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PROCEEDINGS

Crop Improvement in Eastern and Southern Africa

Research Objectives and On-Farm Testing

A regional workshop held in Nairobi, Kenya, 20-22 July 1983

CANADA

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Crop Improvement in Eastern and Southern Africa:

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A regional workshop held in Nairobi, Kenya
20-22 July 1983

Editor: Roger A. Kirkby

RÉSUMÉ

Un atelier a réuni un petit groupe représentatif de scientifiques travaillant à des programmes d'amélioration des cultures alimentaires en Afrique orientale et australe, pour discuter de la planification, de la conduite et de l'élaboration de ces programmes. Le débat a porté surtout sur les aspects méthodologiques, communs à la majorité des cultures réalisées par les petits fermiers et les plus susceptibles de permettre l'utilisation des résultats de la recherche.

On s'intéresse donc ici aux cultures locales et aux pratiques culturales, à l'organisation de l'aide institutionnelle pour améliorer les cultures, aux objectifs particuliers des programmes et au mode d'établissement de ces objectifs, enfin aux méthodes d'évaluation employées pour formuler une nouvelle recommandation sur les travaux de vulgarisation. On résume aussi la séance de discussion qui a porté sur l'organisation des programmes d'amélioration des cultures, l'établissement des objectifs techniques, l'application des critères de sélection, la méthodologie pour les essais tous terrains et sur les fermes et, enfin, l'orientation de la recherche.

RESUMEN

Este seminario reunió un pequeño grupo representativo de científicos que trabajan en programas de mejoramiento de cultivos alimenticios en Africa oriental y meridional con el ánimo de discutir la planificación, la ejecución y el desarrollo de tales programas. El énfasis de la discusión recayó en aquellos aspectos metodológicos, comunes a la mayoría de los cultivos sembrados por los pequeños agricultores, que tienen la probabilidad de influir más en que los resultados de la investigación sean utilizados por el agricultor.

Entre estos trabajos se encuentran breves recuentos de las variedades locales y las prácticas de cultivo empleadas actualmente, la organización institucional para el fitomejoramiento, los objetivos específicos de los programas y su sistema de establecimiento, así como los procedimientos de evaluación empleados para llegar a las nuevas recomendaciones para los trabajos de extensión. También se incluye en este volumen un resumen de la sesión de discusión sobre la organización de los programas de fitomejoramiento, la fijación de los objetivos técnicos y la aplicación de los criterios de selección y la metodología para las pruebas tanto en fincas como en localización múltiple. Varios temas de política fueron identificados.

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CEREALS

SORGHUM RESEARCH AT SERERE, UGANDA

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Sorghum research in Uganda is carried out at Serere Research Station in Eastern Uganda, an important sorghum- and millet-growing area. In this area, farmers require cereal crops that produce high and reliable yields. The area has a bimodal rainfall that makes it possible to grow two generations of the crop each year.

Sorghum is the second most important grain crop in Uganda, after finger millet. It occupies about 37%, in pure stands, of the total cultivable acreage in Uganda. In the banana-growing areas of Western and Southern Uganda, sorghum is planted twice a year or as a ratoon crop. In the drier northeastern portions of the country, sorghum is intersown with finger millet. Some farmers also grow the crop in mixtures with maize, simsim, and pigeon peas.

Sorghum may be used unmixed for food in Kigezi and parts of the east and north, especially in Karamoja. Generally, food is prepared from a mixture of sorghum with cassava or sweet potato flours. It is used for making beer throughout Uganda and is grown solely for this purpose in the banana-growing areas. In Kigezi, the grain is germinated with wood ash and dried. The resultant malt makes a sweet porridge (uji).

The crop grows well during both seasons, but birds can be troublesome and attack food varieties at certain times. In the north and east, bitter types are planted during the first rains, when birds are a menace; but during the second rains, very palatable sorghums can often be grown without bird damage. It is an excellent second rains crop and the groundnut/sorghum rotation is highly recommended and practiced--the groundnuts being lifted as soon as they are ready and the sorghum planted immediately. The crop is also useful as a second rains opening crop, with the land being opened to sorghum during the first rains, followed by cotton during the main rains. Sorghum or sorghum and millet are not grown continuously on the same land because this results in the parasitic witchweed Striga becoming abundant.

There are many local varieties and these are still recommended in high-altitude areas such as Kigezi. The local types are also the best for making banana beer. In the north and east, which are generally intermediate to lowland and unreliable rainfall areas, the improved

varieties of Serena, Seredo, and E 525 HT are recommended and have been released to farmers because they are better yielding, have shorter maturation periods, and are reasonably resistant to Striga and shootfly.

Research on indigenous sorghum was started at Serere by the Department of Agriculture in 1952. The project gained importance in 1958 when it was taken over by the then East African Agriculture and Forestry Research Organisation (EAAFRO), a branch of the then East African Community. In the same year, sorghum work at Ukiriguru in Tanzania was transferred to Serere by EAAFRO, and since then cultivars have been developed to cover the whole of East Africa. Germ plasm is received from and exchanged with several sources such as Ethiopia, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Semi-Arid Food Grains Research and Development (SAFGRAD), Texas A & M University, and other organizations actively engaged in sorghum research.

PROJECT OBJECTIVES

The ultimate objectives of sorghum research at Serere are to improve yield, quality, maturation period, plant height, and resistance to diseases, pests, Striga, and lodging.

Specifically, the objectives are to:

(1) Select high-yielding palatable sorghums with white or brown flinty grains that are resistant to leaf diseases and insect pests and have good weathering attributes.

(2) Select drought-escaping or drought-tolerant sorghum varieties for growing in the more difficult Karamoja and North Teso areas.

(3) Develop high-yielding short sorghum hybrids with good grain quality that are resistant to diseases and insect pests and have good weathering attributes.

(4) Screen for grain-mold resistance.

(5) Select varieties having a satisfactory level of resistance to shootfly, witchweed, weevils, and other insect pests.

(6) Continue to evaluate the performance and adaptability of improved sorghum varieties and hybrids screened from existing programs over a wide range of environments with the aim of identifying suitable varieties for release to farmers.

(7) Select for early seedling vigour, good seedling establishment, and better plant stands in the field.

(8) Select the most acceptable grain types consistent with the prevailing bird damage situation.

METHODOLOGY

At Serere, there are over 3000 entries in the world collection. These are grown each year for character evaluation and maintenance.

Records are kept of imported, collected, assembled, and locally bred varieties/lines. The entries with desirable characteristics are selected for inclusion in the breeding programs. A number of methods are used in the improvement efforts:

(1) Conversion methods for improving self-pollinating cereals have been adapted.

(2) Population improvement methods developed so successfully for maize are being applied to sorghum as well. In effect, the procedures adopted are: (a) In the development of high-yielding palatable sorghum with white or brown flinty grains, selection criteria include grain endosperm hardness and over 50% corneousness, larger sized panicles with medium to large seeds, and a good seed set. Activities include mass selection, selfing, and recombination. (b) Development of drought-escaping or drought-tolerant varieties for the semi-arid areas: Local Turkana sorghum selections and improved Serere varieties are being combined. Early-maturing derivatives are crossed with CK 60 to produce early-maturing sorghum hybrids. (c) Screening trials: A large number of genotypes that have been visually selected from segregated populations are being screened for yield and any other obvious agronomic or grain-quality weakness that may not have appeared in previous generations of visually selected genotypes. (d) Breeding high-yielding sorghum varieties that are resistant to weathering and grain-mold fungi: This program aims to identify grain mold causal agents and screen and identify resistant sources that are utilized through appropriate breeding procedures to combine grain-mold resistance, grain quality, and agronomic excellence.

(3) The testing of promising lines of sorghum is carried out throughout Uganda at Variety Trial Centres. These are 40 in number and are distributed within the three principal ecological zones distinguished by rainfall and altitude -- cool, wet highlands; moist Lake Basin zone; and semi-arid lowlands. These centres are managed by Variety Trial Observers under the Department of Agriculture extension service. The variety hybrid developed at Serere is sent for testing of its performance, stability, and adaptability to all of the centres. These centres have proven very useful in adaptability evaluations of particular varieties, e.g., it was found that the variety Serena takes about 105 days to mature in lowland areas but more than 120 days in high-altitude areas. Also, variety Dobbs Bora was found to be better suited to the wetter areas around Lake Victoria. A successful variety is recommended for release in a specified zone to the Variety Release Board. The board, if satisfied, releases the variety. Then, the Seed Multiplication Scheme multiplies the seed and makes it available to farmers through Cooperative Societies.

Although sorghum breeding has continued along similar lines for 30 years, the principal program improvements made recently have been the addition of agronomy and entomology objectives.

PLANT DISEASE ASPECTS OF SORGHUM IN UGANDA

The sorghum improvement project at Serere, although concentrating on breeding, considers sorghum diseases as one of the major criteria upon which to base selection. A survey of farmers' crops was conducted in Northern, Eastern, and Southern Uganda to assess the

occurrence and distribution of sorghum diseases. The survey showed that diseases can be a limiting factor in the production of sorghum in Uganda. Varietal susceptibility can lead to up to 100% loss of the crop. Both foliar and inflorescence diseases occur. Generally, foliar diseases are more important on the local varieties, whereas grain molds are more important on the improved varieties.

Among the foliar diseases, anthracnose (Colletotrichum lindernuthianum) was rated as the most important, particularly in high-rainfall areas of Eastern and Southern Uganda. It was the most frequent and most intensive foliar disease on most sorghum varieties. In highly susceptible varieties, the disease occurred before flowering and intensified toward maturity. Often, in such varieties, the disease led to severe defoliation, the resultant effects of which were lengthening the maturation period, or incomplete filling of the grain, or both. In the less susceptible varieties, symptoms appeared after flowering and did not seem to affect grain development. Other diseases that were found to be important on local cultivars included gray leaf spot (Cercospora sorghi) and zonate leaf spot (Gloecescospora sorghi). Interestingly, it was observed that on varieties with zonate leaf spot and gray leaf spot, anthracnose was absent.

In Northern Uganda, gray leaf spot was observed to be the most important foliar disease. However, the disease sets in when the plant is approaching maturity so, economically, it may not be very important. Sorghum downy mildew (Perenosclerospora sorghi) is another important disease. Early infections led to complete leaf shredding. In such cases, the plants did not head at all; they remained stunted and dried up prematurely. Later, infections led to the production of small heads and poor grain development.

This survey, therefore, revealed that three foliar diseases, anthracnose, downy mildew, and gray leaf spot, need immediate attention.

On the heads, grain molds are important. The infested grains develop fluffy-white or pinkish or black discolourations. Both types of discolourations may be present on the same head. Grain molds have become a major and widespread disease problem. The disease has been known to cause yield losses due to the failure of the grain to produce seed. Qualitatively, grain molds lower the market and nutritional value of the grain. The market value is lowered due to grain discolouration, whereas the nutritional value is lowered due to deterioration resulting from physical and chemical changes in the grain. The disease also causes loss in viability of the grain and reduction in seedling vigour. Infected seedlings that germinate often produce blighted seedlings.

Grain molds, therefore, are proving to be one of the major disease and research problems in the improvement of the sorghum crop. The infection is invariably more intensive on the improved light-coloured seed cultivars than on the local dark-coloured cultivars. It is postulated that these improved cultivars lack the built-in mold escape mechanism inherent in the local varieties (Williams and Rao 1978).

A number of methods, including the use of fungicides for the eradication of and protection against pathogens, and quarantines and seed certification for the exclusion of pathogens, have always

provided very effective control of plant diseases. These methods, however, are expensive and sometimes require very precise operations by the farmer before any appreciable benefit can be achieved.

Hence, it is recognized at Serere that screening for crop genetic resistance is the one and probably only way of economically controlling the diseases affecting sorghum. A backcross program is planned to incorporate anthracnose and other leaf-disease resistance into the highly susceptible local varieties while still maintaining their good attributes. As for grain molds, heavy selection pressure must be exerted on much of the working material because most of the improved varieties are highly susceptible.

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