	14	30	42
NO	12	16	13	19
YES	69	70	57	39

6. Job security of botanists (Table shows percentage response)

	Retrenchment	Early retirement	Contract appointments
Uncertain	42	37	28
NO	37	34	23
YES	21	29	49

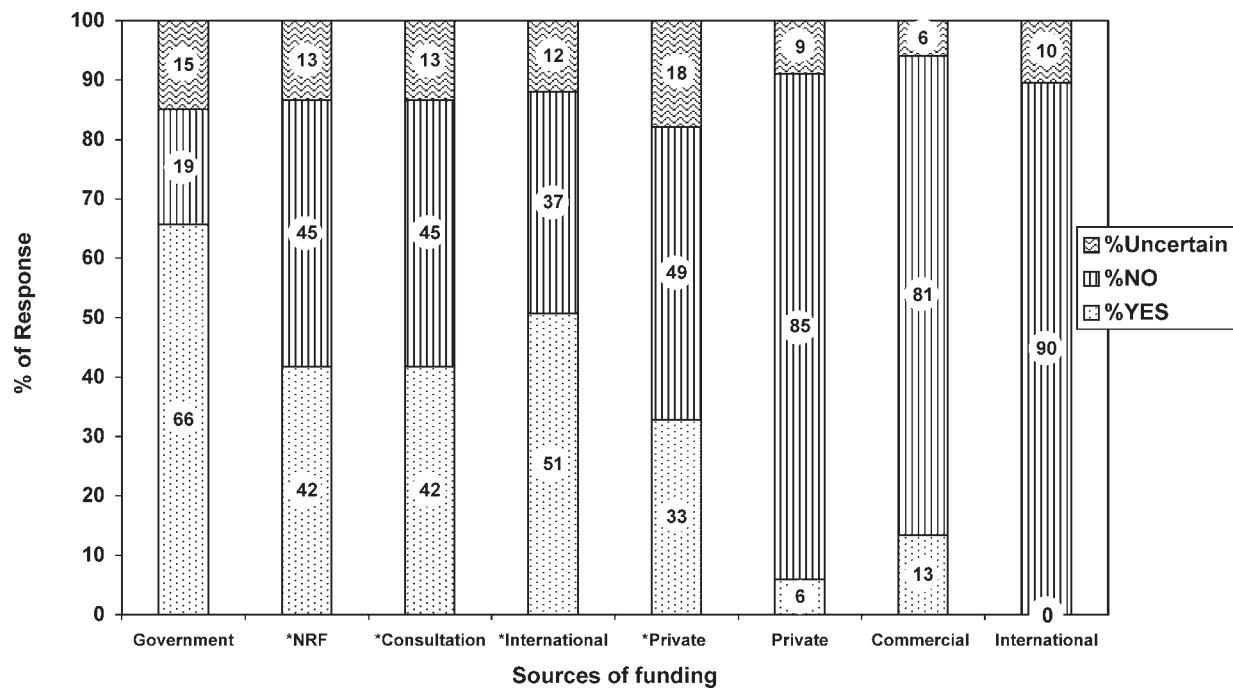


Fig. A. Institutional funding. Supplementary income indicated by asterisk.

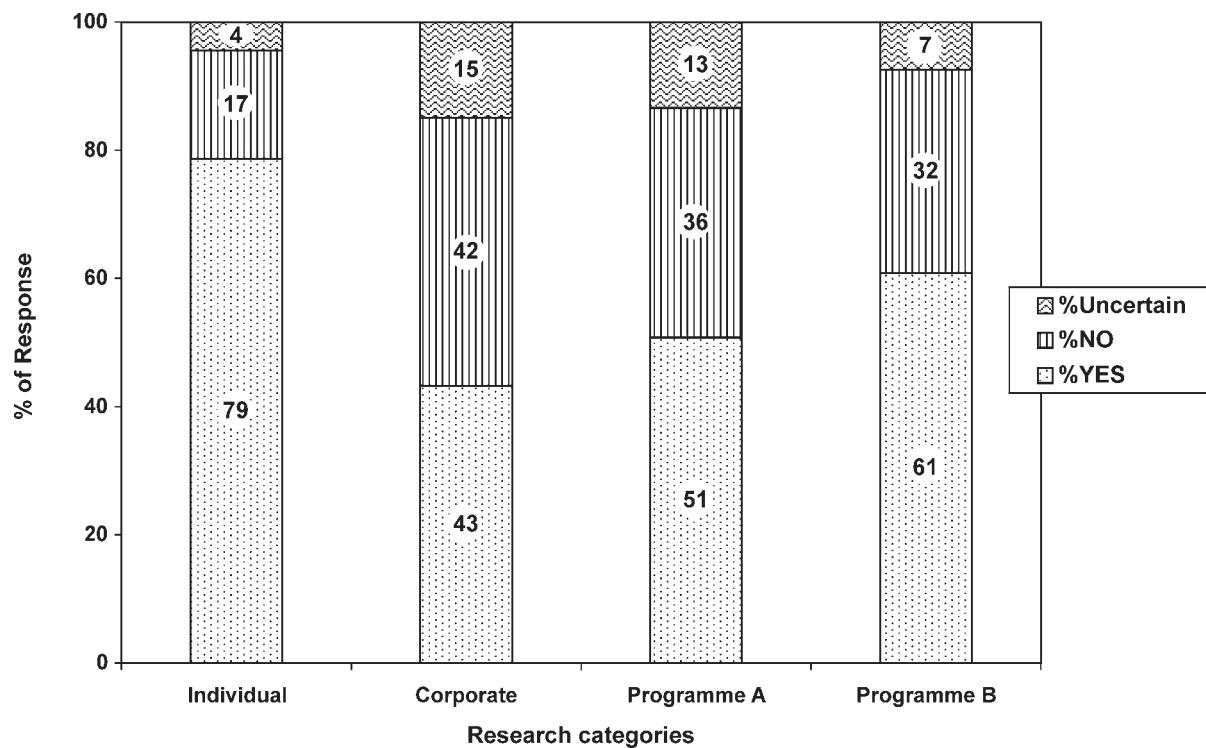
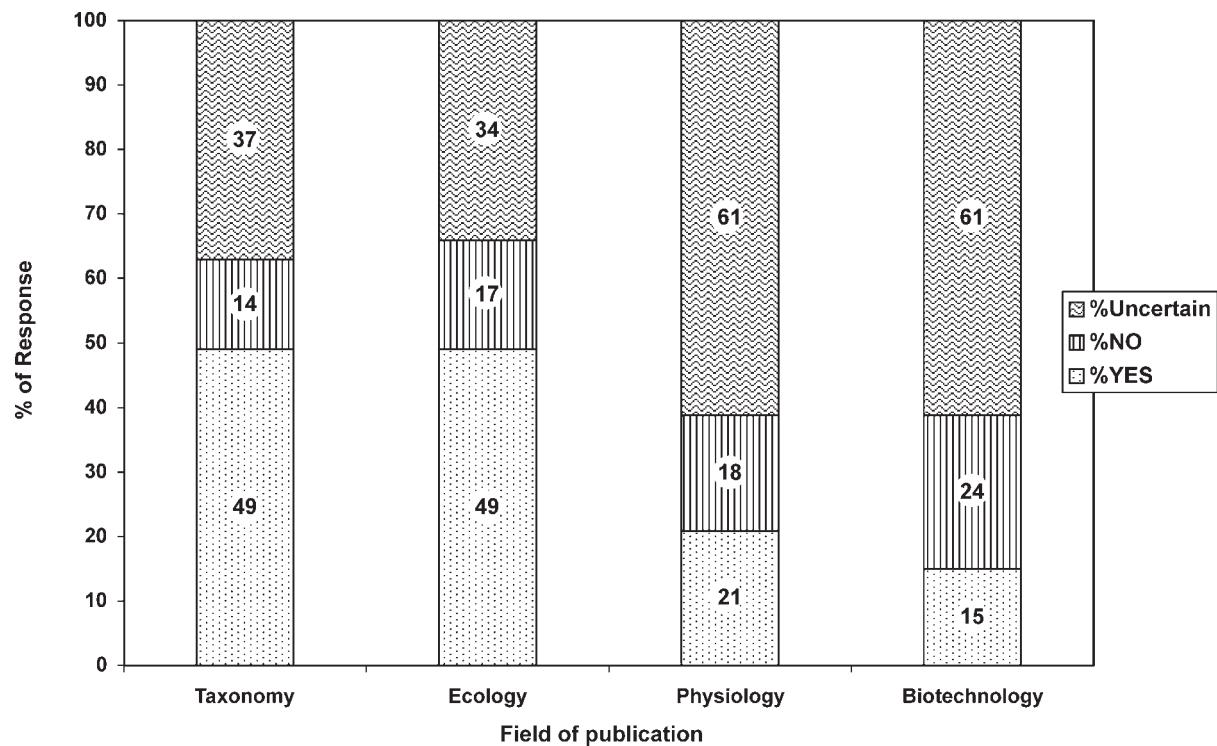
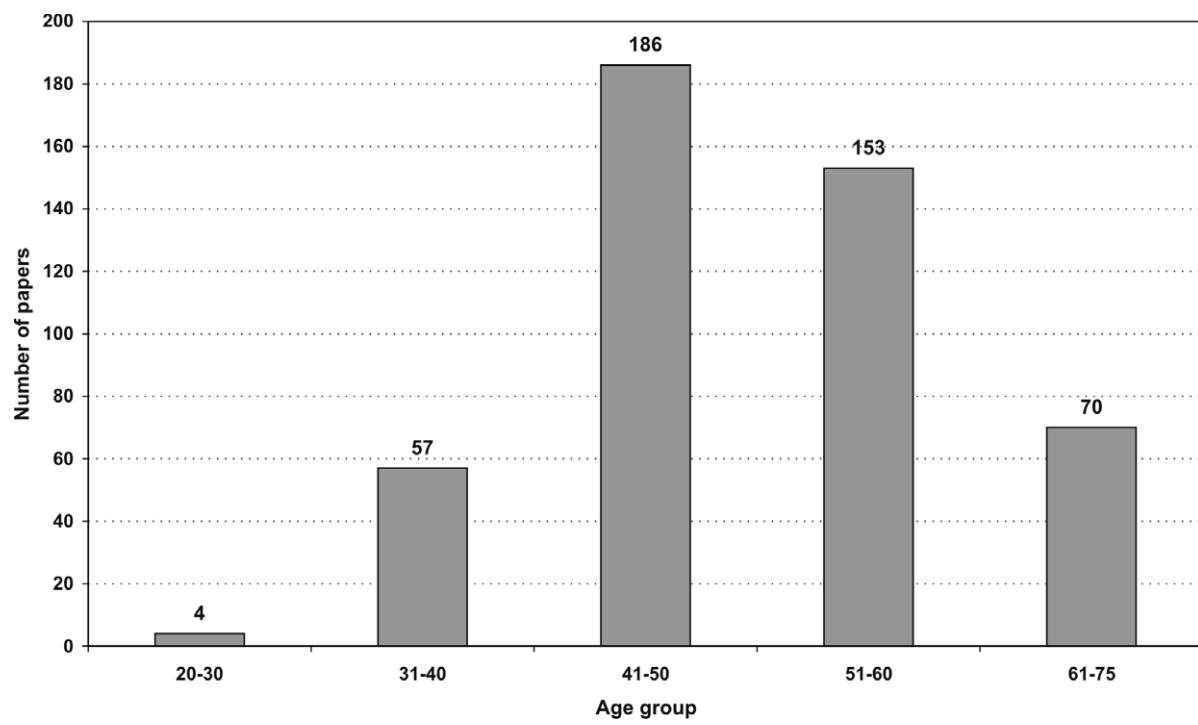


Fig. B. Execution of research.



**Fig. C.** Fields of publication in botany.



**Fig. D.** Number of papers per age group for the two years prior to the questionnaire.

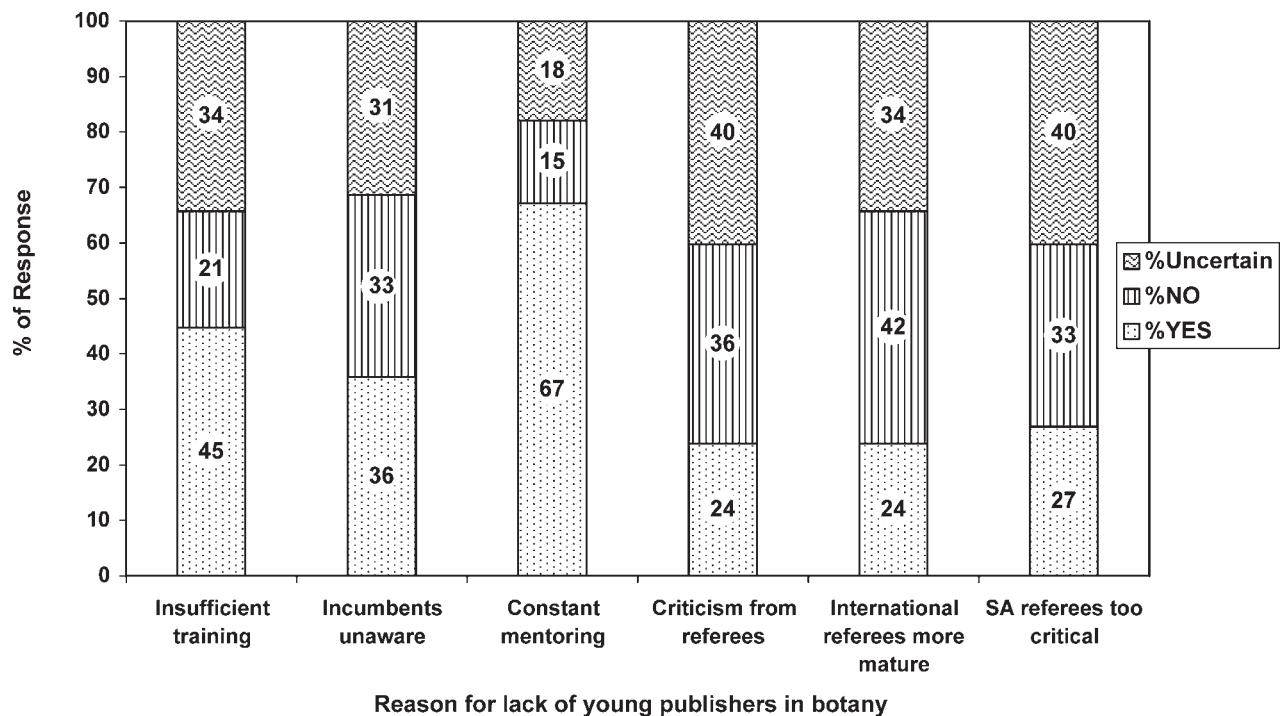


Fig. E. Reasons for ageing population of contributors in botanical publication.

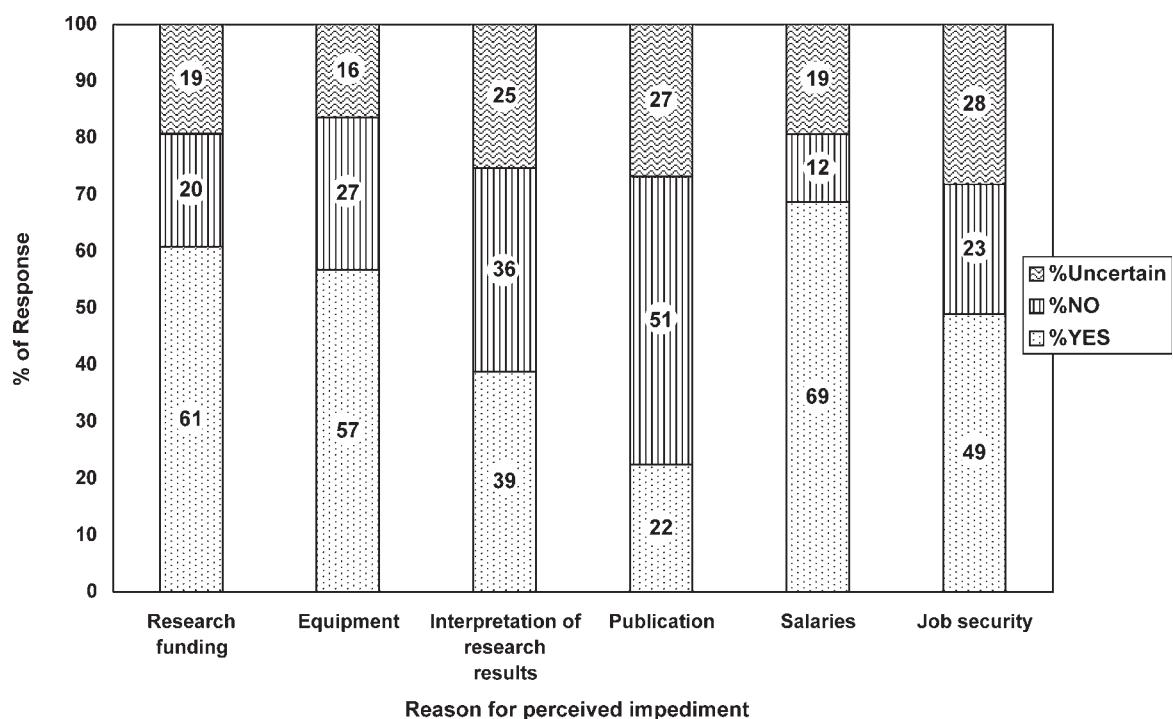


Fig. F. Reasons for the perceived impediments in botany in South Africa.