

Discussion paper

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Introduction

Accurate documentation is central to the effective conservation and use of plant genetic resources. Collaborative work by the International Plant Genetic Resources Institute (IPGRI) and various other crop research establishments (including other centres within the Consultative Group on International Agricultural Research (CGIAR) and various national agricultural research institutes (NARIs)) has attempted to improve the documentation of plant genetic resources by providing a uniform series of crop descriptors. These descriptors, which are currently available for more than 80 crops, provide unambiguous guidelines for the documentation of accessions held in germplasm collections. The descriptors are distributed through IPGRI's mailing lists, by IPGRI staff when travelling and attending meetings, and in response to individual requests. In recent years, IPGRI has produced, on average, three sets of descriptors per year in English, Spanish and French.

The crop descriptors are international standards for which IPGRI takes responsibility. Each new or revised set of crop descriptors is prepared in consultation with various groups, including international experts on specific crops, genebank documentation staff and members of IPGRI's thematic and regional groups. The aims of this extensive consultation are to ensure a transparent production process and maintain a standard format in the face of a wide variety of potentially conflicting opinions. This in turn ensures that the final result has the broad support of the majority of intended users.

In 1996, a preliminary study of the impact of the IPGRI crop descriptors was undertaken as part of the Institute's External Programme Management Review. This initial study showed that the descriptors were well known in the field, but generated little information either on user perceptions of their quality and usefulness, or on the extent to which they have been adopted. An initial assessment suggested that the highly technical terminology and methods of scoring used in the descriptors could be obstacles to their adoption. Concern was also expressed over the suitability of the descriptors for discriminating between accessions of the same species and for quantifying the heterogeneity of accessions. The findings of this preliminary study, together with the fact that the IPGRI descriptors are a well-established and discrete product, made them a particularly suitable subject for a more detailed impact assessment.

The case study reported here sought both to determine the extent of adoption of the IPGRI descriptors and to evaluate any constraints on their adoption, with the ultimate aim of increasing their impact on the conservation and use of plant genetic resources. The study concentrated on qualitative aspects of the use of the descriptors and focused on three crops (banana, coconut and maize) which were selected for their diversity, economic importance, geographical distribution, and their representation in germplasm collections.

Methods

This case study employed the illustrative approach as defined by Sechrest *et al.* (1996), which attempts to describe processes in detail in order to obtain a clear understanding of the cause

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and effect relationships involved.

Primary data were obtained by various means, including questionnaires and interviews with users of the crop descriptors. Three questionnaires were developed: one for managers of germplasm collections of each of the three selected crops ($N=456$), one for individuals who had requested a copy of the crop descriptors in 1997 ($N=146$), and one for the libraries and documentation centres on the 1996 IPGRI mailing list for the banana descriptors ($N=56$). Of these target groups, replies were received from 36% ($N=165$) of the genebank curators, 40% ($N=58$) of those who had requested copies of the descriptors, and 27% ($N=15$) of the libraries and documentation centres.

Interviews were conducted with staff from both IPGRI and the other institutions that had been involved in developing the banana and coconut descriptors. In addition, a focus-group discussion was conducted in October 1997 with the curators of the world's 10 largest banana germplasm collections during a training workshop at the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) in Guadeloupe. This workshop also provided an opportunity to test and evaluate the banana descriptors on CIRAD's field collection.

Secondary data were obtained from sources such as archives, reports and previously collected feedback from collaborators and users of the IPGRI descriptors.

Results and discussion

How well known are the descriptors?

A review of the literature suggested that IPGRI descriptors were well known in the plant genetic resources community, especially by target users (i.e., genebank curators, crop specialists and plant breeders). This impression was confirmed by the high proportion of survey respondents who knew of the descriptors (overall mean=78%).

The various ways of publicizing and distributing the descriptors appear to be complementary: most respondents became aware of them in one of three ways: by receiving a printed copy directly from IPGRI (46%), through contact with IPGRI staff (23%), or through newsletters and other publications (20%) (results averaged over all crops). Personal contact was particularly important in the case of the banana descriptors, 48% of which were distributed by IPGRI staff.

How frequently should the descriptors be revised?

On average, each set of descriptors is revised approximately every 10 years, with the decision to do so being based on the same consultative approach adopted during their initial development. According to the feedback received on the banana descriptors, such revisions are definite improvements and should be continued. Feedback concerning the maize, and to some extent the coconut, descriptors indicates that revisions should be undertaken at shorter intervals. The majority (61%) of the maize collection managers, for example, felt that the descriptors need updating after 6 years.

Use of the descriptors

The majority (84%) of responding germplasm collection managers maintained documentation systems/databases for their accessions which were either fully computerized (26%), partially computerized (46%), or completely manual (28%). Of the 143 respondents who held germplasm accessions for the three target crops, 80% used descriptors of some type to document their collections, 69% used the IPGRI descriptors and 45% used them exclusively. The 11% who used descriptors other than those developed by IPGRI either used their own or those developed by other organizations, such as the International Union for the Protection of New Varieties of Plants (UPOV), or the Council for Mutual Economic Assistance (COMECON).

Of the 143 respondents who held germplasm collections for the three target crops, 50%

adopted the IPGRI descriptors because they met their specific needs for germplasm documentation and 32% because the IPGRI descriptors were the only ones available for their crop. For banana, compatibility of the descriptors with the *Musa* Germplasm Information System (MGIS) and *MUSAID* (*Musa* identification software) was an important issue identified by both the members of the focus group and those responding to the questionnaire.

The majority (62%) of responding collection managers used only those descriptors that they found most useful; in total, only 26% used the complete list, while 49% modified or adapted the descriptors in some way and 21% used them only as a reference or guideline. However, in the case of banana, a much higher proportion (47%) of collection managers used the complete set of IPGRI descriptors (mainly characterization descriptors), probably because of their compatibility with MGIS and *MUSAID*.

When asked why it was necessary to modify the descriptors, the reasons given included the fact that (1) some traits were not adequately characterized by the published descriptors (32%), (2) an institute-specific documentation system was already in place (30%), (3) no descriptors were provided for some characters considered important (28%), and (4) descriptors had to be translated to suit local needs (16%).

Which categories of descriptor are most commonly used?

The most commonly used category of descriptors for all three crops was the *Passport data*. For maize collections, *Seed management, multiplication and regeneration data* were also heavily used, while *Pest and disease susceptibility data* were particularly important for banana. In the case of coconut, less use was made of the *Further characterization and evaluation data* than was reported for the other two crops, probably because of the preference for the Stantech (IPGRI/COGENT 1995) descriptors for this category. The relatively small proportion of respondents using the descriptors for *Biochemical composition* and *Cytological characters and identified genes* probably reflects the expertise and resources required to evaluate these characters, rather than an intrinsic lack of value.

How useful are the descriptors?

Survey respondents were asked to rate the usefulness of the IPGRI descriptors using a scale of 0–3, where 3 = very useful, 2 = useful, 1 = moderately useful and 0 = not useful at all. Users considered the descriptors to be ‘very useful’ for various purposes, including characterization of accessions (71%), standardization of information (70%), establishment of databases (66%), documentation of accessions (65%), creation of core collections (57%) (*Musa* germplasm curators only), data exchange (55%), evaluation (53%), generating more requests for germplasm as a result of better documented accessions (53%), facilitating networking activities (52%), increased access to information (49%), and collection/accession management (39%). In addition, 56% of respondents considered the revised version of the banana descriptors, produced in 1996, to be ‘very useful’ for identifying duplicates in collections, mainly due to their compatibility with the *MUSAID* identification software. In general, the 1996 banana descriptors were found to be more useful than the 1984 version for all of the above activities, confirming the impression reported earlier.

Factors affecting adoption and use of the descriptors

Some of the difficulties reported by users merely impose limitations on the usefulness of the descriptors, whereas more serious problems affect the fundamental decision of whether or not to adopt them. For example, the omission of certain characters from a set of descriptors might limit its usefulness without necessarily being a major constraint to adoption, whereas difficulties in understanding the terminology or language of the material could prevent adoption altogether. Furthermore, while some limitations are under IPGRI’s control (such as the suitability of particular descriptors or the accessibility of the material), others are not (e.g. lack of the financial and human resources needed to

undertake documentation of collections).

Of those who had adopted the descriptors, most reported some limitations to their usefulness (87% for banana, 60% for maize and 75% for coconut). However, most of the documented constraints applied to the use of crop descriptors in general rather than specifically to those developed by IPGRI; some limitations had even wider implications. Thus 53% of respondents reported a lack of financial resources and 39% a shortage of human resources, while 44% reported a lack of training and expertise in documentation and 32% a complete lack of any documentation system. Of the problems specific to the IPGRI descriptors, 27% of respondents reported various difficulties associated with the recommended colour charts (including their relatively high cost, their accessibility, and difficulty in selecting colours because of the wide choice and small differences between shades); 25% of respondents reported problems with scoring certain descriptors (either because the character in question was particularly difficult to measure, or because the methodology was inappropriate). Other problems included the length of the list of descriptors (22%), difficulties with terminology (14%), selection of descriptors (11%) and the language of publication (10%). In the case of the latter, a survey of potential users would help to determine the translations required.

Amongst those who were not using the IPGRI descriptors, the main reasons given were either because their collections had already been documented before the descriptors were published (33%) or because they simply did not know about, or have access to, the IPGRI material (28%). The latter point needs further investigation to determine exactly why potential users did not know of the descriptors so that their distribution can be improved. Only in a few cases (11%) were the descriptors unsuitable for their purpose and/or not available in the first language of the user (9% overall, but 25% in the case of the coconut descriptors, which were published only in English). A very small proportion of nonadopters (6%) found the descriptors to be incompatible with their existing documentation system.

Improving future editions of the descriptors

Overall, 53% of survey respondents felt that the descriptors could be improved in some way, and regular reviews appear to be essential to meet users' needs. This impression was reinforced by the fact that fewer users of the banana descriptors (the most recently revised of the three) felt a need for improvements than did users of the maize and coconut material. The banana descriptors were last revised in 1996, and only 38% of users considered improvements necessary, compared to 61% of those using the maize descriptors (last revised in 1991) and 80% of those using the coconut material (revised in 1992). Suggestions for increasing the level of adoption of future sets of descriptors are given below.

Improving the process of developing crop descriptors

IPGRI's capacity to produce more descriptors could be increased by sharing the work with other organizations, or by encouraging existing crop networks to develop descriptors for their particular crop and allowing IPGRI to concentrate on crops for which no formal network currently exists. Alternatively, IPGRI could focus less on producing specific descriptors and more on producing guidelines to help crop networks and working groups produce their own descriptors. This would help collection managers select the most useful descriptors and generate a final product that may be better suited to their needs. However, IPGRI would have to ensure that such decentralized development of descriptors did not lead to compatibility problems between different networks or crops. Wherever possible, descriptors should be compatible with the documentation methodology being developed by the crop networks. Where no documentation system exists, it would be advantageous to develop both in a fully integrated manner.

The development process might benefit from the inclusion of a larger proportion of end-users, or from more extensive field testing by target groups prior to publication. New descriptors could also include a questionnaire to encourage users to suggest improvements

which could be taken into consideration by IPGRI when undertaking revisions. Where a complete revision of descriptors is not feasible, an update leaflet could be produced for insertion into the existing publication.

Content and comprehensiveness of the IPGRI descriptors

The IPGRI descriptors need to provide clear, detailed explanations of scoring methodology in order to standardize data recording. Wherever possible, photographs or drawings should be included to improve understanding of the characters and states to be assessed. Rather than using the entire list of descriptors, IPGRI recommends selecting those most appropriate to individual needs. However, since 22% of respondents felt that the lists were probably too long, IPGRI's recommendation may not be fully understood by all users. Most survey respondents (74% for banana, 68% for maize and 58% for coconut) felt that there was no need to change the number of descriptors in the lists.

Describing heterogeneous accessions

According to the surveys, 62% of collection managers experienced difficulty in describing heterogeneous accessions, primarily in detailing the diversity of a particular trait within a given accession and in managing this information. Although suitable methods are available, very few curators appear to use them. There is thus a need to increase awareness of this issue amongst curators to ensure that variability is fully documented.

Improving the usefulness of descriptors for discriminating between accessions

A study of the IPGRI descriptors for barley (Cross 1990) indicated that the list was only moderately useful in discriminating between accessions. Molecular markers could be used to check the heritability of those descriptors that IPGRI considers to be the most discriminating. This would increase the reliability of the information and assist users in making selections based on a small number of discriminating descriptors. Research is therefore urgently needed to determine the correlation between these key descriptors and their genetic background.

Colour charts and collecting forms

Feedback on the 1996 descriptors for banana confirmed that although the detachable colour chart was useful, it presented a problem for many users. Some felt restricted in their choice of colour, indicating that they did not clearly understand the main purpose of the chart. Once this had been explained, most users could see the advantages of using it for colour selection. Other limitations identified by users included the fact that the chart cannot be obtained separately from the publication or photocopied when it needs replacing. The data collecting form included with the most recent set of descriptors was considered a useful indicator of the minimum number of descriptors to use, but most curators created their own form for use in the field.

Need for training

Many of the difficulties and constraints affecting the adoption and usefulness of the descriptors could be addressed through improved training. Of those responding to the surveys, 82% felt that they would benefit from more training, particularly in data analysis. According to the focus-group discussions, there is also a particular need for training on the use and selection of adequate descriptors in the field, especially of those features useful for characterization and evaluation.

IPGRI is already very active in providing training related to documentation and the use of descriptors, and is currently developing proposals for developing additional training in data analysis. Approaches to training include the provision of short courses, workshops, videos, site visits to collection managers, and the production of guidelines for the use of descriptors.

Distribution to target groups

Of the total number of descriptor sets distributed, 52% were sent in an initial mass mailing based on IPGRI's mailing list. The majority of the remainder were distributed by IPGRI staff, usually during meetings and workshops. A small proportion was distributed in response to specific requests (e.g. 3% of the banana descriptors). However, while IPGRI reaches 50% of genebank curators through its mailing list, distribution could be targeted more effectively by giving priority to the germplasm collection managers listed in the IPGRI germplasm database. For example, although a total of 1236 institutes were selected from the main IPGRI mailing list to receive the initial release of the banana descriptors, this included only 34 of the 96 institutions with *Musa* or *Ensete* collections listed in the germplasm holdings database.

Distribution to libraries and documentation centres

IPGRI's distribution policy now includes sending publications to libraries and documentation centres, a strategy which is believed to be effective in reaching a wider audience. In 1996, a detailed analysis was conducted of the distribution of the banana descriptors, 10% of which were sent to libraries and documentation centres. Of this 10%, 73% were retained by the libraries, 93% of whom wanted to continue to receive the descriptors, either in a printed format (71%) or in both a printed and electronic format (29%).

It was difficult to obtain data on the use of the publications held in library collections and this issue should be investigated further through a detailed study of the records of a few selected libraries. Nevertheless, it seems clear that IPGRI should continue to send the descriptors to libraries and documentation centres, since this represents only a small proportion of the total mailing but greatly improves the visibility and accessibility of the descriptors.

Publicizing the descriptors

Since 22% of responding germplasm collection managers were unaware of the IPGRI descriptors for their crop, more publicity is clearly needed. Various approaches could be taken to address this need. For example, a leaflet advertising the descriptors could be produced and sent to collection managers listed in the IPGRI germplasm holdings database, and information in several languages could be provided for partner organizations to include in their publications.

When this study was conducted, IPGRI was already using the Internet to advertise the descriptor sets and some (banana, coffee and tomato) were available for downloading from the IPGRI website. However, only 6% of respondents to the banana questionnaire who had access to the Internet had visited the IPGRI website. This very low proportion emphasises the need for a diversity of approaches in order to reach the main target groups.

Conclusions

The IPGRI descriptors are well-known international standards for the detailed description of specific crop genetic resources and are used by most managers of germplasm collections. The descriptors are developed in close collaboration with target beneficiaries and other organizations in order to ensure their suitability for their intended use. In this study, a strategic choice of crops produced useful feedback from end-users and provided a clear understanding of the use of the descriptors in general.

The IPGRI descriptors are adopted because they meet the needs of users and/or because, in many cases, they are the only descriptors available. Most users modify the lists and select those descriptors most relevant to their needs. In general, users consider the descriptors to be 'very useful' for a range of applications, including characterization of accessions, standardization of information, establishment of databases, documentation of accessions, creation of core collections and exchange of data.

The major constraints on the use of the IPGRI descriptors relate not so much to problems inherent in the descriptors themselves, but to wider issues related to resource availability, including a lack of financial and/or human resources for documentation activities, a lack of

training or expertise in documentation, or the complete lack of documentation systems within some collections. Many collection managers also reported difficulty in describing heterogeneous accessions, which is a general documentation and management problem. Less common difficulties – which could be addressed by IPGRI – include the use of the colour charts included in the descriptor sets, problems with the specific methodology recommended for scoring some descriptors, and difficulties in understanding some of the terminology.

The main reasons for not adopting the descriptors were either that potential users were unaware of them, or because their collections had already been documented prior to the publication of the IPGRI descriptors. A variety of approaches could help improve the level of adoption of the descriptors in future, including improving distribution to ensure that they reach more collection managers, publishing them in more languages to increase their accessibility and usefulness, and providing more training on their use. The comprehensibility of the descriptors could be improved by including more illustrations and reference material, and by seeking ways of facilitating the use of the colour charts.

Periodic revisions of the descriptors are clearly valuable and ideally should be carried out more frequently than the current average of approximately once every 10 years; where a full revision is impractical, an update could be issued at least every 5 years. When revisions are undertaken (or new descriptors prepared), then more collection curators should be included in the process and used to field-test the descriptors prior to publication.

IPGRI could also play a part in stimulating research into improved methods of scoring heterogeneous characters and on the heritability of highly discriminating descriptors. It could also encourage and provide advice to crop networks to enable them to develop their own descriptor lists.

In general, while the descriptors are considered to be well-known and valued products, their development and use should be closely monitored and documented at all stages in order to improve their impact and aid future evaluation efforts.

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