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A preliminary survey of primitive crops cultivated in the northern Transvaal of South Africa

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ABSTRACT

The different tribal economies of South Africa rely extensively on a number of primitive crop taxa which are cultivated as a primary food source. The most important of these include *Sorghum bicolor, Pennisetum americanum, Citrullus lanatus, Lagenaria siceraria, Vigna unguiculata, Voandzeia subterranea* and *Hibiscus esculentus.*

Morphological variation within these and a number of less important crops is discussed. The frequency with which each crop is grown and preference ratings allotted to them by individual tribal families are compared between the three major ethnic regions of the northern Transvaal. Factors which determine preferences are also discussed and suggestions made relating to germ plasm conservation.

RÉSUMÉ

UN RELEVÉ PRÉLIMINAIRE DES CULTURES PRIMITIVES PRATIQUÉES DANS LE NORD DU TRANSVAAL EN AFRIQUE DU SUD

Les économies tribales différentes d'Afrique du Sud reposent largement sur un nombre de taxa de cultures primitives qui sont cultivées comme sources primaires d'alimentation. Les plus importantes de cel-les-ci incluent Sorghum bicolor, Pennisetum americanum, Citrullus lanatus, Lagenaria siceraria, Vigna unguiculata, Voandzeia subterranea *et* Hibiscus esculentus.

La variation morphologique existant chez celles-ci ainsi que dans un nombre de cultures moins importantes est discutée. La fréquence avec laquelle chaque culture est pratiquée et les degrés de préférence qui leur sont attribués par des famille tribales individuelles sont comparés entre les trois régions ethniques majeures du Transvaal du Nord. Les facteurs qui déterminent les préférences sont aussi discutés et des suggestions sont émises en ce qui concerne la conservation du patrimoine génétique.

INTRODUCTION

Little is known about the exact nature and diversity of primitive crop taxa cultivated in South Africa, despite that many of these crops, for example, *Sorghum bicolor, Pennisetum americanum, Vigna unguiculata* and *Citrullus lanatus,* exhibit a considerable range in variation and are extensively cultivated by the various ethnic groups throughout the country.

The majority of these crops are considered to have originated and evolved in North and West Africa (Harris, 1976), with South Africa representing merely the southern most extreme of their distibution. This may account, at least in part, for many workers (De Wet, 1972; Doku & Karikari, 1971; Stemler *et al.*, 1977 and Westphal, 1974), investigating the origin, evolution and taxonomy of these crops, having focused their attention upon the northern half of the continent. Where reference is made in the literature to primitive crops grown in this country (Brunken *et al.*, 1977; De Wet & Huckabay 1967; De Wet *et al.*, 1976; Harlan & Stemler, 1976; and Fursa, 1972), it is largely inadequate, based on limited information and usually forms part of more detailed investigations centred around the region of origin of these crops.

In order to expand our knowledge of primitive crops grown in South Africa and bring it into line with that from elsewhere in Africa, a detailed study of the morphological variation and distribution of these crops is being undertaken by the present authors, together with extensive germ plasm collection. Included in this paper is some of the information so far collected from the Transvaal, which is presented essentially as an introduction to a much wider study covering the whole country.

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STUDY AREA AND SAMPLING METHODS

Information presented in this paper was gathered during a pilot study of the ethnic regions of Lebowa, Gazankulu and Venda in the northern Transvaal of South Africa (Fig. 1), and represents part of a more extensive survey to be undertaken throughout the Republic of South Africa.

A total of 119 families from 73 villages was interviewed in the three regions. These include: Lebowa — 17 families from 13 villages, Gazankulu — 67 families from 31 villages, and Venda — 35 families from 29 villages. With the help of interpreters, a questionnaire was completed for each family. Herbarium specimens and seed were collected to support the information gathered for the questionnaire.

It is impossible to provide definite conclusions as to the nature and variability of the crops cultivated, because only a limited number of families were sampled in each village. Additional information requires to be gathered for a more complete assessment of the situation.

MORPHOLOGICAL VARIATION

Eight major primitive, dryland crops, considered by Harris (1976) to be of African origin, are

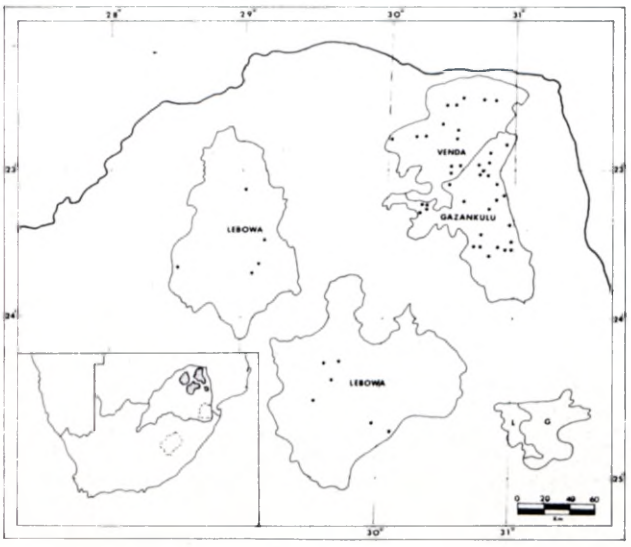

FIG. 1.—Study area. Black dots represent villages sampled. Single dots sometimes represent more than one village situated in close proximity to one another.

cultivated within the study area. These include *Sorghum bicolor* (L.) Moench, *Pennisetum americanum* (L.) K. Schum., *Vigna unguiculata* (L.) Walp., *Voandzeia subterranea* (L.) Thouars, *Citrullus lanatus* (Thunb.) Matsumura & Nakai, *Lagenaria siceraria* (Molina) Standl. and *Hibiscus esculentus* L. Important crops of extra-African origin include *Zea mays* L., *Arachis hypogaea* L., *Cucurbita* sp. (cf. *C. pepo* L.) and *Phaseolus radiatus* L.

The extent to which each crop varied morphologically differed between the taxa. *Phaseolus radiatus* and *Hibiscus esculentus* showed little variation, whereas the remainder showed extreme variation not only at the regional level but also within a single village and even within individual cultivated fields. Variation within the major primitive crops is discussed below, as well as that observed in *Arachis hypogaea* and *Cucurbita* sp.

Sorghum bicolor *(Sorghum).*

All five cultivated races of *S. bicolor* recognized by De Wet (1978) were recorded. Race Caffra is the most common, followed by races Guinea and Bicolor. Caudatum sorghums were present in Venda, with a single collection from Lebowa, and race Durra was recorded twice from a single village in Venda.

Morphological variation was considerable in all the races except race Durra, with Caffra sorghums exhibiting the greatest amount of variation. Variation within each race was expressed largely in the size and degree of compaction of the inflorescence, the number of grains per inflorescence, the colour of the glumes, and the size and colour of the grains. Seven Intermediate races were also observed (Intermediate races according to Harlan & De Wet, 1972). Morphological variation in South African sorghums is discussed in greater detail by Arnold (1982).

Pennisetum americanum *(Bulrush/Pearl millet)*

This crop is cultivated in differing amounts throughout the study area. Weedy forms (subsp. *stenostachyum*), distinguished by their disarticulating spikelets, were often found growing alongside cultivated forms (subsp. *americanum*). The amount of variation observed within this crop differed markedly between the different regions. In Lebowa variation of the inflorescence was minimal, whereas in Venda it was often difficult to find two inflorescences from a single field that looked suitably alike.

Throughout the study area inflorescence length ranged between 10 and 55 cm, and included club as well as candle-shaped forms. Involucral bristles (3–10 mm in length) varied from $\frac{2}{3}$ spikelet length in some individuals to three times spikelet length in others. Grain size also varied (2,1–4,1 mm by 1,3–2,5 mm) as did grain colour which ranged from cream-yellow to light or dark grey.

Vigna unguiculata *(Cowpea)*

Cowpeas are commonly cultivated in all three regions. Two basic forms were collected: a soft, purple-podded form characterized by purple leaves; and a hard, cream-podded form with green leaves. The beans were found to be extremely variable, particularly in colour, but also in size and shape. Colour forms included cream, beige, orange, red, mauve, purple and black and were either plain-coloured or speckled. A high proportion of diminutive, angular beans were also observed.

Voandzeia subterranea *(Juga bean/African or Bambarra groundnut)*

Juga beans exhibited similar although less variation than cowpeas. This was manifested mainly in the colour of the beans, which ranged from cream (often with black around the hilum) to beige, orange-brown, red, purple and black. Speckled forms of most of these colours also exist.

Citrullus lanatus *(Watermelon)*

Two major types are grown. The first includes the sweet melons which have a relatively spongy, sweet, cream-white or pink flesh, and are eaten raw immediately they are harvested. The second type includes the cooking melons, with an insipid tasting, slightly firmer flesh, ranging in colour from cream-white to pale yellow or salmon-orange.

Melon size ranged from 10–35 cm in length (diameter in spherical forms). Skin colour patterning is highly variable, being plain light or dark green, or cream-green coloured (cooking type) or a combination of these colours, either mottled, speckled, or arranged in stripes (sweet and cooking types). Intermediate patterns also exist. The seeds showed a similar range in variation, ranging in length from 0,9–1,4 cm and in colour from cream to green, light or dark brown, red and black. Speckled forms of the green, brown and red colours also exist.

Lagenaria siceraria *(Gourd/Calabash)*

As in the case of the watermelons, calabashes are grown throughout the study area. Variation is limited to the fruits and seeds. Two basic groups are recognized by the different ethnic tribes, based on utilization. In the first group, the calabashes are characterized by their suitability for use as household utensils (water or medicine containers, bowls, scoops for water, beer or meal, etc). Calabashes that cannot be used as utensils comprise the second group cultivated specifically for eating.

A number of basic fruit shapes can be recognized in both the utensil and eating forms, but at this stage these have not been formally categorized. Intermediate shapes have also been collected. The colour of the skin remains relatively uniform, varying between light and dark green and changing with age to cream-beige. Skin texture is either smooth or rough (covered in small ± 1 cm high rounded or angled growths). The rough forms are always eaten irrespective of their shape.

The seeds comprise two major types, those with wing-like margins and those without. A single intermediate form with the margins partly developed has been observed. Seeds range in size from 1,3–2,5 cm in length and 0,9–1,4 cm in width and vary in colour to include cream-yellow, brown and olive-brown.

Hibiscus esculentus *(Okra)*

Together with *Sesamum indicum*, this crop is grown almost exclusively in Gazankulu (by 60% of the families interviewed) and in immediately adjoining areas of Lebowa and Venda. This suggests a later introduction into South Africa than other primitive crops, possibly from Moçambique. Two forms are recognized by the families who grow this crop: the first includes plants with short, fat fruits 7,8–10,0 cm long and 3,6–3,8 cm broad, whereas those of the second form are noticeably long and thin, 11,4–13,8 cm long and 2,1–2,2 cm broad. A range of intermediates exists between these two extremes.

Phaseolus radiatus *(Mung bean)*

Although grown in Gazankulu and Venda, mung beans are important only in Lebowa where they are grown by 53% of the families interviewed. Morphological variation in the three regions is minimal. Throughout the study area this crop was erroneously referred to as China pea by the villagers. According to Westphal (1974), China pea is one of the many common names for *Vigna unguiculata*.

Arachis hypogaea *(Peanuts/Groundnuts)*

This species is not native to Africa and is probably a recent introduction into tribal agriculture in South Africa. Peanuts are grown in varying amounts throughout the study area. Three distinct forms are cultivated differing in the size and colour of the nuts. These include a long red form (1,7–2,3 cm by 0,8–1,1 cm), a small dark red form (0,9–1,4 cm by 0,6–0,9 cm) and an intermediate pink form (1,1–1,7 by 0,7–1,0 cm).

Cucurbita *sp. cf.* C. pepo *(Pumpkin/Squash)*

Like *Arachis hypogaea*, this crop is not native to Africa. It is considered to be a relatively recent introduction into tribal agriculture, possibly a derivative of one or more of the modern pumpkin or Hubbard squash forms grown throughout the country. Pumpkins are an extremely important crop, not only because they are grown throughout the study area, but also because selection has produced forms that are extremely hardy and reasonably well adapted to survive under low rainfall, dryland agricultural conditions. It is impossible at this stage to give a realistic assessment of the variation exhibited by this crop.

Minor crops

Crops of minor importance that are also grown include: *Saccharum* sp. (sugar cane); *Eleusine coracana* (L.) Gaerth (finger millet); *Cajanus cajan* (L.) Millsp. (pigeon pea); *Phaseolus acutifolius* Gray var. *latifolius* Freem. (tepary bean); *Mucuna* sp. (velvet bean); *Ipomaea batatas* (L.) Lam. (sweet potato); *Manihot esculenta* Crantz (cassava); *Sesamum inducum* L. (sesame); *Ricinus communis* L. (castor-oil bean). The variation exhibited by these crops was either negligable or not sufficiently well recorded to be discussed in this paper.

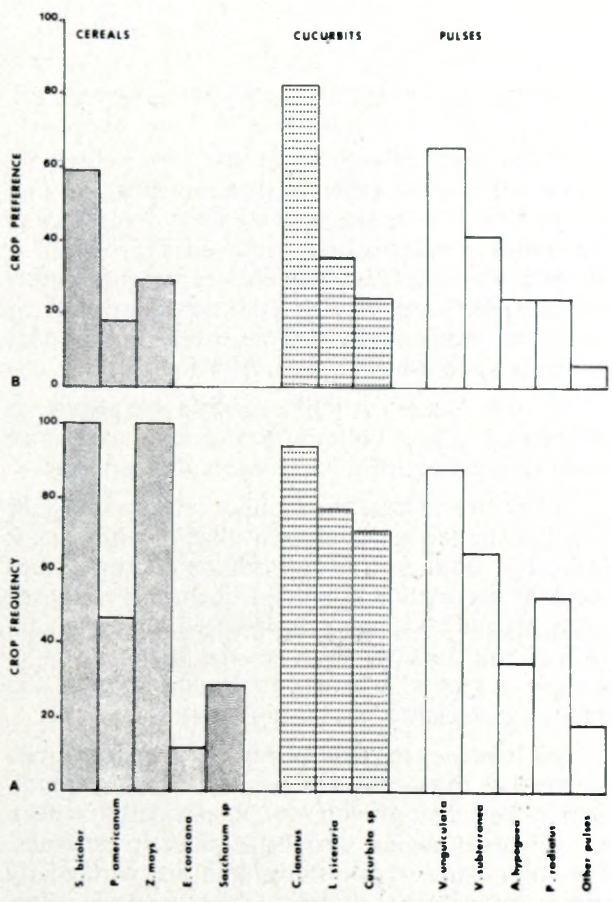

FIG. 2.—Relative frequencies and preference ratings of major crops cultivated in Lebowa.

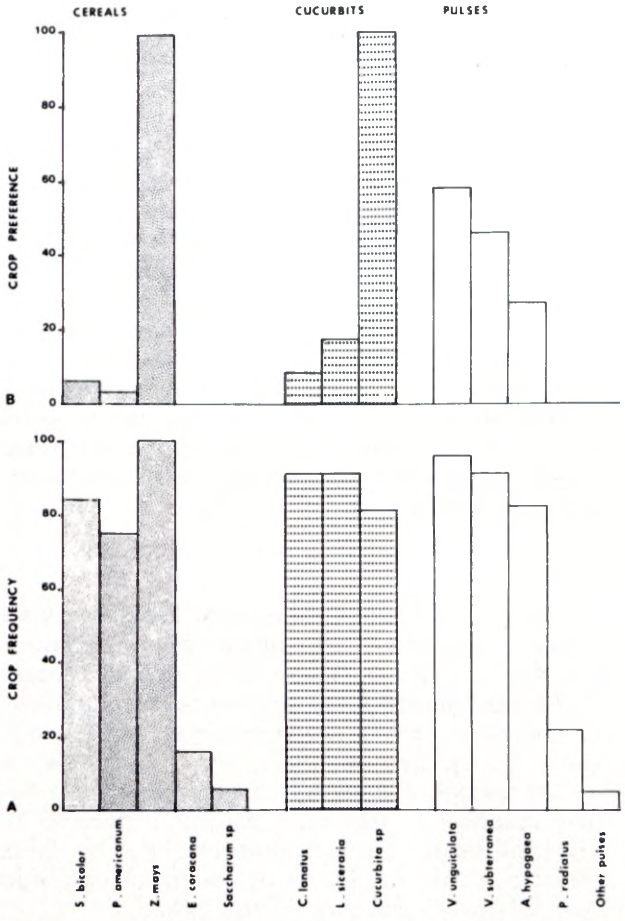

FIG. 3.—Relative frequencies and preference ratings of major crops cultivated in Gazankulu.

RELATIVE FREQUENCIES AND PREFERENCE RATINGS

The frequencies with which the major corps are grown within each ethnic region are shown in Figs 2a, 3a & 4a. These data indicate what percentage of the families interviewed grew each crop. It is important to note that frequency represents merely whether the crop was or was not cultivated by individual families and not the extent (area under cultivation) to which it was grown.

At this stage of the survey, frequency is considered to be a better indicator than abundance on which to base germ plasm conservation priorities.

In Lebowa 65% of the families interviewed grew seven of the ten major crops available, with at least two crops from each of the differenct crop groups (cereals, cucurbits and pulses), including the three extra-African taxa, being represented. In Gazankulu 74% of the families grew all the major crops in varying amounts, whereas in Venda 66% of the families grew eight of the ten most important crops.

This tendency to grow as many of the major crops as possible irrespective of whether climatic conditions favour their growth may be ascribed to a need to safe-guard against periods of climatic extremes. The drier parts of the study area are particularly prone to periods of drought which seriously affect the cultivation of maize, sorghum (in some areas), pumpkins and peanuts. When these crops are favoured in such areas the more drought resistant taxa are also planted, but to a lesser extent, thus ensuring at least some food during bad years. Another reason for planting a large variety of crops is that besides providing a varied diet, they also provide a variety of foods with differing tastes. Also significant is that many crops have a particular desirable quality absent in other similar crops, for example, although maize is preferred in Gazankulu for meal, limited amounts of sorghum and *Pennisetum americanum* are also grown for making beer. Similarly, although *Lagenaria siceraria* is a relatively low priority crop throughout the study area, it is still cultivated, being the only crop from which household utensils are made.

Preference indicates the relative importance attached to each crop by different ethnic tribes and is seen also as a potential indicator of possible trends towards or away from specific crops. The data presented in Figs 2b, 3b & 4b represents the percentage of families that allotted a 1st preference rating to the various crops. As some families gave a priority one rating to more than one crop, the percentage totals for the different crop groups (cereals, cucurbits and pulses) generally exceeded 100%. Preferences did not necessarily reflect the frequency with which the different crops were grown. Where preferences contrasted strongly with frequencies, this was due largely to the tendency for the majority of families to grow as many of the major crops as possible. The reasons for this have already been discussed.

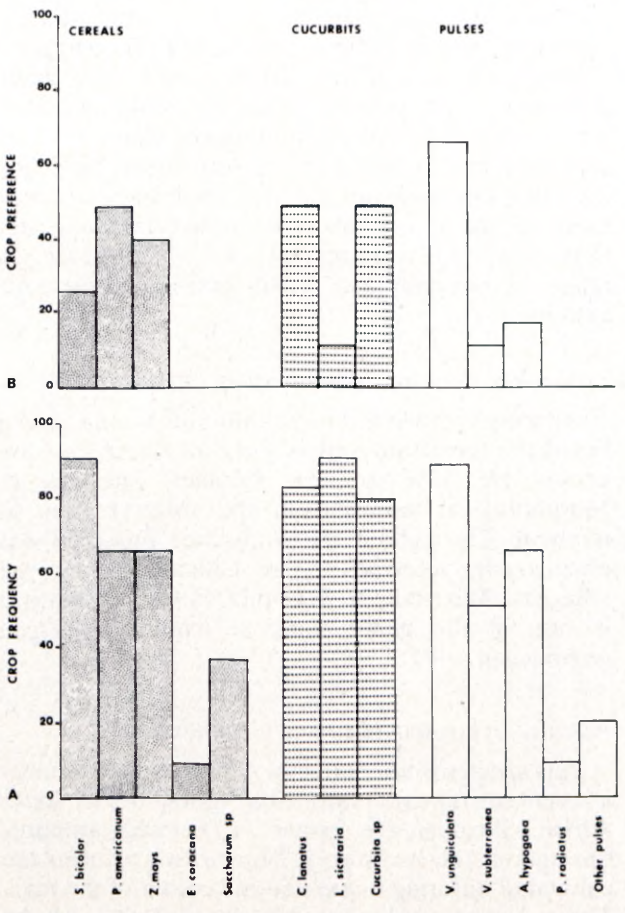

FIG. 4.—Relative frequencies and preference ratings of major crops cultivated in Venda.

Cereals

In Lebowa (Fig. 2) *Pennisetum americanum* is less frequently grown (47% of the families) than sorghum and maize (100% respectively). This is also shown by the preference ratings. Although *P. americanum* is more suited to the drier parts of this region, sorghum is more frequently grown as it is considered much more palatable. In Gazankulu (Fig. 3), maize constitutes a serious threat to sorghum and *P. americanum* cultivation. It is grown in large quantities throughout the region and is preferred by the vast majority of families. The cultivation of cereals in Venda (Fig. 4) is closely related to the climate of the region and is also closely correlated with the preference rating for each of these three crops.

Cucurbits

In Lebowa (Fig. 2) the frequency of these crops follows the trend of preference ratings alloted to them In Gazankulu (Fig. 3) pumpkins are highly preferred to watermelons and gourds despite all three of these crops being grown by 80% of the families. In Venda (Fig. 4) the three cucurbits were grown with similar frequency. The reason for the low preference rating for *Lagenaria siceraria* throughout the study area is due, at least in part, to the increasing supply of metal and plastic utensils from local stores.

Pulses

Vigna unguiculata, grown by 88% of the families in Lebowa, is the most important pulse crop in this region (Fig. 2). Here, unlike Gazankulu and Venda, *Phaseolus radiatus* is also commonly cultivated (53% of the families). This latter crop, although occasionally eaten, is grown mainly as a cash crop. The frequency of pulses grown in Gazankulu (Fig. 3) follows closely the preference ratings allocated to these crops. A similar situation was also found in Venda (Fig. 4), with the exception of *Voandzeia subterranea* which is both less preferred and less grown than in Gazankulu and Lebowa, being considered a less versatile crop than *Vigna unguiculata* and lower yielding than *Arachis hypogaea*.

FACTORS DETERMINING PREFERENCES

Whether a crop is cultivated or not and the extent to which it is cultivated, is determined largely by individual preferences (see Figs 2b, 3b & 4b). Preferences, in turn, are determined by a number of factors, working individually or more commonly in combination.

Diversity of Use

In Gazankulu maize is preferred to sorghum and pearl millet because, besides providing meal for porridge, it can also be eaten as a green vegetable during the growing season. Throughout the entire study area, and particularly in Venda, *Vigna unguiculata* is preferred to other pulses because, not only can the beans be eaten green, or dried and stored for later consumption, but the leaves can be eaten as spinach. Similarly, pumpkins not only have edible fruits, but the leaves can be prepared as a vegetable and the male flowers dried and stored for later consumption.

Long-term storage

Crops which can be stored are preferred to those which cannot. Cooking forms of *Citrullus lanatus* and pumpkins are therefore generally preferred to edible forms of *Lagenaria siceraria*.

Resistance to insect attack

The small seeds of pearl millet are less susceptible to insect attack during storage than most other cereals. This crop is therefore favoured more than sorghum and maize in southern Lobowa, west Venda and north-west Gazankulu.

Palatability

In the low rainfall areas of Lebowa *Pennisetum americanum* is considered highly unpalatable and is replaced by sorghum.

Relative yields

Preferences favour high yielding crops. Yield is generally closely related to annual rainfall and to soil type. In Venda (Fig. 5.1) pearl millet, although grown over a wide range of rainfall, is preferred to sorghum and maize in areas with an annual rainfall between 400 and 460 mm. As the annual rainfall increases from 460 to 520 mm, sorghum yields increase and surpass those of pearl millet. In these areas sorghum is preferred. Where the annual rainfall exceeds 520 mm, maize is generally higher yielding than sorghum or pearl millet and is therefore preferred to both these crops.

Although similar, the situation in Lebowa (Fig. 5.2) is complicated because *Pennisetum americanum* is considered unpalatable in areas of low rainfall (400–480 mm). It is consequently replaced by the relatively lower yielding sorghum in these areas.

In Gazankulu (Fig. 5.3) the annual rainfall is between 520 mm and 760 mm for the villages sampled. Within this range, pearl millet and sorghum yield less than maize and are therefore not preferred. Where preferences were recorded for these two crops, they were shared equally with maize.

Soil type

It was generally observed for the cereals that the range in rainfall under which the respective crops grew best was increased or reduced depending on the nature of the soils. Well drained, sandy soils extend the upper rainfall limits at which sorghum and pearl millet are preferred, while reducing preference limits for maize. On the other hand, soils that tend to retain moisture extend the lower preference limits of sorghum and maize.

Commercial value

In Lebowa *Vigna unguiculata*, and in particularly the large speckled blue-grey seeded form which can be sold to the local milling company in Pietersburg

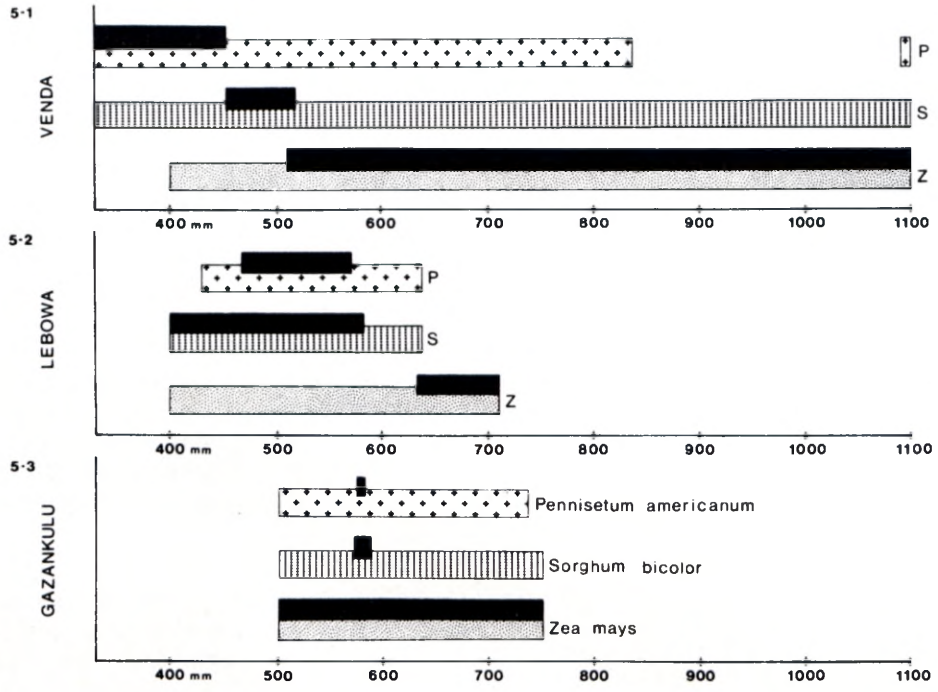

FIG. 5.—Relationship between annual rainfall and cereals cultivated in the three regions of the study area. Black bands represent range in annual rainfall over which the individual crops were given a priority one rating.

for cash, is preferred to most other pulses. Similarly *Phaseolus radiatus* is grown almost exclusively as a cash crop in this region, and is therefore more frequently grown and preferred than in Gazankulu or Venda.

Susceptibility to bird damage

In many parts of the study area birds are a major problem, destroying large fields of sorghum and in particular *Pennisetum americanum*. In north-east Lebowa, south Venda and north-east and south Gazankulu the problem is so great that *P. americanum* is largely excluded from cultivation.

Nutritional value

In parts of Lebowa where sorghum is preferred it is believed that this crop prevents infantile-pellagra (caused by a protein deficiency), while maize does not. Consequently, sorghum is preferred to maize.

GERM PLASM CONSERVATION

One of the primary aims underlying this survey, besides being to assess the nature and variation of primitive South African crops, is the collection and preservation of germ plasm and the assignment of conservation priorities to these crops.

Most of the major primitive crops show a wide range in morphological variation and accordingly constitute a valuable source of germ plasm. Efforts to collect and preserve this germ plasm have been minimal in the past, largely due to a lack of realization as to its potential value. As a result manpower and funding allocated to this work has been limited. This fact is reflected in the mere 201 collections of primitive crops housed in the national seed bank (Department Agriculture and Fisheries, 1980). Included in this total are: *Sorghum bicolor* 118, *Pennisetum americanum* 27, *Eleusine coracana* 1, *Citrullus lanatus* 15, *Lagenaria siceraria* 3, *Vigna unguiculata* 19, *Voandzeia subterranea* 15, *Phaseolus radiatus* 0, *P. acutifolius* 0, *Cajanus cajan* 0, *Sesamum indicum* 1 and *Ricinus communis* 2.

Poor collecting is not the only problem facing the conservation of primitive crop germ plasm in South Africa. In many parts of the study area there is an increasing tendency to move away from low yielding primative crops, and to replace these with better developed higher yielding modern crop types. This is particularly noticeable with cereals, where maize cultivation is being strongly promoted by all local agricultural authorities. This trend is also seen in the increasing importance of *Cucurbita* sp. cf *pepo* and *Arachis hypogaea* as agricultural crops. These changes are particularly, although not exclusively, prevalent in areas where irrigation has been made available. In these situations, the cultivation of vegetables (onions, tomatoes, chillies, cabbages and various bean types, etc), as well as fruit crops (pawpaws, oranges, mangoes, bananas, avocados and guavas) is also promoted, all of which influence the extent to which primitive crops are cultivated. Such changes in attitude do not necessarily mean that the cultivation of primitive crops is being discontinued. In most situations it is merely the reduced area cultivated (up to 90%) that causes a serious loss in germ plasm.

In assessing the situation in South Africa, it is apparent that a concerted effort is required to collect germ plasm of all primitive crops, and that this should include as much as possible of the variation expressed by these crops. In addition, the need to prescribe special conservation priority ratings to certain crops within the ethnic regions studied has emerged from this survey. Special consideration should be given to all minor crops through the study area as well as to *Pennisetum americanum* in the low rainfall areas of Lebowa, to *Sorghum bicolor* and *Pennisetum americanum* in Gazankulu and to *Voandzeia subterranea* in Venda.

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