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WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

HYBRID SORGHUM PRODUCTION IN THE SUDAN

WSARP PUBLICATION No. 34

JANUARY 1985

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THE GOVERNMENT OF SUDAN

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

THE WORLD BANK

CONSORTIUM FOR INTERNATIONAL DEVELOPMENT

WASHINGTON STATE UNIVERSITY

HYBRID SORGHUM PRODUCTION IN THE SUDAN

LYNN MCDONALD

HYBRID SORGHUM PRODUCTION SPECIALIST

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Hybrid Sorghum Production in the Sudan
by Lynn McDonald
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by

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January 1985

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And lastly, I wish to express my appreciation to my wife, Doris, and daughters, Annessa and Amy, for their understanding and support while in the Sudan, and to Mrs. Sue Hamilton for typing this final report.

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PRELUDE

This report does not cover the entire subject of sorghum production in the Sudan. Rather it discusses the more important aspects relating to the production of "Hageen Durra - 1", the first hybrid sorghum released in the Sudan. The first part of the report discusses the development of the hybrid sorghum program, followed by the conditions encountered in the first year of production of certified hybrid seed on a large scale.

The primary purpose of this report is to compile under one cover most of the important events in the evolution of the hybrid sorghum program. It also contains pertinent information necessary for those individuals or firms considering the development of a private hybrid seed production program in the Sudan.

Only one reference is cited in the text of the report as all other sources of information are either contained as annexes or was obtained during discussions with persons closely associated with the development of the hybrid sorghum program.

INTRODUCTION

Sorghum production in the Sudan began thousands of years ago when man first grew sorghum to provide grain as a part of his diet, leaves to feed his livestock and stalks for use in construction of shelter. Over the years he selected sorghum types which produced more palatable grain, more leaves and better stalks for his construction needs - thus was the beginning of sorghum improvement in the Sudan.

The first recorded sorghum improvement was in the early 1900's with the collection of landrace sorghum types, the bulk of which was collected by Punter in 1914 (1). These early collections were not subjected to breeding procedures, and very little selection pressure was applied. Most all early collections were maintained, and improvement work was performed, at the Gezira Research Farm, Wad Medani, by cotton scientists with major emphasis on crop management, weed control, and disease and pest problems.

Varietal development had its beginning in the 1930's with the introduction of several Feterita, Hegari and Milo types from the United States. A cotton agronomist, S. H. Evelyn, was the first researcher to actively subject the sorghum collections to some type of detailed evaluation and yield screening program (1). His work was begun during World War II, and was carried on for the next 30 years by various cotton scientists, at numerous locations throughout the Sudan.

In 1972, at the Agricultural Research Corporation (ARC), Wad Medani, a Plant Breeding Section was established to conduct breeding activities on crops other than cotton. Major emphasis was on groundnuts and sorghum, two of the crops utilized in the crop rotation system of the Gezira Scheme.

HYBRID SORGHUM DEVELOPMENT

It was not until 1977, that hybrid sorghum received a major forward thrust, with the advent of the ICRISAT/Sudan Cooperative Program for Sorghum and Millet Improvement. Through this cooperative program, a full time sorghum breeder was stationed at the ARC, with the initial responsibility of collecting sorghum germplasm for use in the hybrid development program. In 1979, Dr. Gebisa Ejita assumed the duties as the ICRISAT sorghum breeder, and from 1979-82 tested several thousand experimental hybrids at numerous locations throughout the Sudan, in both irrigated schemes and rainfed areas. From these tests emerged 3 hybrids with superior performance records. During the crop year, 1982, these hybrids were produced in one acre crossing blocks to determine the potential problems associated with production. Two of the hybrids were considered producible, with one of these being slightly superior in flour quality. This elite hybrid had been tested as EEH-3, and was selected by Dr. Ejeta and the Plant Breeding Section, ARC, to be submitted to the Sudan Plant Propagation and Variety Release Committee, for consideration of being released as the first hybrid sorghum for the Sudan. A more detailed discussion of the activities involved in the development of the hybrid is presented in annex 1 which is a paper presented to the Hybrid Sorghum Workshop, 5-8 November 1983, by Dr. Ejeta.

RELEASE OF "HAGEEN DURRA - 1"

On 24 January 1983, the Sudan Plant Propagation and Variety Release Committee officially released the hybrid, appropriately designated "Hageen Durra - 1", arabic for "Hybrid Sorghum No.1". Performance history of the hybrid, as well as historical accounts leading up to release, are presented in annex 2, "Application for Approval of Release of the First Sorghum Hybrid in the Sudan".

ADVISORY COMMITTEE FOR HYBRID SORGHUM PRODUCTION

During the discussion by the Variety Release Committee, it became evident there existed many areas in which little information had been accumulated, particularly in the areas of production and seed distribution.

At the suggestion of Dr. Mohamed Bakheit, Director General, ARC, and Mr. Kamal Ali Babiker, Under Secretary, Ministry of Agriculture and Irrigation, a committee was established to oversee the development of the Pilot Seed Production program. A sub-committee was also appointed to function as the Advisory Committee for hybrid sorghum production, and charged with the responsibility to actively formulate plans and procedures for the establishment of a permanent hybrid sorghum production program in the Sudan. Organizations represented, and individuals appointed to the committees, are listed in the minutes of the Variety Release Committee, annex 3 (page 68).

The first item of business confronting the committee was the formulation of an operational budget, which was undertaken at the first organizational gathering of the nominated members. Activities and actions taken by the committee are summarized in the minutes of the committee meetings listed in annex 3. The minutes of all meetings are contained therein and give a good account of the activities that have taken place in the development of the hybrid sorghum production program to-date.

An initial undertaking of the committee was the formulation of a "Pilot Project" in which would be outlined the proposed objectives of the early phase of production. Each committee member was assigned a segment to contribute to the overall project. The proposal was finalized in November, 1983.

Another major undertaking by the committee was the formation of a Hybrid Sorghum Workshop. Through many hours of preparation, and solicitations of financial support, the committee was able to put together a workshop that was held on 5-8 November 1983 at the ARC, Wad Medani, INSORMIL provided most of the financial support for visiting professionals from foreign countries.

The proposed Pilot Project was presented to delegates attending the workshop and accepted as written. As a recommendation of the workshop, the pilot project was submitted to 10 organizations in an attempt to solicit financial support for "Phase I" of hybrid sorghum seed production. The "Pilot Project for Hybrid Sorghum Seed Production, Distribution, and Utilization", "A Proposal" in its entirety, as distributed, is given in annex 4.

In addition to approving the dispersal of the pilot project for solicitation of financial support, the workshop delegates formulated a list of 29 recommendations that were considered vital for the success of the production program. These recommendations are listed in annex 5.

HYBRID SEED PRODUCTION

The release of the new hybrid sorghum presented a new problem to the sorghum development program; the production of pure hybrid seed within the Sudan, where there exists an abundance of wild sorghums (Adar) in almost every cultivated field. The Plant Propagation Administration was familiar with the production of sorghum, having produced and certified the two varieties "Dabar" and "Gadam El Hamam" since their release in 1978. (Dabar and Gadam El Hamam are the only sorghum varieties ever officially released in the Sudan.) However, these two varieties were self-fertile, producing an abundance of pollen, thereby considerably reducing the possibility of pollination by foreign pollen. On the other hand, the production of the new hybrid would utilize a male-sterile seed parent with the floret receptive to any pollen, whatever the source, creating the necessity to isolate production fields from all sources of contaminating pollen. Also the utilization of different components in seed production necessitated the re-evaluation of the seed certification standards and re-writing of them to conform to the procedures utilized in hybrid seed production. Subsequently, a modified version of the Texas Seed Certification Standards was adapted, and the Seed Certification division was charged with the responsibility of policing the production and enforcing the standards.

1983 CERTIFIED SEED PRODUCTION

Following the release of the new hybrid in January 1983, the seed production section of the Sudan Gezira Board agreed to finance and to produce 30 feddan of certified seed during the 1983 crop year. The field was carefully selected so as to insure adequate isolation and provide all necessary factors for a favorable production environment. The field was hand planted and received the best possible cultural practices throughout the growing season. Additionally, at the

initiation of roguing, the field was closely monitored with all off-type plants being removed promptly. Every effort was made to protect the male-sterile plants from contamination by foreign or undesirable pollen. Such extreme precautions were taken, that a growout was deemed not necessary; and therefore, the seeds were processed and distributed for planting, without a growout.

Accurate records were kept on the production with particular emphasis on:

1. Date of planting
2. Date of first irrigation
3. Frequency of irrigation
4. Amount and time of fertilizer applied
5. Developmental patterns of each parent
6. Days to mid-bloom of each parent
7. Days to maturity

Upon completion of the growing season, these data were analyzed, and it was concluded that the hybrid could be produced under current cultural practices of the Gezira Seed Farm. There was observed a difference in days to mid-bloom between the two parent lines, with the male-sterile line attaining mid-bloom 3 to 4 days earlier, than the pollen producing parent. It was determined that this should not present a major problem, and the Hybrid Sorghum Project advanced to the next phase of development, designated "Phase I".

A total of 17 tons of seed were produced on the 30 feddan, which were processed and distributed to various growing areas and farming schemes, as listed in Table 1. The receiving agencies were charged Ls 1.20 per kilo, for the seed, in an attempt to recover some of the production costs. This price was based on 4 times the gate market price of sorghum, in accordance with recommendation 27 of annex 5.

FINANCING OF "PHASE I"

The primary point of concern, in Phase I of the hybrid sorghum production project, was that of financial support. The Pilot Project proposal, outlined the past and current status of the sorghum industry in the Sudan, as well as the projected success of the ICRISAT/Sudan

TABLE 1: Distribution of Hageen Durra-1 seed for demonstration plantings in 1984.

ORGANIZATION	NO. OF FEDDANS	KG. SEED RECEIVED
Gezira Scheme Farming	2400	----
Sudan Gezira Board	630	2520
Mechanized Farming Corporation	100	1000
Blue Nile Corporation	45	200
White Nile Corporation	45	200
Suki Scheme	45	200
Rahad Scheme	90	360
New Halfa Corporation	90	360
USAID	----	620
Blue Nile Company	----	1000
National Seed Administration	10	----
TOTAL	3455	6460

Cooperative Program for Sorghum and Millet Improvement. Additionally, it outlined proposals for the development, production and distribution of hybrid sorghum seed throughout the farming regions of the Sudan, and projected budget for implementation. Immediately following the workshop and complying with recommendation 29, the Pilot Project proposal was distributed to the 10 listed, possible sources of financial support.

USAID on 6 May 1984 approved Ls 220,000 to finance Phase 1 of the project, with these funds to come from money generated from the sale of wheat and flour, brought into the Sudan.

HYBRID SORGHUM PROJECT IMPLEMENTATION

The Government of Sudan (GOS), National Seed Administration (NSA), was charged with the responsibility for overseeing the project, and to make every effort to insure the success of the program. The original plan was for the NSA to produce certified seed and make every possible effort to engage, any and all, private corporations, and/or individuals, in the production program. Plans for certified production during the 1984 crop season, were to make parent seed available, to the Mechanized Farming Corporations (MFC), the Sudan Gezira Board and NSA. Additionally, several private organizations were to be contacted and offered the opportunity, to participate in the first years program.

Those private concerns contacted included:

1. Mr. Muftia
2. H.E. Mr. Mustafa Basher
3. H.E. Dr. Osman Khalifa
4. Damazine Agricultural and Animal Production Co.
5. Sudan-Egyptian Intergrated Co., Gedaref
6. Arab-Sudan Blue Nile Scheme, Agudi
7. Canadian Development Agency, Sem Sem
8. Biriyab Scheme
9. Khalil Farm Agric.
10. El Zubair Ibr.

Interest among the private sector was very low with four individuals indicating an interest; two of which actually obtained seed and made a planting. Production acreages for 1984 are given in annex 6 (page 147).

1984 CERTIFIED SEED PRODUCTION

Initially, the Advisory Committee planned to produce 90 feddan of certified seed at Barakat, with the Sudan Gezira Board cooperating, and an additional 60 feddan at Sennar. However, based on the results of the 1983 crop, the Sudan Gezira Board opted to commit the total sorghum production acreage of the Seed Farm to this year's production for a total of 554 feddan. Combined, the two production totals equaled 614 feddan, well above the acreage for which the Advisory Committee had male-sterile seed. In order to plant these acreages, an additional 500 Kg of male-sterile seed (Tx A-623) were needed, which Dr. Gebisa was able to purchase from Holdens Foundation Seeds, Idalou, Texas. These seeds arrived at Wad Medani 25 June 1984 in ample time for planting.

Having obtained sufficient quantities of seed for the 1984 production acreage, the next major obstacle was the development of an acceptable contract to be presented to the tenant farmers of the Gezira Seed Farm. A contract as prepared by Dr. Omer Fadil and Mr. W. Andraous, and offered to the tenants, is given in annex 7. Involved in the 554 feddan, were 188 tenant farmers, with the crossing blocks comprising 8 fields which ranged in size from 30 to 100 feddan. All fields were sufficiently isolated to meet the certification distance standards as adapted by the Seed Certification Agency, (annex 8).

Following approval of the contract by the tenants, and seed obtained, planting began on 10 July and was completed on 28 July. No major problems were encountered in the planting process, but problems did develop upon plant emergence. These problems were results of variations in irrigation, coupled with herbicide movement. A detailed discussion of these and other factors influencing early plant growth are presented in annex 6.

Following the establishment of an acceptable plant population, the next phase of the production process was the removal of off-type plants and "Adar" from the fields. No problems were encountered in the roguing process, other than the excessive amount of adar, present in many hawashas. The removal of these adar plants accounted for more than 50 percent of the total time spent on roguing. Some of the most infested hawashas were rogued 15 times during the season.

Blooming (Nicking) is the most critical factor in the production of quality seed, as well as, insuring the maximum quantity of seed. This proved to be a major problem, and received more attention and discussion, than any single step in the entire production process. It was known that the A-line would bloom 3-4 days ahead of the R-line, as this difference had been observed in the 1983 production fields. However, the 1983 field was only 30 feddan, and extra care was taken to prepare the land and provide maximum care throughout the season. This season, with the amplification to 554 feddan, a large array of land preparations and environmental variations, were experienced. These variations, in turn, allowed the two parent lines to express themselves in ways never before observed. Thus the 3-4 days to mid-bloom difference was magnified to 2-10 days.

A detailed discussion of the roguing and blooming experiences are presented in annex 9.

CERTIFICATION AND INSPECTION

Recommendation 10 (annex 5) is for the adaption of the Tatwawadi (1979) report on seed handling, with minor modifications. In December 1983, Dr. S. K. Banerjee, FAO Seed Specialist at Sennar, revised the Tatwawadi report to include modifications of the Texas Certification Standards adaptable to hybrid sorghum production in the Sudan. This revision was used as the standards for inspection and certification of the 1984 hybrid sorghum production fields. The revised certification standards applicable to hybrid sorghum are presented in annex 8.

The first inspection of the certified production fields, at the Gezira Seed Farm, was made on 15-18 September, when most fields were in some stage of bloom. Field inspection reports as shown in annex 10, were made for each hawasha at each inspection time (bloom and pre-harvest). The final inspection report was made on 22-25 October, when all fields had set seed, and most were approaching physiological maturity.

Information contained within these field inspection reports was obtained from the Hybrid Sorghum Project Leader, Dr. Omer Fadil, as well as results of each inspection. These accumulated bits of data,

will be combined and analyzed, so as to develop a better understanding of the response of plant development to differing cultural practices. Also, the inspectors' data will be used in conjunction with grow-out readings, to determine possible sources and/or causes, for off-type plants.

Strict adherance to the certification standards, as written, will most likely result in rejection of all seeds produced during 1984, because the roguing and isolation was no better than that experienced during the 1983 production season. And, should the 1983 certified production have been subjected to a grow out, the entire lot would have been rejected. During 1984, in all farmers' fields of Hageen Durra 1, there was observed between 3 and 6% tall, off-type plants.

In the October 1984 meeting of the Advisory Committee, it was agreed that the grow outs should be conducted, but the certification standards should be relaxed, such that most lots of seed, can be utilized for sale.

The relaxing of the certification standards should be closely monitored, and not become an accepted practice each year. There is justification to relax the rigid standards for the first few years, but exerted efforts must be made to attain the purity standards as written. I anticipate that as the amount of acres planted to the Hageen Durra 1 increases, and the farmers become better acquainted with hybrid seed production, the purity problem will eventually be taken care of, and acceptable seed can be produced.

The one factor that allows for the acceptance of the hybrid seed, with such a high percentage of tall, off-type plants, is that the farmers are used to having the tall plants in their fields. Also, in every case, in talking with farmers, their comment about the tall plants was that "they have large heads and produce grain also".

MANAGEMENT SUGGESTIONS FOR HYBRID SEED PRODUCTION FIELDS

All farmers within the Gezira Scheme were familiar with sorghum production, but had never observed a hybrid sorghum production field. Therefore, an introduction to the new production procedures had to be developed and explained, to each farmer involved. A list of management suggestions was prepared and provided to each farmer. However, from the

initial site selection through harvest, the Product Leader and/or technicians, assisted the farmers through each step, and explained the necessity of each treatment and its relationship to the production of quality seed, as well as, seed quantity. The 10 steps outlined in the management suggestions are given in annex 11.

1984 DEMONSTRATION PLANTINGS OF HAGEEN DURRA 1

Seeds produced on the 30 feddan of certified production in 1983 were distributed to various farming organizations throughout the Sudan, for demonstration and testing, for regional adaptability during the 1984 growing season.

All seeds distributed were in 10 Kg bags, with a suggested management practices pamphlet, attached to each bag. These suggestions are listed in annex 12, and were provided in an attempt to get the farmers to pay more attention to the new hybrid and provide an environment, such that, the plants may attain their maximum potential.

Table I lists all farming organizations that received seeds and the projected acreages to be planted. The exact acreages planted were unobtainable, but each recipient did plant all seeds received. The seed distribution throughout the country was good, but the usefulness of the plantings for demonstration purposes by extension personnel was almost non existent. The extension personnel seemed to just let nature take its course, and exerted no efforts to show the plantings to surrounding farmers, in an effort to create farmer interest.

As discussed in annex 6 and annex 9, I traveled to various locations within the country to observe the performance of the hybrid. In addition to the locations discussed, I visited Juba, Yambio and Damazine.

Conclusions about the performance of the hybrid throughout the country are difficult to formulate. In the Western region of Kadugli and El Obeid, no statement can be made, because of the extreme drought conditions. The testing and demonstration trials should continue, so that some information can be obtained of the performance of the hybrid in comparison to local varieties. It is highly doubtful that in the Kadugli area, a hybrid will be accepted in the near future, because of the problems with distribution of new seed each year.

In the El Obeid area, there exists the possibility of a good acceptance, and it will be much easier to distribute new seed each year. However, testing needs to continue, and the drought has to break, before any crops perform adequately.

In the South, around Juba and Yambio, there needs to be continued testing to determine the optimum planting dates. Early July plantings mature during the rainy season, and all heads were observed to be destroyed by mold, as they were unable to adequately dry. A possible late August or early September planting, may work, as the heads will be maturing at the end of the rainy season. Plantings, at the time of my visit on October 30, appeared to be very promising.

In the Damazine area, the hybrid appeared to perform very well. Many sorghum varieties were heavily infested with charcoal rot, resulting from the extreme dry conditions. Normal rainfall is 500 to 800mm per year, but this year only 380mm were received. However, in one 70 acre field, the hybrid averaged 400 Kg per acre; whereas, many surrounding fields of local varieties, produced no heads. With a near normal rainfall in the region, the hybrid will possibly have an excellent yield.

Within the Gezira Scheme, there were 3030 feddan of the hybrid planted, and all fields were expected to have excellent yields. At the time of my departure, harvest had just begun, with few results reported. The average yield per feddan of local varieties is 500 to 700 Kg. Reports, thus far, on the 1984 Hageen Durra-1 ranged between 1,000 and 2,550 Kg, with an average of 1,825 Kg per feddan.

There is excellent acceptance of the hybrid among farmers in the irrigated Gezira Scheme, and all farmers have indicated they will plant their 1985 sorghum acreage to the hybrid.

CONCLUSIONS

The development, release and large scale production of a hybrid grain sorghum in the Sudan has been accomplished. Testing of the hybrid, in farmer trials throughout the sorghum producing regions, has been initiated, with initial results varying, because of the drought stress experienced during the 1984 season. In those regions with irrigation, the hybrid performed exceptionally well, with most preliminary yield

reports in excess of two times the farmers normal yield averages.

The performance of the hybrid "Hageen Durra 1" is exceptionally good, and thus far has met with wide spread acceptance by research and extension personnel, as well as farmers. However, milling of the seeds into flour has not been performed on a commercial basis. Following the harvest of the 1984 crop, numerous grinding mills will be using the grains in their daily grinding operations, at which time the grinding properties will be determined. Preliminary grinding results indicate the grains will not be difficult to dehull, with seed hardness not being a problem in the grinding operation.

The most critical test the hybrid will have in determining its continued acceptance will be in the taste of the foods prepared from the flour. Preliminary tests have indicated the foods prepared from the flour were at least comparable to those produced from sorghum varieties currently being grown.

Production of hybrid seed on a large scale was carried out during the 1984 growing season, and was for the most part, very successful. Within the confines of the Gezira Seed Farm at Barakat, hybrid seed can be produced, but extra precautions must be taken to provide an abundance of R-line pollen at the time the A-line florets are receptive. This is extremely critical because of the excessive amount of foreign pollen available from distant fields. The extremely high population of wild sorghums and other local varieties coupled with the strong early morning winds, makes the necessity of extra R-line pollen very critical for the production of quality certified seed.

Cultural practices, especially irrigation, being as they are in the Gezira, make it near impossible to stagger the planting dates of the two parent lines. The only possible way to stagger planting (plant emergence) is to plant border rows around each hawasha. This planting could then be irrigated early and thus provide an early pollen supply.

So long as the two parents currently used in producing Hageen Durra 1, are utilized, there will always exist the problem of nicking. This was evidenced this season, as had been observed in the development of the hybrid, where conditions were maintained near optimum. Cultural practices can be manipulated, but in all cases, the R-line will most likely bloom later than the A-line, as has been observed in every

situation to-date. To go into each plot and attempt to manipulate only the R-line, to speed up blooming, would be unthinkable and very expensive in a large scale production program. The only solution to the nicking problem, is to rework the R-line, in hopes that selections can be made that will bloom up to 4-5 days earlier.

Personnel associated with the certified hybrid production fields during 1984, from the National Seed Administration and The Sudan Gezira Board, demonstrated an intense interest and the desire to make the hybrid seed project succeed, as well as an understanding of the procedures necessary for the production of a quality product.

In summary: Hageen Durra 1 has demonstrated its ability to outyield all other varieties in the irrigated sections, has performed acceptably well under rainfed conditions; and certified seed can be produced, if a percentage of off-type plants will be acceptable..

RECOMMENDATIONS

Several recommendations have previously been stated in annex 9, (page 173), which had particular reference to factors affecting roguing and seed set.

I. The Hybrid Sorghum Advisory Committee members are very knowledgeable about procedures necessary for the production of quality certified hybrid sorghum seed and are planning to implement many test plantings in an effort to determine which environmental factors are exerting the most influence on the nicking problem. Some of these tests include:
   A. Off season land plowing and leveling.
   B. Close supervision of the bedding operation so as to establish a good uniform ridge to facilitate a more uniform planting.
   C. Two pre-plant irrigations - provided water is available - in an attempt to germinate as much wild sorghum seeds as possible.
   D. Plant an R-line border around each hawash and irrigate, to initiate germination, one week prior to planting the female.

E. Make R-line seeds available to farmers in fields adjacent to the seed blocks. This would provide an additional supply of acceptable pollen at blooming.

F. Apply an additional amount of urea to the male rows to speed up heading and blooming.

These test need to be performed, but precautions must be taken to make sure that responses can be detected and identified, and that they can be applied to large scale production plantings.

Precautions must be taken so as to not develop an artificial environment that will have to be closely monitored each season. The two parents are going to have to be stable and rugged enough to perform acceptably well, when subjected to the varying environmental conditions, and different cultural practices of the many farmers.

The end goal of this project is to prove that hybrid sorghum seed can be produced, with the hopes that private seed concerns will become interested, and take over the seed production. Therefore, it is imperative, that no artificial conditions be utilized that cannot be applied to large scale production fields.

II. The male parent is a derivative of a single head selection, and has proven to produce a good hybrid; but there exists much variation within the line, which needs to be worked out. The Sorghum Research Section, of the ARC, has to rework the R-line in head-to-row plots to purify the line, and possibly shorten the time to bloom. This can be accomplished and not affect the performance of the hybrid.

III. Demonstration plantings need to be continued but the extension personnel have to be energized so as to obtain yield data and plant performance. During 1984, very little efforts were exerted by extension personnel in conducting field tours, or any activity, that would create added interest in the hybrid among farmers and users.

IV. Production fields must be subjected to certification inspections, with accurate records made of any suspected source of seed contaminant. No relaxation of the inspection standards should be allowed.

V. Production from each five feddan unit must be planted in an off-season growout, with no seeds processed, until after the

growouts have been read. Growouts must be closely scrutenized and only after all samples from a production field unit have been read should there be any consideration of relaxing the minimum growout requirements. Every effort must be made to use only the most pure seeds.

VI. Attempts to interest the private sector in the seed production program should be made, but no individual or firm should be coaxed into the venture. Once the NSA and the Sudan Gezira Board have completed the initial production phase of the project, and have demonstrated the hybrid can be produced, and there develops a market for the seed, the private sector will voluntarily come forward; provided they see the potential for a profit from their investments.

VII. At the current point, in the developmental process of the production program, it would be most advantageous for members of the Hybrid Sorghum Advisory Committee to visit the USA to observe private hybrid sorghum production companies. The summer of 1985 would be the most opportune time for this tour, because the committee members have completed one year of production and have seen the problems that can occur, and will be able to look for solutions to their existing problems.

VIII. Continued financial support of the production program must be provided. Without financial support, the NSA and the Advisory Committee, will not have funds with which to operate, and the project would terminate. The interest of the Sudan Gezira Board is such, that they would continue the production of certified seed to meet the needs of the farmers within the Gezira Scheme.

IX. At the point in time when private cooperations enter the hybrid seed production program, consideration must be given, to allow the private firms to produce their own breeder and foundation seeds. No private firm will be willing to release to the ARC their breeder-parent lines for propagation. Breeder parent lines are generally considered private, and in many cases, the line pedigrees are confidential.

REFERENCES

1. Mahmoud, M. A. 1983, "Sorghum Research and Development in The Sudan Before 1975," Hybrid Sorghum Seed Workshop, 5-8 November 1983, Wad Medani, Sudan.

ANNEX 1

HYBRID SORGHUM SEED WORKSHOP

November 5-8, 1983

Wad Medani, Sudan

CURRENT STATUS OF SORGHUM IMPROVEMENT RESEARCH AND DEVELOPMENT IN THE SUDAN

By

Gebisa Ejeta

Sorghum Breeder

ICRISAT-Sudan

I. INTRODUCTION:

Sorghum (Sorghum bicolor L. Moench) is the most important grain crop in the Sudanese economy and diet. It ranks first both in total tonnage of grain produced and total area cultivated, with over 1/3 of the total crop land in the country devoted to sorghum. Every year some 75% of the total cereal production in the Sudan is generated from sorghum. Currently the total area under sorghum is over 3 million hectares and over 2.5 million metric tons of sorghum grain is produced; whereas the total production from all other cereals (millet, wheat, rice and maize) is less than one million tons.

In Sudan, like in many other semi-arid tropical African countries, sorghum is the main staff of life for millions of people in the country. In many parts of the country, the crop is wholly utilized. The grain is used for making kisra (unleavened bread from fermented dough); a significant portion is also used as thick porridged, asida;

as locally popular beverage, abreih and as local beer, marisa. The stalks are used as building material and the straw is used as animal feed or as source of fuel. Sorghum is undoubtedly the nutritional backbone of the country.

Sorghum is produced in all provinces of the country, from the arid region of the North to the high rainfall climate of the Southern region. However, the bulk of the crop is grown mainly in the Central Clay Plains which include the provinces of Kassala, Gezira, Blue Nile, White Nile and Southern Kordofan. This area which is essentially the sorghum belt of the country accounts for over 65% of the total sorghum production in the country. Over 90% of the total sorghum acreage is under rains and most of that is mechanized.

II. RECENT DEVELOPMENT OF SORGHUM RESEARCH PROGRAM IN THE SUDAN:

As discussed in the previous paper, sorghum improvement program in the Sudan is several years old, starting with the establishment of the Gezira Research Station in 1918 and growing into a full fledged sorghum research program at Tozi in 1952. It was later moved to Abu Naama in 1963. During those years an array of sorghum research activities were undertaken. Several varieties were developed and released for farmers use. More significantly, however, it was during that period that the rationals for sorghum improvement research in the Sudan were resolved. Many of those rationals remain unchanged today and serve as the basis for an expanded sorghum improvement program that is currently underway.

The 1970's witnessed events that were very significant in providing increased opportunity to the development and maturity of sorghum improvement research in the Sudan. The following events were particularly significant:

1) In 1971 Professor Mahmoud A. Mahmoud was transferred from Abu Naama to Wad Medani - an event that provided a better communication opportunity for the sorghum breeder with various national and international sorghum research programs that were also mushrooming elsewhere about the same time.

2) In 1972 the Arid Lands Agricultural Development (ALAD) Program established a cooperative program in sorghum research with the Gezira Research Station. Although other international programs, namely the Food and Agricultural Organization (FAO) and Purdue University in U.S.A. had sent international variety trials to the Sudan earlier, the ALAD program has to be credited with initiating a large introduction of a wide array of useful sorghum germplasm with good yield potential and good grain quality characteristics.

3) Following this and through the ALAD program, increased interaction and exchange of germplasm were undertaken with the Ethiopian Sorghum Improvement Program (ESIP), Purdue University and Texas A&M in the U.S.A..

4) At the request of the Government of Sudan, the ICRISAT-Sudan Cooperative Program for Sorghum and Millet Improvement financed by the United Nations Development Program (UNDP), was established in 1977 to assist in the strengthening of the national research efforts in the development of improved cultivars of sorghum and millets in the Sudan. This event made possible the assignment of the first full time sorghum breeder in the Sudan.

5) In late 1978 the Sudan Striga Project, supported by the International Development Research Centre (IDRC) was established as a joint program between the Agricultural Research Corporation

and the University of Khartoum.

6) In 1979 the International Sorghum and Millet (INTSORMIL) Collaborative Research Support Program was activated under the Title XII Research Development Program of the United States Agency for International Development. INTSORMIL soon recognized the opportunity of cooperative sorghum and millet research in the Sudan and signed a memorandum of agreement in 1980.

All of the above events certainly gave the necessary increased impetus to the development of sorghum improvement research in the Sudan. However, I would be remiss if I don't recognize the singular role ICRISAT has played in strengthening and widening the scope of sorghum improvement research in the Sudan, and assist in making it perhaps one of the best sorghum research programs in the continent today.

The sorghum improvement component of the ICRISAT-Sudan Cooperative Program has been guided by the following specific objectives:

Program Objectives

a) To develop early to medium maturing improved varieties with good grain quality, good adaptation and high yield potential through intercrossing local varieties with elite introductions.
b) To collect, evaluate, maintain local sorghums and diversify the local germplasm through intercrossing.
c) To develop early to medium maturing hybrids for irrigated and rainfed situations (400-800 mm) through synthesis and evaluation of experimental hybrids using introduced females (A lines) and a diverse array of local and exotic pollinator lines.

d) To conduct international, Regional and National yield testing of varieties for adaptation and expand the germplasm base with introductions.

e) To breed early to medium maturing varieties with increased levels of pre-flowering and/or post-flowering drought tolerance.

f) To screen sorghum germplasm for tolerance/resistance to Striga and study the effects of cultural practices on the incidence of Striga.

g) To collaborate with National scientists in other disciplines namely, pathology, entomology, agronomy, and weed science in developing and strengthening a coordinated multidisciplinary sorghum improvement research team in the country.

III. RECENT ACHIEVEMENTS:

Condiserable progress has been made in sorghum improvement research in the Sudan since the advent of the ICRISAT-Sudan Cooperative Program for Sorghum and Millet Improvement. The following points highlight some of the recent past activities and achievements.

A. Research

1. Collection, evaluation and maintenance of Sudanese sorghum germplasm.

Over the years several hundred sorghum cultivars have been collected from various parts of the Sudan. Many of the sorghum accessions from the Sudan have been introduced to many sorghum research programs around the world and were proven useful. This valuable set of germplasm had not been hitherto characterized and documented, however, because of limited funds and

facilities within the national programs. Several entries in this accessions were either missing or had lost viability stored under very poor storage facilities.

In addition, more and more areas of the sorghum lands in the Central Clay Plains are mechanized and planted to only a selected number of local sorghum varieties. This has had an eroding effect in the genetic diversity of local sorghum, and hence necessitates further collection and maintenance of local land races before extinction.

Good progress has been made in both maintenance, evaluation and characterization of previous collections and also routinely getting new land race types from various parts of the country. In 1979 a big effort was made to grow out the existing Sudanese collection maintained both in the Sudan and at Genetics Resources Unit, ICRISAT. The collections were planted in paired rows for cross-comparison and checking of loss of identity. Useful data were obtained. Since 1979 a total of 442 new local sorghums have been collected either through direct collection expeditions or in collaboration with colleagues in other development projects in the Sudan.

2. Expansion of the germplasm base with introductions. In an attempt to expand the genetic base of the local germplasm, sorghum accessions have been introduced from various cooperative programs, with major consignments coming from the ICRISAT core program at Hyderabad, India. Useful introductions have also been received from agencies namely Texas A&M University and Purdue University in the U.S.A. and the Ethiopian Sorghum

Improvement Project. Such a massive, but careful, introduction is proving useful as accessions recently received are contributing important traits through diversification. Some materials are also showing good adaptation and these have potential for direct use. Over the last few years we also had the opportunity to provide other programs with improved and local sorghum types from Sudan.

3. Diversify Sudanese sorghums through intercrossing.

Much of the early success of sorghum improvement in the Sudan had been realized only through individual plant selections among local types for short, combine types to meet the increasing mechanized farming. Very little hybridization was done to diversify Sudanese types with exotic sorghums with better yield and grain quality characteristics. This was due to two important reasons. First, the sorghum breeders had always had additional responsibilities in other crops or in administration. Secondly, the standard of the exotic introductions in the early days was poor, as many of them yielded lower than the local types. With the establishment of the ICRISAT-Sudan Cooperative Program at Wad Medani, both problems have been alleviated. A wide array of useful exotic types were introduced and utilized in cross-combinations to generate elite progenies with improved grain quality, and high yield potential.

Local sorghum varieties that were improved and released to farmers by the national program, while possessing good local adaptation, suffer from poor grain quality characteristics. An intercrossing program of local and exotic sorghum varieties has been undertaken on a continual basis since early 1977 to diversify

the local sorghum germplasm with emphasis on development of sorghum varieties with good adaptation, early to medium maturity, higher yield potential as well as acceptable food quality. At the present an array of promising sorghum varieties combining the desired attributes are available in the program.

4. Development of an empirical drought tolerant breeding scheme.

A considerable portion of our efforts was geared towards selection of sorghum genotypes for pre-flowering and post-flowering drought tolerance. By direct evaluation and selection of genotypes under moisture stress field conditions at El Obeid and Gadambalia, two drought prone locations, some excellent drought tolerant varieties have been identified. The process is slow but sure and results obtained so far are very encouraging. Confirmed sources of drought tolerance identified in the program have also been used in cross-combinations to gain increased levels of drought tolerance. Emphasis is put in crossing pre-flowering exotic or breeding selections with local varieties known to have post-flowering drought tolerance. Segregating progenies at various stages are currently available in the program.

Furthermore in cooperation with physiologists, Dr. Saeed Farah (ARC) and Dr. Gerald Eastin (INTSORMIL) an investigation is initiated towards the understanding of the drought tolerance mechanisms of some of these selections.

5. Placed major thrust on Striga resistance.

Striga hermonthica is a noxious sorghum weed and a production problem of significant importance in all areas where sorghum is grown. Even newly developed farm lands devoted to

sorghum are often seen with heavy infestation of Striga. In areas where there is too little crop rotation activity and seasonal rainfall is low, severe cases of Striga infestation are more noticeable often resulting in total crop failure. The problem of Striga has also become a major factor for land abuse. Farms with intolerable level of Striga infestation are abandoned and reverted to bush fallow, with the farmer procuring new farm land as there seems to be no scarcity of land in the Sudan, at least for now.

In view of the magnitude of the Striga problem in the country, there have been national research efforts geared towards alleviating this menancing production constraint. In 1978 IDRC signed an agreement with ARC to support research on Striga. The second phase of the project was recently renewed. Today, Striga research in the Sudan is a well integrated and a multidisciplinary effort involving breeders, biochemists, botanists, agronomists and biologists. Perhaps other than in India there is nowhere in the world where such a concentrated effort is made by an array of specialists in focusing on Striga.

The bulk of the Striga research work, particularly the biology/physiology and biochemical aspect has been undertaken by the IDRC/Sudan Striga Project. The ICRISAT-Sudan Project has also joined hands and made good progress on this front. Using the Striga-sick plot developed at the Gezira Research Station at Wad Medani, local and exotic sorghum genotypes are routinely screened for tolerance to Striga. This exercise

has led to the identification of genotypes with good levels of Striga tolerance, (namely, Tetron, P-967083, IS-9830 and SRN39). Intercrossing of these tolerant selections has also been initiated with the objective of deriving selections with increased levels of tolerance.

B. Development

1. Establishment of a multidisciplinary sorghum improvement research team.

One of the positive developments in the last few years has been the establishment of an integrated, multidisciplinary sorghum research team covering research activities in the areas of pathology, entomology, agronomy, Striga and grain quality. Several joint projects were undertaken. The following is a brief listing of some such research projects:

Pathology:

(i) Screening germplasm for charcoal rot resistance.

(ii) Conducted studies towards the understanding of charcoal rot in sorghum.

(iii) Developing techniques for artificial innoculation and screening of germplasm for resistance to long smut in sorghum.

(iv) Screening sorghum lines for resistance to anthracnose, leaf blight and other important leaf diseases.

(v) Cooperating in testing of ICRISAT as well as Texas A&M sorghum disease nurseries.

Entomology: Work concentrated on screening for stemborer tolerance, particularly:

(i) Identifying planting dates for optimum infestation of stem borer for a reliable screening of germplasm for tolerance to stem borer.

(ii) Screening breeding lines for tolerance to stem borer.

(iii) Evaluating the ICRISAT stem borer tolerant sorghum nurseries.

Agronomy/Physiology:

(i) Studies on effects of nitrogen fertilization, plant population and planting arrangements on local and improved sorghum cultivars.

(ii) Screening for drought tolerance.

(iii) Initiation of studies towards understanding of the mechanism of tolerance in drought tolerant sorghum selections.

Grain Quality:

(i) Testing of improved sorghum cultivars for local food cooking and industrial milling qualities.

(ii) In cooperation with Purdue University conducted studies characterizing an array of physical and chemical properties of sorghum grains that make good local products to identify traits that the breeder can use to screen breeding materials.

Striga research:

(i) Major thrust put in screening genotypes for tolerance to Striga hermonthica.

(ii) Study the effects of cultural practices and improved inputs on the incidence of Striga.

(iii) Evaluation of the utility of chemical compounds in controlling Striga.

(iv) Studies on the biology of Striga.

2. Expansion of the Sorghum Improvement Research Activities in the Country.

Increased effort was made during the last few seasons to accelerate simultaneous evaluation and selection of breeding nurseries at stations with varying ecological conditions. In addition to the enhanced activity at GRS, major thrust was made to undertake evaluation of specialized nurseries for agronomic adaptation, drought tolerance, disease resistance and Striga work at El Obeid and Kadugli Research Stations in Kordofan; at Agadi and Abu Naama in Blue Nile Province; at Sam Sam and Gadambalia in Kassala Province. Cooperative testing of breeding materials was also initiated at several other locations including Gash, Jebel Marra, Jumeiza and etc. This network of test locations provided useful data that were very essential for a meaningful evaluation of breeding materials.

3. Development of a viable hybrid sorghum improvement research Program.

The potential for commercial sorghum hybrid production in the Sudan is very good and will perhaps be a natural development. For several years now the national sorghum improvement program had been doing intensive selection for short combine types within the otherwise good local varieties to meet the demands of the rapidly expanding large mechanized farms. In

the Clay Plains of Kassala, Gezira and Blue Nile Provines, which essentially constitute the sorghum belt of the Sudan, sorghum production has been mechanized and the farm size very big that short combinable types have been on good demand. In much of the rain lands seasonal precipitation is usually unpredictable and unreliable that in some years yield reductions and even total crop failures do occur. It is believed that, superior hybrids identified under local conditions will have a rapid influence in increasing and stabilizing yield levels in the rain lands. In general, F_1 sorghum hybrids, with their vigorous early growth, fast rate of growth, and ability to efficiently utilize limited moisture, produce higher yield under stress conditions than do varieties.

Progress on hybrid sorghum research in the ICRISAT-Sudan Project has been very good. The necessary ingredients have been put together. Staff have been trained on the technical routines of handling large size nurseries, on synthesis and evaluation of experimental hybrids; selection, maintenance and evaluation of parental lines from various source materials, and the overall concept of hybrid improvement vis-a-vis varietal improvement program. With the back-up support of the Sorghum Improvement Program at ICRISAT Center and in cooperation with sorghum programs elsewhere, an array of diverse male sterile (A & B) lines have been accumulated. These are continually being evaluated both for seed production potential and combining ability with several pollinator lines. An elite and diverse pool of pollinator lines have also been put together,

evaluated, and characterized in locations with good potential for hybrid seed production. The hybrid program is also well integrated and balanced with the varietal improvement program both with regard to logistic arrangement and material flow. In short, the research work on sorghum hybrids for the Sudan has advanced well.

In the last four seasons, over 3,000 experimental hybrids have been synthesized and evaluated both under irrigated and rainfed conditions. This has led to the identification of three elite hybrids with a combined mean average of 50% over open pollinated local varieties in a total of 27 yield trials over four crop seasons. Experimental seed production on these three elite hybrids conducted, each on a one acre area. during the 1982 crop season indicated that two of the experimental hybrids were easily produceable. These results from four years of yield trial data and the experimental seed production testing were presented to the Sudan Plant Propagation and Variety Release Committee earlier this year. On the basis of this document, the Committee at its 24 Jan. 1983 meeting officially released one experimental hybrid (EEH-3) as the first commercial sorghum hybrid in the Sudan and renamed it in Arabic "Mageen Durra-1" (Sorghum Hybrid No. 1). Following the release of this hybrid, and Advisory Committee representing key institutions, namely, the Agricultural Research Corporation, the National Seed Administration, the Sudan Gezira Board and the Mechanized Farms Corporation was appointed by the Under Secretary of the Ministry of Agriculture to develop a Pilot Project with the following specific objectives:

1. To organize scheduled production of different categories of seed (breeder, foundation and certified) by both the public and private sectors.
2. To undertake an aggressive extension and demonstration program on the use of sorghum hybrids.
3. To capitalize on the concept of hybrid sorghum seed in promoting the use of improved seeds in general.
4. To utilize the hybrid seed program as a vehicle for promoting better management practices for sorghum production.
5. To train technical staff from both the public and private sectors in various aspects of the seed program.
6. To arrange, for a relevant team of Sudanese administrators, a study tour of the seed industry in countries where it is now functional.
7. To develop plans, based on experience gained during the Pilot Project, for the establishment of a Sudan Hybrid Sorghum Industry involving both the public and private sectors.

The Advisory Committee has already finalized the Pilot Project proposal and delivered it to the Under Secretary for submitting it to would-be donors following government procedures. In addition, it was also felt that it would be useful to organize this workshop involving concerned and relevant Sudanese and experts from outside the country with demonstrated ability and experience in hybrid seed industry organizations of their respective countries so that a recommendation will be formulated suggesting ways and means of establishing a Hybrid Seed Industry in the Sudan.

IV. FUTURE PROGRAM OF WORK ON SORGHUM IMPROVEMENT - A CONJECTURE:

A. To continue to intensify sorghum research activities for the Central Clay Plains. Emphasis is to be placed on developing varieties and hybrids with good grain quality, early-medium maturity and high yield potential.

B. To expand efforts for variety and hybrid improvement into Western and Southern Sudan.

C. To strengthen the research for control of Striga.

D. To further strengthen research on drought, insects, diseases and weed control leading to an increasingly more effective multi-disciplinary team.

E. To continue to collect the land race sorghums of the country.

F. To participate in the development of a sorghum hybrid seed industry in the country.

ANNEX 2

APPLICATION FOR APPROVAL OF RELEASE OF THE FIRST SORGHUM HYBRID IN THE SUDAN

Submitted to

THE TECHNICAL COMMITTEE FOR PLANT PROPAGATION AND VARIETY RELEASE

January 1983

PLANT BREEDING SECTION, GEZIRA

RESEARCH STATION

WAD MEDANI

I. INTRODUCTION

It has been widely demonstrated that sorghum hybrids yield higher and have higher yield stability than open pollinated varieties under irrigated or rainfed conditions in the semi-arid tropics. In general, F_1 hybirds, with their vigorous early growth, fast rate of growth, and ability to efficiently utilize limited moisture, produce higher yield under stress conditions than do open pollinated varieties.

The potential for commercial sorghum hybrid production in the Sudan is good. Sorghum is the most important crop in the Sudan, not only in total production but also in total acreage. It is planted on a significant percentage of the total area on the irrigated, rainfed traditional and mechanized schemes of the country. For several years now, the national sorghum improvement program has been doing intensive selection for short combine-type sorghums within the land-race varieties to meet the demands from the rapidly expanding mechanized farms. In the Clay Plains of Kassale, Blue Nile and Southern Kordofan Provinces, sorghum production has been mechanized and the farm sizes getting larger, making it desirable to have short combinable types suitable for mechanized harvesting. In the rainlands, seasonal precipitation is usually unpredictable and unreliable resulting in frequent yield reductions and occasional crop failures. It is believed that superior hybrids selected under local conditions will have a rapid influence in increasing and stabilizing yield levels of sorghum production in the country.

Over the past few years there has been an accentuated research effort by the ICRISAT-Sudan Cooperative Program for Sorghum and Millet Improvement, to develop and evaluate the potential of sorghum

hybrids in the country. The work on hybrid sorghum at the Gezira Research Station (GRS) has progressed well. This research effort has now produced several hybrids that have consistently outyielded improved and unimproved local varieties both under irrigated and rainfed conditions.

The Sudan National Seed Administration has the necessary structure to support a viable hybrid seed industry. It is believed that NSA can fully take up the production of foundation seed and assist in coordination of commercial hybrid seed production by both the public and private sectors.

The following is a documentation of brief historical development of hybrid sorghum research in the Sudan, performance comparison and further description of recently developed new sorghum hybrids, submitted to the Technical Sub-Committee for Plant Propagation and Variety Release, as an application for consideration for release of the first commercial hybrid sorghum in the Sudan.

II. BRIEF HISTORY OF HYBRID SORGHUM RESEARCH IN THE SUDAN

A. Early Years

Research on evaluation of the potential of sorghum hybrids started at Tozi and continued at Abu Naama into the mid-sixties. Initial efforts concentrated on evaluating introduced commercial hybrids from the U.S.A.; but later sorghum research activity included development of experimental hybrids locally. The first local hybrid synthesis was made in 1962 using 30 Sudanese locals (male parents) and a male sterile (female) line, 602A introduced from the U.S.A. Even a large scale seed production of a sorghum hybrid from U.S.A. (RS 630) was attempted at Abu Naama in 1963.

These early efforts to develop and evaluate the potential of sorghum hybrids for the Sudan were not pursued, however.

Breeding program on sorghum hybrids was later reinitiated in the early 1970's in cooperation with the Arid Lands Agricultural Development (ALAD) program, centered in Lebanon. Many ALAD hybrids were evaluated at the Gezira Research Station and new experimental hybrids synthesized locally during winter off-season using parental lines introduced from ALAD.

B. Recent Developments

In 1977 the ICRISAT-Sudan Cooperative Program for Sorghum and Millet Improvement, supported by the UNDP, was initiated with the mandate of strengthening sorghum and pearl millet improvement research in the country. It was with the advent of the ICRISAT-Sudan Project that hybrid sorghum improvement research received the continuity it needed. Through the cooperative program the assignment of the first full time sorghum breeder in the country was also made possible.

Today the hybrid sorghum improvement activity at the GRS is a full-fledged program. The necessary ingredients have been put together. Staff have been trained on the technical routines of handling large size nurseries, on synthesis and evaluation of experimental hybrids; selection, maintenance and evaluation of parental lines from various source materials, and the overall concept of hybrid improvement vis-a-vis varietal improvement program. With the back-up support of the Sorghum Improvement Program at ICRISAT centre and in cooperation with sorghum programs elsewhere, an array of diverse male sterile (A & B) lines have been accumulated. These are continually

being evaluated both for seed production potential and combining ability with several pollinator lines. An elite and diverse pool of pollinator lines have also been put together, evaluated, and characterized in locations with good potential for hybrid seed production. The hybrid program is also well integrated and balanced with the varietal improvement program both with regard to logistic arrangement and material flow. In short, the research work on hybrid sorghums at GRS has advanced well.

III. PERFORMANCE COMPARISON

A. 1979-1981 Seasons

Extensive testing of experimental hybrids started in earnest in 1979. Since then a total of 3033 hybrids (Table 1) have been evaluated under irrigated and rainfed conditions of the Sudan. At the end of the 1981 crop season an assessment was made of the performance data accumulated during the previous seasons, and 3 elite experimental hybrids with consistently higher yields over locals and showing promise for farmer's use in parts of the Central Clay Plains were identified (Table 2). Yearly agronomic data on the 3 elite hybrids and their percentage superiority over an improved local variety, Dabar 1/1 are given in Tables 3-8. These data, summarized over 3 years (1979-1981) depict that the 3 elite hybrids have a combined yield superiority of about 50% (Table 2) over local, open pollinated varieties under irrigated and rainfed conditions.

B. 1982 Season

A final multilocational yield evaluation trial was conducted, this past crop season, in 18 locations representing both irrigated

and rainfed situations of the country, to clearly establish superiority of the newly developed hybrids over both improved and unimproved local open pollinated varieties. Data from 14 locations of this regional trial are reported in here. Table 9 summarizes the grain yield data from nine irrigated stations in the Masalamiya and Centre Groups of the Gezira Scheme. The 3 elite experimental hybrids, namely EEH-1, EEH-2, and EEH-3 gave an average grain yield superiority of 34%, 45% and 37%, respectively over the improved local variety Dabar 1/1; and 87%, 101%, and 90%, respectively over Dwarf White Milo, the most commonly grown variety in the Gezira.

Table 10 provides yield data from five rainfed locations in the central clay plains. The 3 elite hybrids outyielded the locals significantly at most of the rainfed locations, as well. EEH-3 was far more superior under rainfed situations with average grain yield in excess of 3 tons/ha and outyielding both improved and unimproved locals by over 40% (Table 10). EEH-1 and EEH-2 also gave yield superiority of 22% and 25%, respectively over Dabar.

Detailed agronomic data, including days to 50% flowering, plant height, plant stand, stalk yield, and major components of grain yield on the 1982 Regional Testing trial at GRS is given in Table 11.

C. Overall Performance

Tables 12 and 13 summarize the results of several yield trials conducted over the last four seasons (1979-1982) to establish superiority of the most promising elite experimental hybrids developed at the Gezira Research Station. A summary of yield

performance of the 3 experimental hybrids over four crop seasons and a total of 21 yield trials (Table 13) depicts a combined yield average of 49% over open pollinated varieties that were used as checks. EEH-1 and EEH-3 both gave an overall yield of over 4 tons/ha while EEH-2 averaged about 3.5 tons/ha over all trials.

IV. SEED PRODUCTION

During the 1982 crop season an experimental seed production testing of the most elite 3 hybrids, each on a one feddan area, was carried out with the purpose of identifying the one most elite hybrid that could be produced without difficulty. This exercise was useful also in getting a first-hand experience on some of the ramifications involved in hybrid seed production operations. The results, as depicted in Table 14, indicate that two of the elite experimental hybrids, EEH-1 and EEH-3, are readily produceable with both the female and male parents flowering at about the same time. EEH-1 gave seed yield of 1.9 tons per feddan, whereas EEH-3 yielded 1.7 tons per feddan. The third elite hybrid, EEH-2 had its parents poorly nicked, and was thus not readily produceable. However, with some laborious and expensive differential manipulations of the parental plots, an acceptable seed yield (1.5 tons per feddan) was obtained.

V. QUALITY TESTING

Bulk seed harvested from the set of the 1982 Advanced Regional Testing of Elite Experimental Hybrids grown at the GRS farm has been supplied to the Food Research Centre at Shambat for quality testing. Chemical analysis, determination of milling properties, physical characterization of the grains, and kisra baking quality

are currently underway at the FRC; and the results will be available at the meeting.

VI. DESCRIPTION OF PARENTAL LINES

A. Source

Appendix Table A1 provides original source of introduction for the parental lines of the 3 elite experimental hybrids. (Note that Tx 623A is the common female parent for all the three Elite Experimental Hybrids).

B. Description of Plant Characteristics

Each of the parental lines for the 3 elite hybrids has been fully characterized using part of the comprehensive list of plant characteristics listed in the Sorghum Descriptors adopted by the Secretariat of the International Board for Plant Genetic Resources (IBPGR). The descriptions are given in Appendix Tables A2, A3, and A4 for parental lines of EEH-1, EEH-2, and EEH-3, respectively.

C. Samples

Head and seed samples of each of the 3 elite hybrids and their respective parental lines will be displayed for review by members of the Technical Committee for Variety Release at the time of the meeting.

VII. RECOMMENDATION

Careful analyses of the foregoing results on the performance comparison of the 3 experimental hybrids indicate that EEH-1 and EEH-2 are high yield potential hybrids possessing ability to maximize yield under optimum fertility and moisture situations, and therefore more suitable for irrigated farms with good management. EEH-3, on the other hand, performed consistently better under rainfed situ-

ations providing better drought tolerance and is perhaps a more suitable cultivar than the other two. It is also earlier in maturity and possesses bold yellow seeds with good evident grain quality. EEH-3 is also the most readily produceable experimental hybrid (Table 14). Produceability of a hybrid is one criterion of significant importance in determining the feasibility and eventual success of a new commercial hybrid seed program.

Whereas we realize that EEH-3 is not the hybrid with the highest recorded average grain yield, stover yield, or the one with the highest yield potential, by virtue of its early maturity, demonstrated yield stability, (ability to withstand adverse climatic conditions), and ease of produceability, we propose that this experimental hybrid (EEH-3) be released for farmers' use in both the irrigated and rainfed sectors of the country.

Table 1. Number of experimental sorghum hybrids developed and evaluated in a stepwise testing procedure during 1979-1982 crop seasons in the Sudan.

	Trials	1979	1980	1981	1982	Total
1.	New Experimental Hybrid (Initial Obs. Nursery)	519	754	1580	180	3033
2.	Selected Experimental Hybrids (Preliminary Yield Trials)	-	55	47	100	202
3.	Elite Experimental Hybrids (Advanced Yield Trial)	-	-	28	28	56
	T o t a l	519	809	1655	308	- -

Table 2. Summary of yield performance of 3 promising experimental hybrids during 1979-1981 crop seasons under irrigated and rainfed situations.

	Irrigated (Wad Medani)		Rainfed (Agadi)		Total	
	kg/ha	% local	kg/ha	% local	kg/ha	% local
TX 623A x Su.Cr.54: 18/17	6389	172	1915	158	4152	165
TX 623A x Su.Cr.36: 80/70	4093	113	1248	102	2670	107
TX 623A x Karper 1597	5203	148	2580	212	3891	180
Mean	5228	144	1914	157	3571	151

Table 3. Results of New Experimental Hybrids, Selected Summer 1979 - Data at Wad Medani.

Pedigree	Days to 50 % Flow.	Plant height (cm)	Grain yield kg/ha	Grain yield % local	Leaf disease score (Cercospora)
TX 623A x Su.Cr.54: 18/17	72	160	7923	171	1.0
TX 623A x Su.Cr.36: 80/70	68	190	4961	107	1.0
TX 623A x Karper 1597	70	135	7380	159	1.0
:	:	:	:	:	:
:	:	:	:	:	:
:	:	:	:	:	:
Dabar	80	145	4635	100	1.0
Mean (Excl Dabar)	69	143	6204	134	1.2

Table 4. Results of New Experimental Hybrids Selected Summer 1980, Wad Medani

Pedigree	Days to 50 % Flow.	Plant height (cm)	Grain yield kg/ha	% local	Agron. score (1-5)
TX 623A x Su.Cr.54: 18/17	73	170	5233	255	1.0
TX 623A x Su.Cr.36: 80/70	73	150	2933	142	1.0
:	:	:	:	:	:
:	:	:	:	:	:
:	:	:	:	:	:
Dabar	82	150	2063	100	2.0
Mean	73	162	2751	-	1.9

Table 5. Results of Selected Experimental Hybrids - Wad Medani 1980

Pedigree	Days to 50 % Flow.	Plant height (cm)	Grain yield kg/ha	Grain yield % local	Agron. score (1-5)	Head bug attack score (1 -5)
TX 623A x Su.Cr.54: 18/17	71	153	3730	254	1.0	2.0
TX 623A x Su.Cr.36: 80/70	77	168	3183	217	2.0	3.0
TX 623A x Karper 1597	58	125	2666	182	3.0	2.5
:	:	:	:	:	:	:
:	:	:	:	:	:	:
:	:	:	:	:	:	:
Dabar	80	148	1465	100	4.0	2.0
Mean	65	142	1986	-	2.3	2.2
$S\bar{d}$	2.1	6.3	155.2	-	-	-
CV %	3	4	26	-	-	-

Table 6. Results of Selected Experimental Hybrid Yield Trial, Wad Medani, 1981

Pedigree	Days to 50 % Flow.	Plant height (cm)	Grain yield kg/ha	Grain yield % local	100 seed wt.	Agron. score (1-5)
TX 623A x Su.Cr.54: 18/17	72	176	6410	213	2.49	2.0
TX 623A x Su.Cr.36: 81/71	75	200	6660	222	2.24	1.5
:	:	:	:	:	:	:
:	:	:	:	:	:	:
:	:	:	:	:	:	:
Dabar	81	160	2997	100	2.49	5.0
Mean	71	189	4236	-	2.37	3.0
Sd̄	2.1	14.3	519.5	-	-	-
CV %	3.1	7.5	24.8	-	-	-

Table 7. Mean grain yield (kg/ha) of 3 Elite Experimental Hybrids - Data at Wad Medani, Gadambalia, and Agadi (1981).

Pedigree	Days to 50 % Flow.	Plant height (cm)	Grain yield (kg/ha
Location: Wad Medani.			
TX 623A x Su.Cr.54: 18/17	73	180	6012
TX 623A x Su.Cr.36: 80/70	77	190	5552
TX 623A x Karper 1597	66	160	5970
Location: Gadambalia.			
TX 623A x Su.Cr.54: 18/17	65	200	2264
TX 623A x Su.Cr.36: 80/70	75	160	1998
TX 623A x Karper 1597	70	145	3014
Location: Agadi.			
TX 623A x Su.Cr.54: 18/17	71	190	1915
TX 623A x Su.Cr.36: 80/70	83	145	1248
TX 623A x Karper 1597	70	140	2580

Table 8. Mean Grain Yield (kg/ha) of top 10 Elite Experimental Hybrids at Irrigated (Wad Medani) and Rainfed (Gadambalia and Agadi) Locations (1981).

Pedigree	Wad Medani	Gadambalia	Agadi	Mean
TX 623A x Karper 1597	5970 (2)*	3014 (3)	2580 (1)	3855 (1)
TX 623A x Su.Cr.54: 18/17	6012 (1)	2264 (10)	1915 (2)	3397 (2)
TX 623A x Karper 669	4843 (7)	4013 (1)	0999 (20)	3285 (3)
TX 623A x Karper 1489	5260 (5)	2198 (14)	1415 (13)	2958 (4)
TX 623A x Su.Cr.36: 80/70	5552 (3)	1998 (18)	1248 (16)	2933 (5)
CSH-5	5010 (6)	2414 (9)	1415 (14)	2946 (6)
TX 623A x Karper 551	4091 (15)	2731 (6)	1748 (5)	2857 (7)
2219A x MR - 703	4425 (9)	2264 (11)	1665 (9)	2785 (8)
2077A x MR - 381	4383 (10)	2031 (17)	1914 (3)	2776 (9)
TX 623A x SC - 108 - 3	3381 (21)	2814 (5)	1581 (11)	2592 (10)
:	:	:		
:	:	:		
:	:	:		
Mean	4047	2386	1479	2733
$S\bar{d}$	734.8	606.1	NS	-
CV %	18.2	25.3	34.3	-

(*) Figures in parenthesis indicate grain yield ranking at the location.

Table 9. Mean Grain Yield (kg/ha) of the 1982 Advanced Regional Testing of Elite Experimental Hybrids at irrigated locations.

Cultivar	Gezira Res.St Farm	Para-kat	Seed Farm	El Tayiba	Medina	Abdel Hakim	Abdel Rahman	Saa dalla	Abdel Galil	Mean	% Dabar	% DWM
EEH-1	7183	7305	5338	6681	5170	2753	3370	2657	1381	4649	134	187
EEH-2	7391	7871	5392	7411	6473	2456	3691	2676	1693	5006	145	201
EEH-3	6749	7324	5066	6955	4470	2996	4476	2899	1732	4741	137	190
EEH-4	6662	6951	4297	6681	3492	1998	2721	2040	1381	4024	116	162
EEH-5	7703	7507	4712	7118	3581	2824	4055	2796	1068	4596	133	185
EEH-6	7148	7695	4360	6903	3701	3074	3037	2274	1615	4423	128	178
Local-1(Dabar)	5379	6195	4024	4897	2933	1561	2794	2573	808	3463	100	139
Local-2(DWM)	4008	3984	2608	3920	1940	1406	1732	1880	938	2491	72	100
Mean	6530	6854	4475	6321	3970	2383	3235	2475	1327	-	-	-
Sd̄	237.3	299.1	437.6	456.4	700.2	428.8	401.2	184.9	NS	-	-	-
CV %	3.6	4.4	9.8	7.2	17.6	17.9	12.4	7.5	19.9	-	-	-
Planting date	Jul.10	Jul.7	Jul.11	Jul.20	Jul.8	Jul.10	Jul.10	Jul.12	Jul.13	-	-	-
Fertilizer*	2N	2N	1N	2N	2N	1N	1N	1N	1N	-	-	-
Problems	Nil	Nil	Low fertilizer	Nil	Irrigation irregularity Weeds	Weeds, Striga	Late thinning; weeds birds	Weeds, stand, birds.	Weeds, stand, birds.			

* 1N = 40 kg N/ha.

Table 10. Mean grain yield (kg/ha) of the 1982 Advanced Regional Testing of Elite Experimental Hybrids at rainfed locations (with and without supplemental irrigation).

Cultivar	Sennar Main	Sennar West	Samsam	Gadam-balia	Abu Naama	Mean	% Dabar	% Local-2
EEH-1	6482	3300	1826	1367	651	2725	122	129
EEH-2	6753	3616	1779	1287	518	2791	125	132
EEH-3	6967	3590	2088	1708	1346	3140	141	148
EEH-4	6450	2824	1393	1329	1191	2637	118	124
EEH-5	5379	3072	1627	1666	1789	2707	121	128
EEH-6	7310	2960	1807	1637	1470	3037	136	143
Local-1(Dabar)	4010	2579	1482	1033	2040	2229	100	105
Local-2(Variable)	3692	1296	1396	1075	3135	2119	95	100
Mean	5880	2905	1675	1388	1517	-	-	-
Sd̄	843.2	NS	NS	NS	476.8	-	-	-
CV %	14.3	30.2	27.0	20.9	31.4	-	-	-
Planting date	July 14	July 14	July 26	July 30	July 20			
Fertilizers*	1N	1N	1N	1N	1N			
Problems	Birds	Stand; weeds; thinning operation	Rain distribution	Drought	Drought, stand, birds.			

* 1N = 40 kg N/ha.

Table 11. Detailed agronomic data (including major components of yield, maturity, height and stalk yield) on 1982 Advanced Regional Testing of Elite Experimental Hybrids - Location: GRS Farm.

Cultivar Pedigree	Desig-nation	Days to 50 % Flow.	Plant height (cm)	No. of plants per ha	No.of seed/ head	1000 seed weight	Grain weight/ head(g)	Thresh-ing %	stalk yield t/ha	Grain yield kg/ha
Tx 623A x Su.Cr.54:18/17	EEH-1	71	165	89,930	6063	22.4	136	83	17.9	7183
Tx 623A x Su.Cr.36:80/70	EEH-2	71	180	95,078	6876	22.9	157	83	18.1	7391
Tx 623A x Karper 1597	EEH-3	67	160	87,079	3907	27.6	110	82	11.5	6749
Tx 623A x Karper 1755	EEH-4	64	140	104,100	4000	22.8	92	79	16.1	6662
296A x MR - 747	EEH-5	69	170	95,078	3982	31.7	126	82	16.7	7669
2077A x MR - 732	EEH-6	69	190	102,365	5817	24.4	142	82	16.5	7148
Dabar 1/1	Local-1	84	185	103,059	3196	30.9	100	84	15.9	5379
Dwarf White Milo	Local-2	55	160	98,548	1573	31.8	50	82	9.8	4008

Table 12. Mean grain yield (kg/ha) of 3 Elite Experimental Hybrids and 2 local cultivars at irrigated and rainfed locations during 1979 - 1982 seasons.

Trial	Location/year	EEH-1	EEH-2	EEH-3	Dabar 1/1	Safra
1	Wad Medani - 1979	7923	4961	7380	4635	-
2	Wad Medani - 1980	5233	2933	-	2063	-
3	Wad Medani - 1980	3730	3183	2666	1465	-
4	Wad Medani - 1981	6410	6660	-	2997	-
5	Wad Medani - 1981	6012	5552	5970	4445	-
6	Gadambalia - 1981	2364	2864	-	-	1732
7	Gadambalia - 1981	2264	1998	3014	-	3130
8	Agadi - 1981	1915	1248	2580	1215	-
9	Wad Medani - 1982	7183	7391	6749	5379	-
10	Gadambalia - 1982	1367	1287	1708	1033	1075
11	Abu Naama - 1982	651	518	1346	2040	-
12	Samsam - 1982	1826	1779	2088	1482	-

Table 13. Summary of yield performance of 3 promising experimental hybrids over four crop seasons (1979-1982) under irrigated and rainfed situations. (A total of 21 yield trials).

Pedigree	Irrigated		Rainfed		Total	
	kg/ha	% local	kg/ha	% local	kg/ha	% local
Tx 623A x Su.Cr.54:18/17	5816	178	2408	123	4112	157
Tx 623A x Su.Cr.36:80/70	4782	146	2207	113	3495	134
Tx 623A x Karper 1597	5189	158	2968	152	4078	156
Mean	5262	161	2528	129	3895	149

Table 14. Seed Yield (kg/feddan) of Experimental Seed Production Testing of 3 Promising Elite Experimental Hybrids and their Female Parent - GRS Farm (1982).

Seed Field	Pedigree	Seed Yield (kg/fed.)*
EEH-1	TX 623A x Su. Cr. 54: 18/17	1922
EEH-2	TX 623A x Su. Cr. 36: 80/70	1529
EEH-3	TX 623A x Karper 1597	1753
A x B	TX 623A x TX 623B	2294

* Planting arrangement used was 2:4 i.e. 2 rows of pollen parent and 4 rows of seed parent. The recorded yield is, therefore, on $\frac{2}{3}$ of a feddan.

A P P E N D I X

Table A1. Sources of introduction of parental lines involved in the development of EEH-1, EEH-2 and EEH-3.

Entry	Pedigree (Description)	Parent	Source
1.	Su.Cr.54:18/17	Male parent (EEH-1	Sudan National Program
2.	Su.Cr.36:80/70	Male parent (EEH-2	Sudan National Program
3.	Karper 1597	Male parent (EEH-3	Introduced from Genetic Resources Unit, ICRISAT Centre.
4.	Tx 623A & B	Female parent(EEH-1, EEH-2, EEH-3)	Introduced from Texas A & M Univ., U.S.A.

Table 12. Some morphological characteristics of EEH-1 and its male and female parents

Descriptors	Female parent (Tx 623A)	Male parent (Su.Cr.54:18/17)	Hybrid (EEH-1)
1. Days to 50 % flowering	73	77	71
2. Plant height (cm)	130	150	165
3. Plant color	Pigmented	Pigmented	Pigmented
4. Internode length	Short	Short	Short
5. Av. No. of nodes	11	11	13
6. Stalk juiciness	Juicy	Juicy	Juicy
7. Juice quality	Sweet	Insipid	Insipid
8. Leaf width	Medium; 3.5"	Medium; 3.5"	Broad; 4"
9. Leaf surface	Rough	Very rough; (with vivid veins)	Rough with vivid veins
10. Leaf midrib color	Dull green	Dull green	Dull green
11. Head compactness and shape	Semi compact; elliptic	Semi compact; elliptic	Semi compact; elliptic
12. Head length (cm)	22	17	35
13. Head width (cm)	6.0	5.5	10.5
14. Head Exertion	2-10 cm between liguile and head base	2-10 cm between liguile and head base	More than 10 cm between liguile and head base
15. Tillering habit	Rare	Yes, basal	Yes, basal (nodular if end of seasson wet)
16. Synchrony of tillers	Poor	Good	Fair
17. Shattering habit	Non shattering	Non shattering	Non shattering
18. Threshability	Good; (2-10 % unthreshed)	Good; (2-10 % unthreshed)	Freely threshable; (0-1 % unthreshed)
19. Glume color	Red	Black	Mahogany (brown)
20. Kernel covering	0.5 grain covered	0.5 grain covered	0.5 grain covered
21. Awns	Awnless	Awnless	Awnless
22. Kernel color	White	White	White
23. Kernel weight(g)/100	2.32	2.56	2.24
24. Endosperm texture	Partly corneous	Almost corneous	Partly corneous
25. Endosperm color	White	White	White
26. Endosperm type	Normal	Normal	Normal
27. Kernel lustre	Non lustrous	lustrous	Lustrous
28. Sub-coat	Absent	Absent	Absent

Table 13. Some morphological characteristics of EEH-2 and its male and female parents

Descriptors	Female parent (Tx 623A)	Male parent (Su.Cr.36:80/70)	Hybrid (EEH-2)
1. Days to 50 % flowering	73	84	71
2. Plant height (cm)	130	140	180
3. Plant color	Pigmented	Tan	Pigmented
4. Internode length	Short	Short	Short
5. Av. No. of nodes	11	13	13
6. Stalk juiciness	Juicy	Juicy	Juicy
7. Juice quality	Sweet	Insipid	Insipid
8. Leaf width	Medium; 3.5"	Broad; 4.5"	Broad; 5"
9. Leaf surface	Rough	Rough with vivid veins	Very rough
10. Leaf midrib color	Dull green	Dull green	Dull green
11. Head compactness and shape	Semi compact; elliptic	Semi compact; elliptic	Semi compact elliptic
12. Head length (cm)	22	20	39
13. Head width (cm)	6.0	5.0	11.0
14. Head exertion	2-10 cm between liguile and head base	2-10 cm between liguile and head base	More than 10 cm liguile and head base
15. Tillering	Rare	Yes, basal	Yes, basal
16. Synchrony of tillers	Poor	Good	Good
17. Shattering habit	Non shattering	Non shattering	Non shattering
18. Threshability	Good; (2-10 % unthreshed)	Good; (2-10 % unthreshed)	Good; (2-10 % unthreshed)
19. Glume color	Red	Sienna (yellow)	Red
20. Kernel covering	0.5 grain covered	0.5 grain covered	0.5 grain covered
21. Awns	Awnless	Awnless	Awnless
22. Kernel color	White	White	White
23. Kernel weight(g)/100	2.32	2.36	2.29
24. Endosperm texture	Partly corneous	Partly corneous	Partly corneous
25. Endosperm color	White	White	White
26. Endosperm type	Normal	Normal	Normal
27. Kernel lustre	Non-Lustrous	Non-Lustrous	Non-Lustrous
28. Sub-coat	Absent	Absent	Absent

Table A4. Some morphological characteristics of EEH-3 and its male and female parents

Descriptors	Female parent (Tx 623A)	Male parent (karper 1597)	Hybrid (EEH-3)
1. Days to 50 % flowering	73	73	67
2. Plant height (cm)	130	130	160
3. Plant color	Pigmented	Pigmented	Pigmented
4. Internode length	Short	Short	Short
5. Av. No. of nodes	11	11	11
6. Stalk juiciness	Juicy	Juicy	Juicy
7. Juice quality	Sweet	Sweet	Sweet
8. Leaf width	Medium; 3.5"	Narrow; 2.5"	Narrow; 3.0"
9. Leaf surface	Rough	Very rough	Rough
10. Leaf midrib color	Dull green	Colorless (white)	Colorless (white)
11. Head compactness and shape	Semi compact; elliptic	Semi compact; elliptic	Semi compact; elliptic
12. Head length (cm)	22	22	33
13. Head width (cm)	6.0	5.5	8.5
14. Head exertion	2-10 cm between liguile and head base	More than 10 cm between liguile and head base	More than 10 cm between liguile and head base
15. Tillering	Rare	Rare	Yes
16. Synchrony of tillers	Poor	Non	Good
17. Shattering habit	Non shattering	Non shattering	Non shattering
18. Threshability	Good; (2-10 % unthreshed)	Good; (2-10 % unthreshed)	Good; (2-10 % unthreshed)
19. Glume color	Red	White	Red
20. Kernel covering	0.5 grain covered	0.25 grain covered	0.25 grain covered
21. Awns	Awnless	Awnless	Awnless
22. Kernel color	White	Yellow	Yellow
23. Kernel weight(g)/100	2.32	3.44	2.76
24. Endosperm texture	Partly corneous	Almost corneous	Almost corneous
25. Endosperm color	White	Yellow	White
26. Endosperm type	Normal	Normal	Normal
27. Kernel lustre	Non-Lustrous	Lustrous	Lustrous
28. Sub-coat	Absent	Absent	Absent

ANNEX 3

Minutes of the Plant Propagation and Cultivar Release Committee Meeting held at the ARC Hqrs., Wad Medani, On Monday, 24th January, 1983.

The members of the committee and participants present at the meeting were as follows :-

Name	Designation
Dr. Mohamed Bakheit Saeed	Director General, ARC (Chairman)
Mr. Kamal Ali Babiker	Under Secretary, Ministry of Agriculture and Irrigation
Dr. Osman Ibrahim Gameel	Deputy Director General, ARC
Dr. Hassan Khalifa	Deputy Director General, ARC
Dr. Mohamed A/Rahman A/Fattah	Asst. Director General for Training and publication, ARC
Dr. Ahmed Abu Elgasim Ahmed	Acting Director General, National Seed Administration (NSA)
Mr. Mohamed A/Farag Khamees	Acting Director, SCA, NSA (Secretary)
Mr. Abdelaziz Ahmed Mohamed	Acting Director, PPA, NSA
Dr. Mohamed Badr A. Saleem	NC, ARC, Cotton
Dr. Hassan Mohamed Ishag	NC, ARC, Groundnut
Dr. Mahmoud Salih Hassan	NC, ARC, Horticulture
Dr. Ibrahim Ahmed Babiker	NC, ARC, Soil
Dr. Nasr el Din Mohamed	Sudan Gezira Board (SGB)
Mr. Mahmoud Ahmed Mahmoud	Mechanized Farming Corporation (MFC)
Dr. Abdel Moneim B. El Ahmadi	Head Plant Breeding, GRS, ARC
Dr. Abdalla B. El Ahmadi	Breeder, GRS, ARC
Dr. Farouk Ahmed Salih	Breeder, Shabat Research Station, ARC
Dr. Abd Ellatif M. Nour	Breeder, GRS, ARC
Dr. R. P. Jain	Millet Breeder, ICRISAT, ARC
Dr. Gebisa Ejeta	Sorghum Breeder, ICRISAT, ARC
Dr. M. S. Joshi	Project Coordinator, NSA (FAO)
Mr. Abdalla el Zubeir	Sudan Gezira Board
Dr. El Tigani Mohamed Elamin	Gezira Research Station, ARC
Dr. Ibrahim El Jack Mursal	ARC
Mr. Mohamed Hasab el Rasoul	Seed Certification Administration, NSA
Mr. Mohamed Ahmed Yousif	Plant Propagation Administration, NSA
Dr. Ahmed Nasir Balla	ARC
Mr. Ahmed El Beshir Ahmed	Sudan Gezira Board
Mr. Mustafa M. Mahmoud	Plant Propagation Administration

The Chairman welcomed the participants in particular those who were attending the meeting of the committee for the first time in their new capacities.

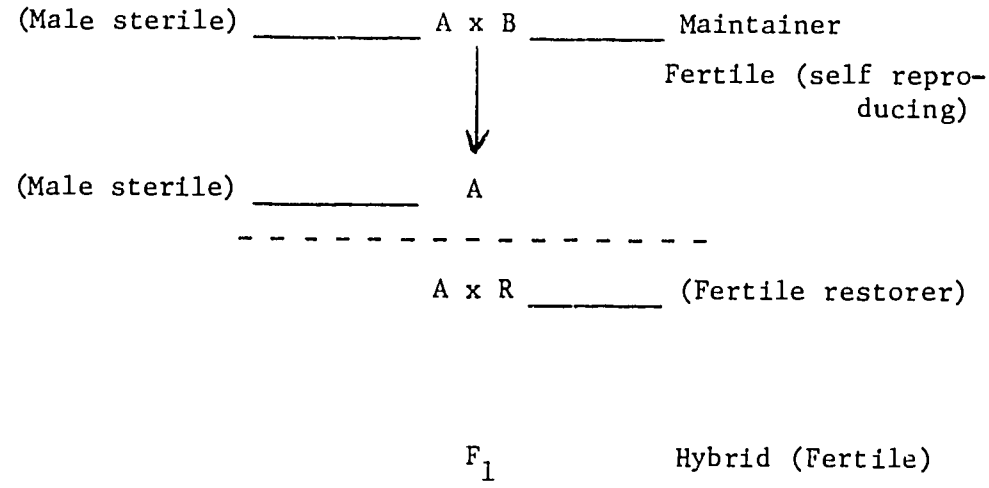
Endorsement of Minutes of the Previous Meeting :-

The minutes of the previous meeting were endorsed. Dr. Abdalla El Ahmadi requested to amend the statement in the last paragraph, page 2 of the minutes; to be read "last few years in both areas" and added that CV. Mukhtar was not abandoned from New Halfa, but care should be taken on further expansion.

Presentation of the New Sorghum Cultivar "Hybrids" :-

The chairman requested Dr. A/Moneim El Ahmadi to present the report on the sorghum hybrid.

Dr. El Ahmadi summarized a technical introduction of hybridization and sketched the pattern of crosses which will take place in order to get the hybrid:-



Then the test of the report was read by Dr. Ahmadi who mentioned that the quality test report was not available yet.

Discussion :-

There was a discussion regarding technical aspects of the hybrid, the quality analysis of the grain, palatability of (kisra) and economic evaluation regarding cost of production of the hybrid in comparison to yield and the ideal management.....etc.

Dr. Gebisa gave a brief explanation on technical analysis and added that the hybrid EEH-3 grain is semi-hard; a preferable criterion of milling property; that the 1000- grain weight is moderately heavy that protein level is extremely high (17%) compared to Dabar and that the kernel color which determines (kisra) property is bright.

Dr. Hassan Ishag suggested that the addition of a column of harvest index (expressed in terms of $\frac{\text{grain yield}}{\text{total dry matter content}} \times 100$) to Table II would be appropriate.

The core of the remarks and questions raised by the members was aimed at attaining an explanation regarding the technical, social and economic merits of introducing a sorghum hybrid in conjunction with wide scale production. In reply to this, Dr. Gebisa explained that consideration had been given to the standard cultural practices recommended by the ARC, and assumed that, although there had been no studies on cost evaluation of hybrid, the gross obvious economic return is always significant. As regards to the social benefits, the hybrid is acceptable.

The question of susceptability and tolerance to pests and diseases was tackled within the scope of this discussion. Dr. Gebisa explained that not so many insects were a menace and that there was a future plan for screening for some; such as stem-borer; while Charcoal Rot screening will be carried out.

Release of the New Cultivar "Hybrid" :-

The members of the committee agreed on the release of only the new cultivar (Hybrid) EEH-3 under the name of "Hageen Dura-1". This cultivar is recommended for irrigated and rainfed areas.

Pilot Seed Production :-

Dr. A/Moneim Ahmadi presented the suggestion made by Dr. House for Pilot seed production of hybrid seed, the essential components of which include :-

a. Identification of a Sudanese project leader.

b. Arrangement of a workshop

Dr. Bakheit and Mr. Kamal Ali Babiker jointly suggested the formation of a committee presided by the Director General, NSA and included the membership of the following :-

1. Director SCA, NSA
2. Director PPA, NSA
3. Director Seed Propagation Dept., SGB
4. Senior official from MFC
5. Dr. Gebisa Ejeta, ARC
6. Dr. A/Moneim B. El Ahmadi, ARC
7. Dr. Ibrahim Nour Edin, ARC
8. Dr. Abd Ellatif M. Nour, ARC

The consultants for the committee are :-

1. Dr. Hassan M. Ishag, ARC
2. Dr. Faisal Merghani Ali, ARC
3. Dr. Saeed Farah, ARC

The committee should have the following responsibilities and terms of reference :-

i. Organization of training for PPA officers,
ii. Advise on seed certification of hybrid seed,
iii. Advise on management practices.

A sub-committee branched from the main one included the membership of the following :-

1. Dr. Ahmed Abu El Gasim, NSA
2. Mr. Mahmoud A. Mahmoud, MFC
3. Dr. M. S. Joshi, NSA
4. Dr. Abdel Moneim B. El Ahmadi, ARC
5. Dr. Gebisa Ejeta, ARC

The main objective of this sub-committee is to find out domestic or foreign sources for financing the project.

Recommendations and Decisions :-

It was recommended not to release the cultivars EEH-1 and EEH-2 for certain technical reasons observed by the breeders themselves.

As regards to the cultivar EEH-3 "Hageen Dura-1", it was decided to hand over the whole matter of programming for seed produciton to the

main Pilot Seed Production Committee, taking into consideration that GRS will bear the responsibility of supplying the breeder seed, and that PPA will be responsible for foundation seed production; while production corporations (SGB and MFC) and keen farmers in the private sector will cater for certified seed production.

Closing of the meeting :-

The chairman congratulated the breeders for this achievement, thanked the members of the committee and participants for their contribution and ended the meeting.

Second Meeting of Advisory Committee
Pilot Hybrid Sorghum Project

FN9/21/1(14)/SUD/038/SUD

The meeting of the above committee was held in Khartoum on Thursday 7th of April, 1983 attended by:

Dr. Abdel Moneim El Ahmadi
Dr. Gebisa Ejeta
Dr. Ahmed Abu El Gasim

There was a general agreement that discussion should be based on the budget estimate drafted by Dr. Joshi and the details should be thoroughly discussed in the meeting before including it in the second draft.

The budget proposed in NSA draft included 1983 which will be taken care of by the respective parties i.e. ARC, NSA and Prod. Schemes, therefore, it was suggested that the budget estimate allocated for 1983 be shifted to 1984 which will move to 1985 and that proposed for 1985 be moved to 1986.

It was thought necessary to include to the committee a fairly senior personnel from Gezira schemc, preferably the agricultural manager, and in his absence to be represented by seed propagation or extension personnel.

Training

Short term training opportunities available for technical assistants from the participating agencies both locally and abroad.

a) It is suggested that 7 instead of 2 to be sent abroad, each for a period of 6 months to obtain training in the areas of seed production (3), processing (3), and certification (1).

The amended proposal:

	1984	1985	1986	TOTAL
Technical Assistance (abroad)	40,000	16,000	--	56,000
Internal Training	2,500	2,500	--	5,000
(two internal one week courses will be arranged for 12 participants in Sennar or Medani)				
Study Tour (a study tour of the seed industry to be organized for a relevant team from the participating agencies for a period of 2 months in countries where hybrid production is functional).	19,200	--	--	19,200
b) Personnel				
Consultant 2 months	--	15,000	--	15,000

Per Diem

There was a general agreement that this item should be recalaulated on the actual cost and jobs expected

a) Advisory Committee members (trips to sites)

4 persons	2 trips	3 locations	2 nights	$25/day
			TOTAL COSTS	$1,200

b) Technical Staff - production officers

2 persons	6 months	2 locations		$10/day
			TOTAL COSTS	$3,600
2 persons	2 months	different locations		$10/day
			TOTAL COSTS	$2,400

c) Drivers

2 persons	6 months	different locations		$5/day
			TOTAL COSTS	$1,800

Overtime for drivers

2 persons	11 months	different locations 2 hrs/day		$1/hr
			TOTAL COSTS	$660

Operational inputs and supplies (amendment to table 1)

	Seed Production	Extension
Fertilizer	as in table 1	30 fed ⟶ 20 fed hybrid ⟶ tone of hybrid seed enough for 90 fed under extension supervision
		Cost $3,600
Herbicides	"	1,800 ($ 20/fed).
Insecticides	Cost to be estimated	Cost to be estimated
Seed dressing	According to quantities produced and rate of dressing and price total cost to be calculated	

Note: Extension material not included above (fertilizers, herbicides, etc.) as appeared in Table 1.

The amendments agreed upon will be passed to other members well before the next meeting which was suggested tentatively on Saturday 16th of April.

27th April, 1983

The third meeting of the Advisory Committee was held in Khartoum on Sunday 17th April, 1983 and attended by:

Dr. A.B. El Ahmadie
Dr. Gebisa Ejeta
Mr. Wageeh Samuel
Dr. Ahmed Abu El Gassim

The main items of the agenda is the finalize the budget proposal in view of the detailed budget presented by S.G.B. It was agreed that the budget proposal be shown as a global and a separate itemized list would be kept for the different participating agencies.

Personnel

1. The consultant (cost as suggested) to be recruited in 1985.
2. The overtime is suggested to be part of the per diem and a footnote will be agreed upon for the breakdown of these items to the different participating agencies.
3. NSA will allocate the appropriate technical staff for SGB and MFC. Their per diem will be covered from the project.

The proposed budget agreed upon as shown in the table below.

PARTICULARS	COST ESTIMATES 1984	1985	1986	TOTAL
Personnel				
a) Overtime				
S.G.B. (Including	1,800	3,600	10,800	16,200
MFC driver)	500	2,000	3,200	5,700
NSA	1,200	2,400	2,300	5,900
ARC				
b) Per diem				
S.G.B. (Including driver)	900	1,800	3,600	6,300
MFC	250	1,000	1,600	2,850
NSA	3,900	3,900	3,900	11,700
ARC	--	--	--	--
Advisory Committee	1,200	1,200	1,200	3,600

PARTICULARS	COST ESTIMATES 1984	1985	1986	TOTAL
Training				
Abroad (Techn. Asst.)	40,000	16,000	--	56,000
Internal	2,500	2,500	--	5,000
Study Tour	19,200	--	--	19,200
Equipment				
3 pick-ups (2 NSA & 1 SGB)	60,000			60,000
Operational Inputs				
Labour (one Hand weeding)				
SGB (Incl. extension area)	8,100	17,100	48,600	73,800
MFC	2,250	9,000	14,400	25,650
NSA	5,400	10,800	10,350	26,550
ARC	300	300	300	900
Fuel (600 gallons/ car/Yr.)	5,400	6,750	8,500	20,650
Lubricants & Oil	600	750	950	2,300
Spare parts for Vehic.	--	3,000	6,000	9,000
Fertilizer (Urea)				
SGB (Propagation & extension)	7,200	10,800	25,200	43,200
NSA	2,400	4,800	4,600	11,800
MFC	--	--	--	--
ARC	120	120	120	360
Herbicides (estimated cost $15 1 fed.)				
SGB (Propagaion & Extension)	2,700	4,050	9,450	16,200
NSA	900	1,800	1,725	4,425
MFC	375	1,500	2,400	4,275
ARC	50	50	50	150
Packing material (cost est. $110/sack)				
SGB (Ave. Yield)	990	1,980	5,940	8,910
NSA (1 ton 1 fed)	660	1,320	1,265	3,246

PARTICULARS	COST ESTIMATES 1984	1985	1986	TOTAL
MFC (0.6 tons/fed)	165	660	1,056	1,881
ARC (1.5 tons/fed)	50	50	50	150
Extension Material	3,000	3,000	3,000	9,000
Transport & Processing (cost estimate) $1.5/sack)				
SGB	1,350	2,700	8,100	12,150
NSA	750	1,500	1,125	3,375
MFC	225	900	1,440	2,565
ARC	65	65	65	195
Contingencies	--	--	--	11,300

* * * * * * * * *

Workshop

It was suggested that the hybrid sorghum workshop should be linked with the proposed sorghum symposium. To attract more participants a separate sponsor for the workshop should be found.

USAID is a possible sponsor and it was decided that Dr. El Ahmadie and Dr. Gebisa should follow up this matter.

Minutes of 4th Meeting
Advisory Committee - Hybrid Sorghum Program
August 8, 1983 - Khartoum

Attendants:

A. Abu El Gassim - Chairman
A. B. El Ahmadie
M. A. Mahmoud
M. S. Joshi
Gebisa Ejeta

The Chairman opened the meeting and listed the following items as agenda for the day :-

1. Progress of work on Pilot Project Proposal,
2. Progress on Hybrid Sorghum Workshop,
3. Matters arising.

The Chairman reiterated that Pilot Project proposal was finalized last April and soon distributed to directors of ARC, SGB, and MFC for endorsement before submitting to the PUS (as agreed upon during last AC meeting). He received no response and hence document not yet submitted. Members felt that the long wait was unnecessary.

Approval from ARC and SGB directors was relayed thru El Ahmadie at this meeting. Mahmoud suggested that Director Tawfik be contacted for MFC response.

Further corrections and amendments to the text and figures in the budget table of the proposal were made at this meeting. It was agreed that Abu El Gassim and Joshi incorporate these corrections and retype the "final-final" version immediately, to be delivered to the PUS for submission to would-be donors.

Chairman asked Gebisa to brief members on developments in the proposed hybrid sorghum workshop.

Gebisa reminded members that in the last AC meeting it was decided that Abu El Gassim contact USAID, Khartoum and that Gebisa solicit funds

from possible donors while on leave in the USA. Contacts and correspondence made with INTSORMIL was discussed and recent telex from INTSORMIL director, Leng was read. All members agreed that arrangements should soon start and workshop should be held as planned.

El Ahmadie relayed a suggestion by M. B. Saeed, ARC director that arrangements should be made to inform the Minister of Agriculture for formal approval. Chairman Abu El Gassim is to write a letter to the Minister thru the office of the PUS.

Gebisa then outlined the following as a possible guide for discussion regarding arrangements for the workshop.

- Form Committee for conference
- Decide Date
- Decide Venue
- Work on Agenda - topics/speakers
- Need to respond to INTSORMIL
    - Statement of Objectives
    - Budget Breakdown
- List of invitees (non-speakers)

It was decided that the AC also serve as Steering Committee for the Workshop with an enlarged membership for subcommittees on various aspects, each to be chaired by an AC member.

Workshop will be held during the period November 5-8, 1983 at ARC Conference Hall, Wad Medani. (Sorghum Crop both rainfed and irrigated will be in good stage in early November). Wad Medani was chosen for ease of coordination, field trips, excellent ARC facilities and low cost. Appropriate accomodations will be arranged at ARC and SGB guesthouses, the Gezira Club and other hotels in town.

Agenda was finalized - topics and speakers identified. Responsibilities were shared among AC members to identify speakers now missing.

Formal response to INTSORMIL to be delayed until approval from the Minister is obtained. However, Gebisa is to telex INTSORMIL on AC's delight on fund availability and informing INTSORMIL Director, Leng that arrangements are already underway.

c.c.: All members (AC)
D.G. ARC
MD. SGB
MD. MFC

Advisory Committee: Hybrid Sorghum Workshop
6th Meeting held on 4th October, 1983 in the room of Dr. M. S. Joshi.

(Minutes of the Meeting)

Present:

Dr. Ahmed Abu El Gassim

Dr. A. B. Ahmadie

Dr. Gebisa Ejeta

Dr. M. S. Joshi

Dr. Gebisa informed about the progress made.

Dr. Earl Leng has been informed about approval of the programme by HE The Minister of Agriculture & Irrigation, Sudan.

Mr. Phillip Montanya will represent Kenya Seed Company.

Mr. Howard Potts has accepted invitation.

Dr. Lee House has proposed the name of Mr. Arne Hagberg of Swedish Seed Agency as a representative from Europe.

Dr. Lee House is supposed to contact Dr. Chopra and Mr. B. R. Barwale.

Mr. Dusan Istanoric from Zambia has accepted.

All other invitees have been informed by telex thru Dr. Leng (Dr. Bruce Maunder, Mr. Johnson Dougas and Mr. Howard Potts).

Speakers for the Workshop:

i.	Seed Marketing and Govt. Policy (Speaker yet to be identified).	
ii.	Private Farming interest in Hybrid Sorghum	HE Mr. Mustafa Mohamed Bashar Regional Minister for Social Welfare
iii.	Private enterpreneur interest in hybrid sorghum seed business.	Mr. M. A. Mufta (informed) Mr. Abdel Rahim El Amin (informed)
iv.	Extension Use of hybrid sorghum seed & associated inputs	Mr. Ali Nour, Sudan Cezira Board (Dr. Ahmadie to inform) Mr. Dirdiri Ahmed. (He is not available. Dr. Ahmed to identify another speaker and obtain his consent).

Opening Session

Welcome - Director-General, ARC, Wad Medani.
(Dr. Ahmadie to inform).

Inaugural address - HE Mr. Soghayroon Zein Sograyroon.
(Dr. Ahmed & Dr. Joshi to contact).

Mr. Yousif Ahmed Dash, Under Secretary
(Dr. Ahmed).

Local Speakers

List of local speakers attached.

Each speaker to be addressed.

Two typed copies of lecture to be received up to 25 Sept. 1983 latest.

Invitees

Final list as amended attached.

Budget

Following tentative allotments have been approved.

S.No.	ITEM	AMOUNT Ls.
1.	Local transport (Car, Minibus, Fuel).	5000
2.	Catering, B'fast/Tea/Coffee (4 days)	3000
3.	Lodging & Meals at Medani	4000
4.	Secretarial Work. Typist; Stationary	1000
5.	Per diem for support staff	1500
6.	Printing Invitation Cards/programme/folders	2000
7.	Publicity (including decoration etc.)	2000
8.	Proceedings (minutes)	3000
9.	Contingency	1280
		21780

Committees

I. Transport (including field trips) (funds alloted: Ls. 5000)

Convenor: Dr. Gebisa

Members: Dr. Abdel Latif El Nour
Mr. Ismat Mustafa

Functions: Hiring of vehicles, arrange for drivers, fuel, etc.
Hiring of vehicle for field trips and arrange field trips.
Coordinate movement in Wad Medani.

II. Accommodation/Reception/Departure

Convenor: Dr. A.B. Ahmadie
Mr. Awad Hassan Juma
Dr. M.S. Joshi (at Khartoum)
Mr. Badr El Din (NSA, Khartoum)

Functions: Reception at Khartoum Airport/Arrange
Accommodation at Khartoum and transport to Medani
Hire travel agent for reservation
Accommodation for delegates at Wad Medani
Transport from Medani to Khartoum
Accommodation at Khartoum
Departure from Khartoum (Hotel to Airport)

III. Meals/Refreshment. (Funds alloted: Ls. 7000)

Convenor: Dr. A.B. Ahmadie
Dr. Gebisa
Mr. Mustafa Mahmoud

Functions: B'fast/Tea and Snacks/Lunch/Dinner
Soliciting financial help
Engage Caterer

IV. Programme and Secretariat. (Funds alloted: Ls. 5500)

Convenor: Dr. Hilo
Dr. Gebisa
Dr. Mohamed Abdel Rahman
Mr. Mahmoud Gamal Sedon
Dr. S.K. Banerjee

Functions: Finalize programme
Conduct of Workshop (sessions)
Announcements
Contact all speakers
Get manuscripts of lectures
Copies of documents for circulation
Division into groups
Identify rapporteurs and print names in printed programme
Arrange conference rooms and room for group discussions
Recording proceedings
All typing and secretarial work
Issue of final proceeding and final report of workshop

V. Publicity: (Funds alloted: Ls. 3000)

Convenor: Dr. Ahmed Abu El Gassim
Dr. Salah El Hassan
Mr. Mustafa Hassan
Mr. Bakri

Functions: Printing and distribution of invitation cards
Printing of programme and circulation
Print name tags, procure folders etc. for distribution
Registration of delegates and arrange information desk at the conference
Decoration of conference hall
Arrange for Radio/television coverage
Rendering of Quran verses at inauguration
Photographer
Visual aids in conference
Question and answer sheets
Microphone arrangements in conference hall

National Seed Administration
Ministry of Agri. & Irrigation, Khartoum

FN9/2/(14)/SUS/038/SUD 8 Oct. 1983

Copy to following:

1. Dr. A.B. Ahmadie (ARC)
2. Dr. Gebisa (ARC)
3. Mr. Mahmoud (MFC)
4. Dr. M.S. Joshi (NSA)

Please inform the members of the committees if they are working with you.

Ahmed Abu El Gasim
Director-General
National Seed Administration
Khartoum

Invitees

Mr. Mahmoud A. Mahmoud (MFC), to inform names of following:

Sudan Farmers Union Representatives.

Representative	Pioneer Hybrid Seed Co.
"	Ciba Geigy
"	Northrup King
Damazine Agri & Animal Production Co.	
	Mr. Abbas Abdel Mageed
Sudanese Egyptian Integrated Agri Co.	
	Mr. Salah El Khalifa
	Saied Mirghani
	Saied Rahimtulla Abdalla

Representatives of selected seed companies in USA and other countries.

University of Gezira, Wad Medani	
Dean, Faculty of Agriculture	Prof. Yousif Mahammed El Tayeeb
Head, Crop Science	Dr. Osman Ahmed Ali
All Plant Breeders	
University of Khartoum	
Dean, Faculty of Agriculture	Prof. Abdel Muhsin
	H. Hassan El Nadi
Head, Agronomy	Dr. Karouri
All Plant Breeders	
National Seed Administration	
Director, SCA, Sennar	Dr. Mahammed Hassan Ismail
Asst. Director (Administration)	Mr. Ibrahim Osman Salih
Head, Sennar (M)	Mr. Ayoub Ziada
Head, Sennar (W)	Mr. Mohammed Hasab El Rasul Ali
Head, Kh. El Girba	Mr. Mohammed Hassan Mohd. Saleh
Head, Tozi	Mr. Sayeed Mohammed Mustafa
Head, Sem Sem	Mr. Abdalla Sir El Khatim
Head, Hudeiba	Dr. Mohammed El Hassan Ahmed
Head, Quality Control & Seed Testing	Mr. Mohammed Abdel Farrag Khamees
Head, Marketing & Distribution	Mr. Mohammed Ahmed Yousif
Training Officer	Mr. Mohammed Ahmed Yousif
FAO Mechanization Expert, Sennar	Mr. S.B. Gupta

FAO Irrigation Engineer	Mr. R.R. Appart
Agriculture College, Abu Naama	
Principal	
Head, Agronomy (Plant Breeding)	

Minutes of the meeting held on Wednesday 14 Dec. 1983 in the room of Dr. Ahmed Abu El Gasim, Director General, NSA, Khartoum.

Subject: Hybrid Sorghum Seed Production Project)

Present: Prof. Mahmoud Ahmed Mahmoud, MFC
Dr. Abdel Moneim Bashir El Ahmadie, ARC
Dr. Gebisa Ejeta
Dr. Ahmed Abu El Gasim
Dr. Omer Abdel Fadil
Mr. Wageeh S. Andraous
Dr. M.S. Joshi

There was detailed discussion on each recommendation made by the Hybrid Sorghum Seed Workshop held at Wad Medani, 5 to 8 November, 1983.

Following action is proposed on each recommendation:

1. Dr. Joshi informed that the modified pilot project proposal has been submitted to 10 donor agencies, as recommended by the Workshop by the Govt. of Sudan.

2. Private growers.
   Dr. Ahmadie and Dr. Omer to contact following and other potential growers and enquire their interest in seed production during 1984 season.
   1 - Mr. Mufti
   2 - H.E. Mr. Mustafa Basher
   3 - H.E. Dr. Osman Khalifa
   4 - Damazine Agri & Animal Production Co.
   5 - Sudan-Egyptian Integrated Co. Gedaref
   6 - Arab-Sudan Blue Nile Scheme, Agudi
   7 - Canadian Dev. Agency, Sem Sem
   8 - Biriyab Scheme

3. Foundation Seed.
   Wad El Nau and ARC farms to be utilized to the maximum for production of foundation seed. Some area to be kept at NSA farm, Sennar.

4. Study team.
   Sudan Gezira Board will be represented under the seed producers category. Dr. Gebisa may solicit support of any other agency for the

visit of the study team; if any delay in funding of the pilot project is apprehended.

5. A leaflet in Arabic giving information on recommended agronomic practices should be prepared and printed. This leaflet should be inserted in each seed bag supplied. Adequate copies of leaflets should be made available to extension workers.

6,7,8,9,10. Draft Certification standards should be prepared for use during 1984 season. These will be approved by the Project Advisory Committee. Dr. Banerjee/Director SCA to take necessary action.

11,12. Grow-out tests: NSA to collect samples, for all lots of seed from ARC/SGB/MFC/NSA and grow-out tests arranged. Dr. Banerjee and Director SCA to take action.

13: Seed Treatment.

The Pesticides committee issues recommendations for seed treatment. For the current season, Swedawa (ICI) should be used for seed treatment. (Action: SGB).

14: Consultant: In case any delay in financing the pilot project is apprehended, possibility of securing services of Dr. Gebisa for planting '84 season crop may be explored. INTSORMIL to be approached for services of expert for assistance during roguing season.

15,16,17. Action has been initiated by NSA. This has to be pursued.

18,19,20. NSA to follow up.

21. Demonstrations.

Following demonstration programme is proposed during 1984 season.

MFC	100 feddans -- (Includes area for H.E. Mr. Basher).
SGB	630 feddans

NHAPC/Blue Nile/White Nile/Rahad at least 2 demonstrations in each scheme.

Dr. Omer will address all schemes and take action for arranging demonstrations.

Seed to be reserved by SGB. Seed will be sold by SGB.

Dr. Omer will also contact Extension Service and decide about the programme to be taken up in cooperation with them.

23,24. Dr. Omer will discuss with the Director, Extension Service and explore the possibility of selecting a person specifically responsible for hybrid sorghum extension work.

25,26. Marketing.

It is expected that about 25 tons of hybrid seed will be available.

Apart from Gezira, seed required for demonstration in other schemes will be as follows:

MFC	1000 Kg.
Blue Nile Corp.	200 Kg.
White Nile Corp.	200 Kg.
Suki	200 Kg.
NSA	200 Kg.
Rahad	360 Kg.
NHAPC	360 Kg.
	2420

This seed should be reserved and kept available up to June 1984. The remaining quantity of seed will be used by the Sudan Gezira Board.

Dr. Omer to contact all schemes and make arrangements for supply of seed.

27. Prof. Mahmoud informed that the current farm gate price for sorghum is Ls. 20 per sack. It was decided to fix sale price of hybrid seed at Ls. 120 per sack or Ls. 1.20 per Kg. This was acceptable to SGB.

National Seed Administration
Ministry of Agriculture & Irrigation
Khartoum

NAI/NSA/GEN/61 18 Dec. 1983

Copy forwarded to following for information and necessary action:

1. Dr. Ahmadie
2. Mr. Wageeh Andraous

3. Dr. Gebisa Ejeta
4. Dr. Omer Abdel Fadil
5. Prof. Mahmoud A. Mahmoud
6. Dr. S.K. Banerjee
7. Director, SCA Sennar
8. Director, PPA, Sennar
9. Dr. M.S. Joshi

Ahmed Abu El Gasim,
Director General,
National Seed Administration
Khartoum

Subject: Seed Programme in Gezira Scheme.

Minutes of the meeting held on Thursday, 15th December, 1983 in the room of Director General, NSA, Khartoum.

Present:

1. Mr. Wageeh S. Andraous
2. Dr. Omer Abdel Fadil
3. Dr. Ahmed Abu El Gasim
4. Dr. M. S. Joshi

Dr. Ahmed explained the purpose of the meeting. He stressed importance of cooperation among NSA and SGB for developing the seed programme as proposed in the ADB Financed Seed Project. During 1983-84, the start will be made with the wheat crop. Subsequently, other crops such as Sorghum/Groundnut will be included in the programme. It was agreed to have constant dialogue so that any deficiencies experienced in the execution of the programme will be rectified in time.

Dr. Omer Abdel Fadil will work as a Liaison Officer between NSA & SGB. He will be stationed at Wad Medani/Barakat. Dr. Omer will be in charge of the Hybrid Sorghum activities until the project becomes operational. He will also serve on a link between NSA & ARC. Suitable terms of reference will be developed for Dr. Omer and all informed.

Following decisions were taken about various facilities to be made available to Dr. Omer.

I. Office - SGB will provide office room.

II. Office Furniture: A table and chair will be supplied from Sennar. A spare table and chair has been kept with Dr. Banerjee at Sennar.

III. Vehicle: Dr. Ahmed will explore possibility of providing old Land Rover from Sennar to be repaired by SGB. Fuel will be supplied by SGB.

IV. Stationary: SGB will supply.

V. Supporting Staff: For the present, Mr. Mustafa Mahmoud will be the only person assisting Dr. Omer. In future, as transport facilities become available more staff will be provided.

VI. Travelling Allowance: Dr. Ahmed to write to SGB requesting for payment of travelling allowance to Dr. Omer and Mr. Mustafa temporarily. In the meantime, NSA will explore possibility of

giving relief to staff in other ways.

VII. Wheat Inspection: Mr. Wageeh informed that the seed production area under different varieties was as follows:

Varieties	Feddans
Condor	5000-6000
Anza	3000
Mexicani	3000

Some portion of this area will be inspected. Dr. Omer will prepare field inspection plan in consultation with Mr. Wageeh, Dr. Banerjee and Director, SCA and the programme will be executed as per plan.

VIII. Training Course: SGB will nominate one candidate for the 2 week training course to be held at Sennar from 4th Feb. to 15 Feb. 83. NSA will formally approach SGB for this.

IX. Equipment Specification: Mr. Wageeh informed that SGB would like to have same brand of equipment which they possess. This will be kept in mind while inviting tenders.

X. Procurement Account: UTFN/SUD/029/SUD.
There is an unspent balance of $12,439 in this account. Mr. Wageeh provided a list of spares required for seed treaters, elevators and seed cleaners. The suppliers will be approached for proforma invoice and orders will be placed for supply by Air Freight. All available funds will be utilized for procurement of spares only.

XI. Cotton Seed delinting project: Dr. Joshi informed that the report of Mr. Philpott, Consultant who visited Sudan in July 1983 is due during this week. A copy will be sent to Mr. Wageeh as soon as possible.

XII. Mr. Abdalla Heidoub: Mr. Heidoub, Communication Officer, FAO HQrs, Rome will be visiting Sudan from 17th Dec. to 24th Dec. 1983. He will be visiting Sennar. He will also visit Gezira Scheme. Information will be given to Mr. Wageeh as soon as programme of visit is finalized.

MAI/NSA/SP/14 18 December, 1983

Copy forwarded to following for information and necessary action:

1. Mr. Wageeh Andraous
2. Dr. Omer Abdel Fadil
3. Dr. M. S. Joshi
4. Dr. S. K. Banerjee
5. Director, SCA, Sennar
6. Mr. Abdel Aziz Ahmed, Sennar

Ahmed Abu El Gasim
Director General
National Seed Administration
Khartoum

Subject: Hybrid Sorghum Seed Production Project

Meeting held in the room of Director General, NSA, on Tuesday, 6th March, 1984 at 10 a.m.

Present

1- Dr. A.M.B. El Ahmadi
2- Mr. Mahmoud Ahmed Mahmoud
3- Mr. Wageeh S. Andraous
4- Dr. Omer Abdel Fadil
5- Dr. Ahmed Abu Elgasim
6- Dr. M.S. Joshi.

Minutes of the Meeting

1- Dr. Ahmed read the minutes of meeting held with USAID officials on 25 February 1984.

The USAID has agreed to finance Phase I of the project and has made available funds in local currency for the 1st year of the project.

2- The allotment made under various heads was considered. It was agreed to distribute funds on pro-rata basis. The general principle to be followed will be as under :-

Breeder Seed Production	5%
Foundation Seed Production	15%
Certified Seed Production	80%

The funds available for foundation and certified seed production to be allocated on the basis of area among the participating agencies. Regarding operation inputs, the allotment to various agencies will be as shown in the statement appended.

For following items, the distribution will be decided later.

Item	Amount
Advisory Committee	Ls. 2 400
Overtime (Labourers)	7 200
Perdiem (Staff)	10 000
Workshop & Seminar	20 000
Extension material	5 000
Contingency	32 200

3- Following action should be taken by the National Seed Administration :-

i- Letter to be sent to Ministry of Finance & Economic Planning (Planning) from the Under Secretary (Agri) regarding funds made available by USAID and execution of the project.

ii- A separate account entitled "Hybrid Sorghum Project Account" to be opened with the Bank of Sudan. The Account to be operated by 3 signatories viz,

Dr. Ahmed Abu Elgasim
Mr. Mahmoud Ahmed Mahmoud
Dr. M.S. Joshi

Only two person sign withdrawals.

4- An Accountant to be engaged on whole time or part-time basis. Remuneration upto Ls. 100 - Ls. 120 p.m. may be paid to attract good person. This should be done initially for one year only.

5- If necessary, a graduate may be entrusted with the work of keeping records and other administrative work. He may be paid suitable remuneration of Ls. 40 - 50 p.m.

6- Letter heads, envelopes etc. for the project may be printed to facilitate work.

7- It was decided to pay honorarium of Ls. 50 per meeting for those members of the Advisory committee who may be eligible to receive it. Honorarium for persons attending the meeting held on 6th March will be paid at this rate.

8- It was decided to procure two pick ups. Information has to be collected about 4 wheel and 2 wheel drive Toyota (benzene) pick-ups (Double Cab). The committee in its next meeting will approve actual purchase on the basis of information collected.

9- Production:-

All breeder seed will be produced by ARC. Foundation seed production will be distributed as follows :-

NSA	5 feddans
SGB	10 feddans

SGB will produce seed at Wad El Nau farm.

Certified seed production will be arranged as follows:

NSA	60 feddans
SGB	100 feddans
MFC	25 feddans.

The tentative revised target for hybrid seed production during 1984-85 was fixed as 500 feddans. For this, 1500 kg of female parent seed is required. Following stock of female parent seed is available.

SGB	206 kg
NSA	413 kg.

It was decided to have 5 feddans under off season production. This will be arranged by ARC.

It was decided to contact Dr. Gebisa to ascertain about availability of female parent seed in USA. Dr. Joshi will contact Dr. Gebisa and obtain information about stock available, cost, air freight etc.

10- Dr. Omer informed about progress of demonstration work. He informed that a meeting of MFC, SGB and Ministry of Agri has been called to decide about the programme to be taken up.

11- It was decided to arrange a meeting between the extension dept. and Extension Section of SGB to prepare a publicity programme for hybrid sorghum activities to enlighten the farmers.

12- It was decided to have the next meeting of the Advisory Committee on Saturday 7th April at 10 a.m.

x

FN9/2/1(49)/SUD/038/SUD 8th March 1984.

Copy to following for information and necessary action :-

i- Dr. A.M.B. El Ahmadi, Head, Plant Breeding Section, ARC, Wad Medani.
ii- Mr. Mahmoud Ahmed Mahmoud, MFC, Khartoum.
iii- Mr. Wageeh S. Andraous, Sudan Gezira Board, Barakat.
iv- Dr. Omer Abdel Fadil, c/o Sudan Gezira Board, Barakat.
v- Dr. M.S. Joshi, Khartoum.
vi- NSA (3 copies).
vii- Under Secretary (Agri) Ministry of Agri & Irrigation, Khartoum.
viii- Director, PPA, Sennar.

Ahmed Abu Elgasim,
Director General.

Subject: Hybrid Sorghum Seed Production Project

Meeting held in the room of Director General, NSA, on Saturday, 7th April, 1984 at 10 a.m.

Present:

1. Dr. A.M.B. El Ahmadi
2. Mr. Wageeh S. Andraous
3. Dr. Omer Abdel Fadil
4. Dr. Ahmed Abu El Gasim
5. Dr. M. S. Joshi

Minutes of the Meeting:

The minutes of the meeting held on 6th March, 1984 were read out and discussed.

1. It was decided to purchase following two vehicles:

One Toyota double cab 4WD diesel pick-up	Ls. 35,000
One Toyota double cab 4WD benzene pick-up	Ls. 31,500
	Ls. 66,500

2. For 400 feddans seed production by SGB, 1200 kg female parent seed is required. It was decided to import 360 kg female parent seed. Dr. Gebisa to be contacted and total cost including Air freight for 400 kg female parent seed to be ascertained. (Action: Dr. M. S. Joshi).

3. Dr. Omer reviewed the progress of work relating to demonstration. Following area has been alloted to different participating agencies for demonstrations.

SGB	630 feddans
MFC	100 "
Blue Nile Corp.	45 "
White Nile Corp.	45 "
Suki Corp.	45 "
NSA	10 "
Rahad Corp.	90 "
NHAPC	90 "

4. USAID to be contacted for arrangements in regard to foreign exchange component of the project.

4. Local Costs. As soon as funds are received in the bank account, advances will be given to participating agencies and subsequently reimbursement will be made against account rendered.

6. Study Tour.

The tenative list of participants for study tour is as follows:

1. Dr. Ahmed Abu El Gasim, Director General, NSA and Chairman, Project Advisory Committee.
2. Dr. A.M.B. Ahmadi, Head, Plant Breeding Section and member.
3. Mr. Wageeh S. Andraous, Sudan Gezira Board.
4. Prof. Mahmoud Ahmed Mahmoud, MFC.
5. Dr. Omer Abdel Fadil, NSA Counterpart Project Leader.
6. Director, PPA, Sennar.
7. Representative of Extension Admin. Min of Agri.
8. Mr. Mohamed Abdel Gadir Mufti, Private Seed Grower.
9. Sorghum Breeder (to be identified) Member.
10. Dr. M. S. Joshi, FAO Seed Project Coordinator (From FAO Project).

Action for study tour will be initiated as soon as arrangements for foreign exchange component are known.

* * * * * * * * * *

FN9/2/1/(49)/SUD/038/SUD 7th April, 1984

Copy forwarded to following for information and necessary action:

i. Dr. A.M.B. El Ahmadi, Head, Plant Breeding Section, ARC, Wad Medani
ii. Prof. Mahmoud Ahmed Mahmoud, MFC, Khartoum
iii. Mr. Wageeh S. Andraous, Asst, Agri Mgr. Seed Propagation Dept. Sudan Gezira Board, Barakat
iv. Dr. Omer Abdel Fadil, Seed Propagation Dept., Sudan Gezira Board, Barakat
v. Dr. M.S. Joshi
vi. NSA (3 copies)
vii. Under Secretary (Agri), Min of Agri & Irrigation, Khartoum

Ahmed Abu El Gasim
Director General
National Seed Administration,
Khartoum

FN9/2/1(49)/SUD/038/SUD 7th May 1984.

Subject: Hybrid Sorghum Seed Production Project

A meeting of the Advisory Committee was held in the room of Director-General, NSA, on Monday, 7th May 1984 at 11 a.m.

Present:

1- Dr. A.M.B. El Ahmadi
2- Dr. Ahmed Abu El Gasim
3- Mr. Wageeh S. Abdraous
4- Dr. Omar Abdel Fadeel

Minutes of the Meeting

1- Dr. Ahmed informed the meeting that INTSORMIL agreed to provide 500 kgs of the (A) parental line seeds, and is expected to arrive from America by the end of May.

2- Dr. Ahmed also informed the meeting of the arrival of the formal letter No. MEEP/AT/AMERICAN/118/1 dated 6th May, 1984 from USAID indicating the release of L.S. 220,000 from their account to the account No. 02/12/378 in the name of Hybrid Sorghum Seed Production Project, Bank of Sudan. The money is to finance Phase I of the project.

3- It was agreed to distribute the fund among the participating agencies according to the formula agreed upon last meeting. The budget breakdown will be done by Dr. Omar and inform all concerned parties.

4- Dr. Ahmed will pursue the purchase and registration of vehicles. It was agreed that the vehicles should carry a private number plate and to have the logo of the project printed on them.

5- It was decided to carry out expenditure on all operational inputs on the following basis :

a- Each contributing agency will request a certain amount of money which will enable that agency to perform its activities.

b- The money will be issued as a personal account.

c- Authorized persons who have the right to sign the request and in whose name the money will be issued are :-

ARC - Dr. A.M.B. Ahmadi, Head PBS

NSA - Mr. Ibrahim Ooman Shiih, Director, PPA.

SGB - Mr. Wageeh S. Andraous, Manager, PPD.

MFC - Prof. Mahmoud A. Mahmoud

d- No cash or cheque will be issued unless the previous amount of money provided has been cleared from the personal account whether by receipts, paysheets or overtime forms.

e- The accountant in charge will have a detailed distribution of the budget and he has to keep record and control of expenditure for each item of the budget.

6- It was decided that all quantities of fertilizer and herbicide required for the programme to be purchased in consultation with SGB. Quantities will be distributed among the participating agencies on the basis of area alloted. Dr. Omar will follow up the matter with SGB.

7- The money for extension material will be divided among the extension service departments of the SGB, MFC and the Ministry of Agriculture. Money will be alloted as follows :-

SGB	Ls. 3,000
MFC	1,000
Ministry of Agric.	1,000
TOTAL	Ls. 5,000

8- Next meeting to be arranged later.

Copy forwarded to following for information and necessary action :

i- Dr. A.M.B. El Ahmadi, Head Plant Breeding Section, ARC, Wad Medani

ii- Prof. Mahmoud A. Mahmoud, MFC, Khartoum

iii- Mr. Wageeh Samuel Andraous, Manager Seed Propagation Dept, SGB, Barakat.

iv- Dr. M.S. Joshi, FAI Project Coordinator

v- Mr. Ibrahim Ooman Salih, Director PPA, Sennar.

vi- Dr. Omar Abdel Fadeel, Counterpart Project Leader, Seed Prop. Dept., SGB, Barakat.

vii- Dr. M. El Hassan Ismail, Director, SCA, Sennar.

viii- Under Secretary, Ministry of Agric., Khartoum.

ix- Extension Service Dept., Min. of Agric.

x- Extension Dept., SGB.

xi- Extension Dept., MFC.

Dr. Ahmed Abu El Gasim,
Director General,
National Seed Admin., Khartoum.

ESTIMATED BUDGET FOR HYBRID SORGHUM SEED

1.	Personnel	
	Advisory committee	2,400
	Overtime - laborers	7,200
	Per Diem - laborers	10,000
2.	Training	
	Workshop and seminar	20,000
3.	Equipment	
	Vehicles - 2	60,000
4.	Operational inputs	
	Labor	32,000
	Fuel	11,000
	Lubricants and oil	1,200
	Fertilizers	20,000
	Herbicides	10,000
	Packaging material	4,000
	Extension material	5,000
	Transport/processing	5,000
5.	Sub-total	187,000
	Contingency	32,200
6.	Total cost	LS 220,000

Subject: Meeting of the Advisory Committee for
Hybrid Sorghum Seed Production Project

Date: 17th June, 1984

Place: Room of the Director General, NSA, Ministry of Agric.

Present:

Dr. A.M.B. Ahmadi
Prof. M. Ahmed Mahmoud
Dr. M. Abu El Gasim
Mr. Ahmed El Bashir
Dr. Omar A/ Fadeel Yousif

Minutes

(1) Mr. Ahmed El Bashir joined the meeting on behalf of S.C.B.

(2) Dr. Ahmed Abu El Gasim revised the minutes of the previous meeting, particularly on the budget breakdown and expenditure. It was agreed that decision on the following 3 items of the budget to be left to Advisory Committee:
a- Advisory committee b- Workshop and Training c- Contingency.
Dr. Ahmed also informed the meeting that the purchase of vehicles is still held up to unavailability of the required types. Alternative types of vehicles were thought, but decision was postponed until next meeting.

(3) Prof. Mahmoud reminded the meeting that copies of the budget breakdown and minutes of the Advisory Committee meetings should be sent to the managing Director of the Agencies involved in the project for information. Dr. Ahmed will take action.

(4) Sudan Gezira Board forwarded two letters requesting the sum of L.s. 10,000 for the plant propagation Dept. And the sum of L.s. 3,000 for the Extension Dept. It was agreed that a cheque for L.s. 13,000 to be issued in the name of the manager, Agric. Administration so that it could be deposited in a suspense account and dispersed between the two departments.

(5) Money allocation to the extension departments involved in the programme was discussed again and the meeting agreed that the distribution decided in the previous meeting was acceptable. Money will be issued for each department on request and it is expected

that documents of expenditure will be submitted to the committee.

(6) Further to the Committee's decision on the regulation of expenditure on operational inputs, it was decided that cheques will be issued in the name of Director General, ARC and the Managing Director, MFC so that the money could be deposited in a suspense account. Authorized persons to withdraw from such accounts were as previously indicated.

(7) The question of providing fertilizer for the programme was discussed. It was agreed that:

a- Quantities of fertilizer for NSA and ARC will be purchased from S.G.B. Dr. Omar informed the meeting that S.G.B. is ready to cooperate in that matter. MFC will purchase their requirement of fertilizer from the Agricultural Bank.

b- The S.G.B. will provide its programme with fertilizer from their own resources. The possibility to use the money allotted for fertilizer to Gezira in the project to buy a planter was discussed. The planter suggested was stanhay provided by Al Magboul Bros. Corporation Ltd. The meeting agreed to this suggestion and decided immediate action should be taken.

(8) Sorgoprim will be purchased from Gezira and arrangements for purchase and transport together with fertilizers will be followed by Dr. Omar.

(9) It was agreed to accept the nominated consultant for the project. The consultant will be stationed at Gezira with Dr. Omar.

(10) Dr. Gebisa submitted a proposal of a joint hybrid sorghum seed production project involving Purdue University, an experienced American company working in the line of hybrid and a private Sudanese company interested to joint the venture in addition to NSA and ARC. The objective of the project is to assist the private sector in the Sudan to promote a hybrid sorghum seed industry. The proposals were briefly discussed and the matter was left for further study.

(11) The members informed the meeting that the preparations to the season are going according to plan.

(12) Next meeting will be after Ramadan Bairam.

Dr. Ahmed Abu EL Gasim
Director General, NSA, and Chairman.

Copy forwarded to :-
Dr. A.M.B. EL Ahmadi, Head Plant Breeding Sector, ARC, Wad Medani.
Prof. Mahmoud Ahmed Mahmoud, MFC, Khartoum
Mr. Ahmed EL Bashir Ahmed, Acting Manager Seed Prop. S.G.B. Barakat.
Dr. Omar A/Fadeel, Project leader, Seed Prop. Dept. S.G.B. Barakat.
Dr. M.S. Joshi, FAO Project Co-ordinator.
Director, PPA, Sennar.
Director, SCA, Sennar.
Under Secretary, Ministry of Agric.
Managing Director, S.G.B. Barakat.
Director General, ARC, Wad Medani.
Managing Director, MFC, Khartoum.

SUBJECT: Meeting of the Advisory Committee for Hybrid Sorghum Project

Date: Wednesday, 8th August, 1984.

Place: Room of the Director General, NSA, Khartoum.

Time: 10 a.m.

Present

Dr. A.M.B. Ahmadi
Dr. Abdel Latif El Nour
Mr. L.D. McDonald
Mr. Ahmed El Bashir
Dr. Omar Abdel Fadil
Dr. Ahmed Abu El Gasim
Dr. M.S. Joshi.

Minutes:

Dr. Omar read out the minutes of the meeting held on 17th June 1984. He informed that money was disbursed as decided. Fertilizer was purchased and distributed among the agencies as required.

Dr. Ahmed accorded welcome to Dr. Abdel Latif El Nour who has been appointed as Sorghum Breeder and who will also represent ARC on the Advisory Committee. Dr. Omar raised the point about supply of one sack of parent seed to a private seed grower by USAID. There was detailed discussion. It was decided that the Chairman will explain personally to USAID officials about the difficulties that may be confronted in such cases, so that in future important things done in consultation with the Advisory Committee.

Regarding encouragement to private sector, all members were unanimous that special efforts should be made to encourage private seed growers or companies in seed production. An attempt has been made to involve selected seed growers during this season. It was, however, felt that the initiative should come from the private seed growers. There are very few growers at present but with more demonstration etc. it is expected that some entrepreneurs would emerge.

Dr. Omar reviewed the Seed Production programme undertaken during the current season. The present status is as follows :-

Seed Production area in Feddans

Institution	Breeder	Foundation	Certified	Remarks.
NSA Sennar	-	5	60	Sowing commenced On 10th July. Stand good.
SGB, Barakat	-	10	554	Fdr Seed growers on Wad El Nau farm certified seed under contract production with 179 farmers sowing timely. Stand Good.
ARC, Wad Medani	1 fed A&B line 0.20 fed. R line			Satisfactory.
MFC	-	25		No information about sowing.

Most of the Institutions carried out the programme as planned.

Per Diem: The Gezira Board has agreed to pay per diem to 3 staff members of NSA for 6 months. There was considerable discussion about payment of per diem or incentive to staff engaged in this work.

It was agreed that for the certification staff - per diem at suitable rate will be paid by the Institution responsible for production i.e. GB will cover per diem to certification staff visiting Gezira.

It was agreed that funds allocated as per diem could be used by the respective Institutions for staff directly involved in Hybrid seed production.

Packaging:- All foundation seed will be packed in convenient sized bags e.g. 10 kg for female and male parents. All packing material will be purchased by SGB centrally and then supplied to various agencies. Money allocated for packaging should not be used by the agencies unless there are specific instructions contrary to this.

Vehicles:- Dr. Ahmed explained about the difficulties in finding suitable vehicles in the market. He will be contacting some suppliers and the vehicles will be procured as soon as available.

It was decided that both the vehicles will be located in Gezira under the overall charge of Dr. Omar Abdel Fadil. Each vehicle will only be used for work related to the project.

Video Film:- Dr. Joshi informed that recently we have bought a video camera and this is kept at Sennar. Suitable video films have to be prepared covering various aspects of seed production. He requested for co-operation of all in this work.

Field Days:- Dr. Omar will prepare plans for arranging field days at suitable locations so that maximum number of farmers attend the hybrid crop.

Dr. Ahmed will be taking action for printing letter heads/envelopes etc. for the project.

The meeting ended with a cheerful note.

NATIONAL SEED ADMINISTRATION

No.: FN9/2/1(49A)/SUD/038/SUD Date: 9th August, 1984

Copy forwarded to following for information and necessary action:

Dr. A.M.B. El Ahmadi, Head, Plant Breeding Sector, ARC, Wad Medani.
Prof. Mahmoud Ahmed Mahmoud, MFC, Khartoum.
Mr. Ahmed El Bashir Ahmed, Acting Manager Seed Prop., SGB, Barakat.
Dr. Omar A/Fadeel, Project Leader, Seed Prop. Dept., SGB, Barakat.
Dr. M.S. Joshi, FAO Project Co-ordinator.
Director, PPA, Sennar.
Director, SCA, Sennar.
Under Secretary, Ministry of Agric.
Managing Director, SGB, Barakat.
Director General, ARC, Wad Medani.
Managing Director, MFC, Khartoum.
Mr. L.D. McDonald, c/o Dr. Omer A. Fadeel, SGB, Barakat.

Ahmed Abu Elgasim,
Director General,
National Seed Administration.
Khartoum.

SUBJECT: Meeting of the Project Advisory Committee for Hybrid Sorghum Project.

Date/Time: 7.10.84 at 1 p.m.

Place: Sudan Gezira Board Guest House, Barakat.

Present:

Dr. A.M.B. Ahmadi

Mr. Ahmed El Bashir

Mr. L. D. McDonald

Dr. Omer Abdel Fadil

Dr. Ahmed Abu El Gasim

Mr. Ballal Hassan Ismail (SGB)

Dr. M. S. Joshi

Minutes:

The members visited Seed Production plots and demonstration plots in the Gezira Scheme. There was general satisfaction for the work done.

The main problem observed in the field was difference in the flowering behavior of parental lines and consequent nicking.

Dr. Ahmadi explained that the breeders were fully aware of the problem at the time of release of Hageen Dura 1. There was other hybrid which did not have this problem, but this could not be recommended for release at that time because of the likely difficulties in seed production.

Dr. Ahmadi suggested that cultural practices such as land preparation, land levelling and water management played important roles. There is need to collect information on various aspects so as to isolate the most important factor governing timely flowering of both male and female parents. This will enable us to manipulate growth so as to bring about perfect nicking.

There was general agreement to have grow out tests of maximum number of lots during off season so that the observations made during the growing season can be verified and seed of only lots meeting the prescribed standards will be allowed for distribution. The grow out tests will be arranged by Seed Cert. Admin., Sennar.

There was considerable discussion on the problem of Adar infestation. There is a general belief that Adar infestation comes only with the seed. It is, however, found that the source of Adar could also be the soil. The Adar seed remains dormant in the soil perhaps for years and whenever deep plowing etc. is done, more Adar seeds are exposed, the dormancy is broken and the seeds germinate infesting the crop. In Gezira utilization of land which is not occupied by wheat may solve the problem as better soil preparation can be given, and this will help in controlling Adar infestation. Other agronomic practices can also be recommended but this requires more data to be collected.

There was also discussion about Certification standards. The Texas standards are more stringent and considering the general conditions of the field this year, it is apprehended that very few fields can meet the standards. It was decided to ask the Seed Certification Admin. Sennar to submit proposals for modifications required in the standards. The Admin. should also prepare a programme for grow out tests to be conducted at Sennar during Dec. - April 1985 along with financial requirement etc.

Per Diem to Staff

It was decided to authorize Dr. Omer to arrange for lodging and boarding of the Inspection staff when they visit the Gezira Scheme. The expenditure incurred will be reimbursed from the provision under the project.

Visit of Dr. Gebisa, Staff of INTSORMIL and other Officials

Dr. Ahmed to contact USAID and arrange programme of visit for the visitors. The tentative proposed date of 28th October, 1984 was considered suitable.

Visit to Rahad Corporation

The Committee represented by Dr. Ahmadi/Dr. Omer/Dr. Abdel Latif/ Dr. Ahmed and Dr. Joshi visited Rahad Corporation on 8.10.84. The members visited the Seed Production fields the Hybrid demonstration plot. All seed production fields show stunted growth due to moisture stress resulting from lack of water in the main canal for about 3 weeks. The fields have not been rogued either. There is nicking problems in about 5 feddans. The condition of fields makes them liable for rejection.

The demonstration plot was free of weeds but delayed due to perhaps late plantings.

NATIONAL SEED ADMINISTRATION

No.: FN9/2/1(49A)/SUD/038/SUD Date: 10th October, 1984.

Copy forwarded to following for information and necessary action:

Dr. A.M.B. Ahmadi, Head, Plant Breeding Section, ARC, Wad Medani.
Prof. Mahmoud Ahmed Mahmoud, MFC, Khartoum.
Mr. Ahmed El Bashir Ahmed, Action Manager, Seed Prop., SGB, Barakat.
Dr. Omer A.Fadeel, Project Leader, Seed Prop. Dept., SGB, Barakat.
Dr. M.S. Joshi, FAO Project Co-ordinator.
Director, PPA, Sennar.
Director, SCA, Sennar.
Under Secretary, Ministry of Agriculture.
Mr. L.D. McDonald, c/o Dr. Omer A. Fadeel, SGB, Barakat.
Mr. Abdel Latif El Nour, Sorghum Breeder, Plant Breeding Section, ARC, Wad Medani.

Ahmed Abu El Gasim,
Director General,
National Seed Administration, Khartoum.

Subject: Meeting of the Project Advisory Committee for Hybrid Sorghum Project held on 7 Oct. 1984 at 1 p.m.

Correction in minutes of the Meeting Para 3 of the minutes should read as follows:

Dr. Ahmadi explained that breeders were aware of the importance of the feasibility of certified seed production of a hybrid and that was why the release proposal for "Hageen Dura-1" contained information not only on the hybrid productivity but also on its produceability. Another experimental hybrid with extremely high yield under optimum conditions was not released primarily because the parents did not nick well.

The error is regretted.

NATIONAL SEED ADMINISTRATION

No.: FN9/2/1/(49A)/SUD/038/SUD Dated: 11th November, 1984.

Copy forwarded to following for information and necessary action:

Dr. A.M.B. Ahmadi, Head, Plant Breeding Section, ARC, Wad Medani.
Prof. Mahmoud Ahmed Mahmoud, MFC, Khartoum.
Mr. Ahmed El Bashir Ahmed, Acting Manager, Seed Prop., SGB, Barakat.
Dr. Omer A/Fadeel, Project Leader, Seed Prop. Dept., SGB, Barakat.
Dr. M.S. Joshi, FAO Project Co-ordinator.
Director, PPA, Sennar.
Director, SCA, Sennar.
Under Secretary, Ministry of Agriculture.
Mr. L.D. McDonald, c/o Omer A/Fadeel, SGB, Barakat.
Mr. Abdel Latif El Nour, Sorghum Breeder, Plant Breeding Section, ARC.
Wad Medani.

Ahmed Abu El Gasim,
Director General.

Hybrid Sorghum Seed Production Meeting held at Sudan Gezira Board Guest House, Barakat on Sunday, 28th. October, 1984 at 11 a.m.

Present:

Name	Position	Organization
Le Moyne Hogan	Deputy Director	WSARP
Ahmed Abu Elgasim Ahmed	Chairman Advisory Committee for H.S. Project	NSA
M.S. Joshi	Project Co-ordinator, Sudan Seed Project	NSA
Omer A/Fadeel Yousif	Project Leader	HSP
M.F. El Mufti	Director (Former head of SGB's Seed Propagation Section)	Gezira Trading House P.O. Box 149
Ahmed El Beshir Ahmed	Acting Manager Seed Prop. Dept. Sudan Gezira Board	SGB
Abdel Latif M. Nour	Agricultural Research Corp.	ARC
George 1. Ghobrial	Senior Agronomist	USAID
Omer Mohd. El Faki Marzoug	Seed Production Specialist	S.G.B.
Mustafa Mohamed Mahmoud	Seed Propagation Officer	NSA
S.K. Banerjee	Seed Technologist, Sudan Seed Project - Sennar	NSA
Awatif Abd El Rahim	Seed Production Inspector	SGB
Hassan Abdel Hafeiz	Asst. Seed Production Officer	SGB
Ahmed Abdel Aziz	Asst. Director for Programming	NSA
Eric Witt	Agricultural Officer	USAID/Khartoum
A. Beshir El Ahmadi	Head, Plant Breeding Sec.	ARC
Ed Uhland	Production Manager	Dekalb-Pfizer Genetics
Lynn McDonald	Hybrid Sorghum Prod. Consultant	USAID, WSARP, WSU
James J. Riley	Sr. Advisor ARC	WSARP/WSU
Gebisa Ejeta	Sorghum Breeder	Purdue University

Proceedings

Dr. Ahmed Abu Elgasim accorded warm welcome to all participants. He informed that the response to H.D.I. which was the first sorghum hybrid released in the country was very encouraging. He pleaded for education of the farmers through extension and demonstration. He requested the participants to make frank observations so that deficiencies observed can be removed and quality of the programme can be improved.

Dr. Omer Abdel Fadil narrated his experience about seed production mainly in Gezira Scheme. The seed production arranged during Kharif 1984 was as in Table 1.

Table 1

Area under hybrid seed production

Organization	Area Feddan
National Seed Administration	60
Sudan Gezira Board	550
MFC	25
Mr. Mufti (Private)	5
Mr. El Khalil (Private)	5
Mr. O. Hamid (Private)	5
TOTAL	650

All foundation seed production was arranged at Wad Nau Farm. The sowing was done on 10th July 1984 and the stand was good. Less off-types were noticed. All certified seed production was taken up under contract with the tenants. It took lot of persuation to register growers. Parental seed, fertilizer and sorgoprim provided free. Tenants were responsible for weeding, irrigation and roguing. Assistance was given in roguing. All sowing was done by a mechanical planter. There were 188 tenants and many did not follow the recommended cultural practices. According to him, roguing was the most critical operation. A crew of 30 labourers moved from place to place. Almost 15 roguings were given in each field.

Variation in flowering of male and female parents, was the main problem. This was particularly evident in the early sown plots. He

could not pin-point any particular reason for this differential behavior in flowering. There seems to be multitude of factors responsible individually and with interaction among them.

Regarding demonstration programme he informed about the area sown under the programme which is summarized in Table 2. The seed for this was provided by the project.

Table 2

Demonstration programme for hybrid sorghum arranged during Kharif 1984

Site	Area
Sudan Gezira Board	3030
Mechanized Farming Corp.	100
Blue Nile Corporation	45
White Nile Corp.	45
Suki Scheme	45
National Seed Administration	10
Rahad Scheme	90
New Halfa Agri. Corp.	90
TOTAL	3455

He informed that inspite of some drawbacks, the hybrid enjoyed popularity among the farmers.

Dr. Ahmed Abdel Aziz who spoke on behalf of the National Seed Administration, gave a detailed account about the practices followed at Sennar farms. The land preparation was started in June. Sowing was started on 18th July. All foundation seed plots were sown by hand and the certified seed production fields by a seed drill. There was no nicking problem except in a small patch which was affected by water logging. No variation in R-Line was noticed. It was also observed that hybrid was more susceptible to long smut, incidence of striga and stemborers attack than the conventional varieties.

Mr. Lynn McDonald presented his paper entitled "Roguing and Blooming". According to him, land preparation was a major factor. In unleveled fields, sorgoprim concentration increased in waterlogged patches adversely affecting the growth of plants in these patches. He felt that there was considerable influence of environmental factors on

both A line and R line. He suggested that head rows should be grown of R line and more suitable selections made on the basis of intensive observations. Regarding performance of hybrid seed produced in 1983 season, he felt that it was perhaps contaminated which alone can explain the large number of off-types observed in the fields. Mr. McDonald observed that the hybrid was indeed popular and farmers will readily go in for it. He pleaded for more thorough examination of the flowering behavior of both parents so as to improve production techniques.

Dr. Banerjee narrated his experiences of certification work. All areas were inspected 3 times. He felt that if the Texas standards were applied in toto, most of the area will be rejected. He said that most of the lots will be tested thru grow out tests.

Dr. Joshi emphasized the need to apply the certification standards pragmatically. He suggested that the standards should be relaxed to some extent this year. Some fields which show very high infestation of objectionable plants should be rejected outright. The fate of the remaining ones may be decided on the basis of grow out tests. He also pleaded for more attention to demonstration plots.

Dr. Ahmadi expressed his agreement with Dr. Gebisa on the various difficulties experienced in seed production. He informed that head rows of R line will be grown next year and critically examined.

Dr. Abdel Latif El Nour and Mr. Ahmed Bashir narrated their experiences.

Dr. Ahmed drew attention of Dr. Gebisa to observation about orientation of rows. Dr. Gebisa informed that orientation of rows had very little effect on production. Dr. Ahmed also made observation on the participation of private sector in the hybrid sorghum seed industry. He said that both the public and the private sector were complimentary to each other. He assured full support of National Seed Administration to the private sector.

Mr. Mufti, a private seedsman, informed that because of lack of irrigation water, he could not plant the seed crop. He intends to start production work soon.

Mr. Uhland representing Dekalb Agri Association, U.S.A. expressed his appreciation for the excellent work done. He enunciated the role of the new project in encouraging private industry.

Dr. Gebisa at the outset, congratulated Dr. Ahmed for the leadership provided in this work. He commended the organization established. He praised the excellent plots observed at Sennar farm. On various points raised by the previous speakers he made his observations.

Planting date is most critical. Delay in planting affects production to a great extent. Grow out tests would be most important in deciding about quality of seed. The variations observed in R line were more or less the same as observed in the past and not significant. However, growing head rows of R line should permit critical examination about the flowering behavior.

The nicking problem observed in some fields are mainly due to management. Stressed plots result in poor crop expression and the two parental lines (A and R) will naturally react to each kind of stress differently, thereby resulting in differential flowering dates. Dr. Gebisa highlighted the scope of the hybrid sorghum programme. He stressed that the public sector alone will not be able to cope up with the programme. Participation of private sector is most important. He felt that Sudan should take advantage of the experience gained by many countries in developing her seed industry. He suggested early visit of the members of the Advisory Committee to U.S.A. and other countries as recommended by the Hybrid Sorghum Workshop held in November 1983, so as to see for themselves the progress possible.

He was happy to see the progress achieved in the first year of the project. He commended the contribution made by several individuals and institutions. He pleaded for continued dedication so as to ensure success of the programme in future.

Dr. Ahmed concluded the meeting with a vote of thanks to all those who were present and who contributed. He thanked the USAID for the generous assistance given for implementation of this project. He thanked the Gezira Board for their help. The meeting ended with a cheerful note.

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National Seed Administration

FN9/2/1(49A)038/SUD 3rd. November, 1984.

Copy forwarded to Prof. Mohd. Bakheit Said, Wad Medani for information.

Ahmed Abu Elgasim,
Director General,
National Seed Administration, Khartoum.

Subject: Hybrid Sorghum Seed Production Project
Meeting of the Advisory Committee held on Saturday, 10.11.1984 at 11 a.m.

Present:

Prof. Mahmoud Ahmed Mahmoud	MFC
Dr. A. Beshir El Ahmadi	ARC
Mr. Wageeh S. Andraous	SGB
Dr. Omer Abdel Fadil	NSA
Mr. Abdel Latif M. Nour	ARC
Mr. Lynn McDonald	USAID/WSARP/WSU/
Dr. Darrell Rosenow	INTSORMIL
Dr. M.S. Joshi	NSA
Dr. Ahmed Abu El Gasim	NSA
Dr. Gebisa Ejeta	Purdue University

Dr. Ahmed accorded warm welcome to all participants. He informed that we have exceeded the targets of seed production set for the 3rd year. He emphasized the need for proper management practices via planting male 1 week ahead; pre-irrigation to reduce off types; better land preparation etc.

He suggested checking all seed lots thru grow out tests. He also felt that NSA farms at Sennar can produce more hybrid seed because of facilities. He was not happy with the performance of private sector. He requested the participants to suggest guidelines for preparing programme for the next season. He also suggested for more experiments to seek information on various problems confronted during this season.

Mr. McDonald told that it will not be possible to eliminate nicking problem. Better practices will reduce this problem. For other problems, he suggested isolation on some which should require priority attention. He suggested that the officer-in-charge should be given more facilities and administrative freedom if any expansion in the area is planned.

Mr. Wageeh (SGB) told that we have only 2 years experience and we should be proud of the performance. The farmers were impressed with the yield obtained. Gezira is not growing any wheat this year and this will permit better land preparation for sorghum for next year. He suggested an expansion to 1000 fed for certified seed in SGB next season.

Dr. Ahmadi felt that we should not sacrifice quality for the sake of increasing area. He felt that considering the resources available the Gezira scheme should not plan for more area under seed production. He advocated more caution. He showed concern for the off types found in hybrid sorghum fields. He informed that the breeding section will pursue studies on this problem during the next season.

Dr. Rosenow told that he was impressed with the work done during this season. He thought that there may not be easy answers to various problems confronted this season. He pleaded for more caution inview of the outcross problems. Increasing the number of pollinator rows and differential application of irrigation water may reduce the problem of nicking.

Dr. Gebisa took note of the various points raised by the earlier speakers. He commented as follows:

There is not real nicking problem. According to him it was mainly a management problem. There is no variation in male parent which can be exploited by further selection.

Most of the off types observed in hybrid were with cultivated sorghum mainly Dwarf White Milo.

The enthusiasm exhibited by all involved in the programme was commendable. It was an achievement to grow seed with a large number of tenants who had no previous experience.

The isolation obtained was amazing.

The roguing operation done was quite impressive.

Though the demonstration programme was arranged on a big scale, not much benefit was achieved because these were not properly exploited as extensive tools.

The contract agreement with the farmers for seed procurement etc. should be carefully prepared.

There is need to ensure that seed from the rejected fields is not sold to farmers as this will bring the hybrids into disrepute.

There is need to conduct experiments, particularly on planting date, planting ratio, pest and disease reaction, herbicide treatment etc.

The committee should take steps to encourage private seed growers. If all public corporations got involved in seed production, it may discourage private seed growers as there will be very limited market potential available for them.

In the end, Dr. Gebisa thanked all those who contributed in this successful venture.

Dr. Omer informed about the contract agreement which was prepared in consultation with the tenants. Some incentives were given to attract the farmers as this was the first year.

He informed that the farmers were quite impressed with the performance of hybrids inspite of off types etc. observed. He said field days will be arranged to make full use of the demonstration. He pleaded for more participation of the private sector. The private sector has to take initiative in this.

Dr. Ahmed summarized the various points raised in the meeting. He thanked Dr. Gebisa, Mr. McDonald and Dr. Rosenow for their contribution in the programme.

All members joined him in his appreciation for the services rendered by Mr. McDonald.

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NATIONAL SEED ADMINISTRATION
MINISTRY OF AGRICULTURE
KHARTOUM.

No.: FN9/2/1(49A)/SUD/038/SUD 12th November, 1984.

Copy forwarded to .....
for information and necessary action.

Ahmed Abu El Gasim,
Director General.

ANNEX 4

Democratic Republic of the Sudan

Ministry of Agriculture & Irrigation

PILOT PROJECT FOR HYBRID SORGHUM SEED PRODUCTION, DISTRIBUTION AND UTILIZATION

A PROPOSAL

November, 1983

I. BACKGROUND & JUSTIFICATION

A. Introduction

Sorghum (Sorghum bicolor) is the most important grain crop in the Sudanese economy and diet. It ranks first both in total tonnage of grain produced and total area cultivated, with over 1/3 of the total crop land in the country devoted to sorghum. Every year some 75% of the total cereal production in the Sudan is generated from sorghum. Currently, the total area under sorghum is over 3 million hectares and over 2.5 million metric tons of sorghum grain is produced; whereas the total production from all other cereals (millet, wheat, rice and maize) is less than one million tons.

Sorghum is produced in all provinces of the country, from the arid region of the North to the high rainfall climate of Southern region. However, the bulk of the crop is grown mainly in the Central Clay Plains which include the provinces of Kassala, Gezira, Blue Nile and Southern Kordofan accounting for over 65% of the total sorghum production in the country. Over 90% of the total sorghum acreage is under rains and about half of that is mechanized.

B. Status of Sorghum Research in the Sudan

Sorghum improvement program in the Sudan is many years old. The Gezira Research Farm at Wad Medani was established in 1918 and although very little effort was spent on crops other than cotton, some attention was given to sorghum research owing to its role in the rotation of the cotton growing schemes in the nation. Most of the sorghum research activities in those early

days included collection and evaluation of local sorghum germplasm and by the 1930's, some introduction of exotic sorghums had started.

A full fledged sorghum improvement program came into existence in 1952 with the establishment of the Central Rainland Research Station at Tozi. The national responsibility to undertake research on all aspects of sorghum improvement was delegated to this station and later on moved to Kenana Research Station at Abu Naama. Today a good multidisciplinary sorghum improvement program has developed at the Gezira Research Station in Wad Medani.

One thing that appeared to have been very evident through the work of several scientists at Tozi and Abu Naama was that the traditional local varieties were too late, too tall, physiologically inefficient and unadaptable to the ever increasing mechanized farming. It was also reported that exotic introduction brought in at that time were not immediately adaptable. Hence selection within local types for dwarf, early maturing, combine types was initiated by Walton and pursued by Tahir and then by M. A. Mahmoud.

The series of selection efforts in local sorghum types resulted in the isolation of such popular name varieties as Tozi Umbenins, Feterita Maatuk, Mugbash, Bahana, Dwarf White Milo, Gadam El Hamam, Dabar, and Karkatib. A number of these elite varieties from the sorghum research are now in farmers' hands in the Central Clay Plains. It was soon realized, however, that most of these improved local types, while physiologically efficient, and well adapted to conditions intended for, possessed poor grain quality. This prompted change in orientation of the sorghum improvement program

and emphasis was put instead on hybridization mainly among local selections.

At about the same time in the 1960's, some activity on hybrid sorghum program was also initiated. Nevertheless, only a limited success was possible from both the diversification and the planned hybrid program as this demanded more of the scarce resources - more attention of senior staff whose responsibilities included several other crops, technical personnel who were totally lacking, funds and facilities.

Breeding program on sorghum hybrids was later reinitiated in the early 1970's initially with ALAD and received the full attention and the continuity it needed with the advent of the ICRISAT-Sudan Cooperative Program for Sorghum and Millet improvement in 1977.

Today the hybrid sorghum improvement activity at the Gezira Research Station is a full-fledged program. In the last four seasons (1979-1982) over 3000 experimental hybrids have been synthesized, evaluated both under irrigated and rainfed conditions. This has led to the identification of three elite hybrids with a combined mean average of 50% over open pollinated local varieties in a total of 21 yield trials over four crop seasons. Experimental seed production on these three elite hybrids conducted, each on a one acre area, during the 1982 crop season indicated that two of the experimental hybrids were easily produceable. These results from four years of yield trials data and the experimental seed production testing were presented to the Sudan Plant Propagation and Variety Release Committee earlier this year. On the basis of this document, the Committee at its 24 January 1983 meeting officially

released one experimental hybrid (EEH-3) as the first commercial sorghum hybrid in the Sudan and renamed it in Arabic "Hageen-Durra-1" (Sorghum Hybrid No.1). The released hybrid is high yielding, early maturing, easily produceable and possesses bold yellow grains. It gave an average yield of 5189 Kg/ha or 158% of the local under irrigation and 2968 Kg/ha or 152% of the local under rainfed conditions.

C. Potential of Commerical Hybrid Sorghum in the Sudan

The potential for commercial sorghum hybrid production in the Sudan is very good and will perhaps be a natural development. For several years now, the national sorghum improvement program undertook intensive selection for short combine types within the otherwise good local varieties to meet the demands of the rapidly expanding large mechanized farms. These large mechanized farms are owned by farmers who are profit oriented and who understand the economics of the farm business fairly well. Such farmers could easily be convinced to pay more for good quality hybrid seed. In the Central Clay Plains which essentially constitute the sorghum belt of the Sudan, sorghum production has been mechanized and the farm size very big that short combinable types have been on good demand. Even in the irrigated sector, particularly in the Gezira, where optimum conditions could be provided, the current yield levels of sorghum are woefully low. The use of good quality seed will substantially increase yields and also promote the use of a package of cultural practices. In much of the rain lands seasonal precipitation is usually unpredictable and unreliable that in some years yield reductions and even total crop failures do occur. It is

believed that superior hybrids identified under local conditions will have a rapid influence in increasing and stabilizing yield levels in the rain lands. In general, F_1 sorghum hybrids, with their vigorous early growth, fast rate of growth, and ability to efficiently utilize limited moisture, produce higher yield under stress conditions than do varieties. In most of the major sorghum producing countries, introduction of hybrids has revolutionized agriculture. Judging from the performance of the released hybrid, it holds similar promise in Sudan.

D. Sudan Seed Project

Currently a reorganized National Seed Administration (NSA) exists under the Under Secretary for Agricultural Services within the Ministry of Agriculture and Irrigation. The new project is financed by the African Development Bank (ADB) and African Development Fund (ADF) and includes a technical assistance component executed by FAO.

Under its present structure the NSA comprises of Plant Propagation Administration (PPA) and Seed Certification Administration (SCA). The PPA is the unit that is given the responsibility of producing all basic varietal seed and of certified seed required by private farmers. The SCA with its field inspectorate and a seed testing laboratory at Sennar is charged with the responsibility of preserving identity and ensuring good quality seed.

The Sudan Seed Project, however, does not include hybrid seed production and distribution and in its present form at least does not have provision for a hybrid seed industry composed of independent growers, producers, processors and distributors including the private sector. With the recent release of the first commercial

sorghum hybrid in the country, however, it is highly imperative that a systematic arrangement be developed soon for the production and marketing of hybrid sorghum in the Sudan. It is anticipated that this first commercial sorghum hybrid will help generate a concept of seed as different from grain and thus preclude the necessity of any kind of subsidy on seed. In addition, the production and marketing of hybrid seed has different requirements than for varieties; as farmers must purchase seed on an annual basis; the volume of seed required increases so that private commercial interests are encouraged.

II. THE PROJECT

A. Title: Pilot Project for Hybrid Sorghum Seed Production, Distribution and Utilization.

B. Objectives:

1. To organize scheduled production of different categories of seed (breeder, foundation and certified) by both the public and private sectors.
2. To undertake an aggressive extension and demonstrate program on the use of sorghum hybrids.
3. To capitalize on the concept of hybrid sorghum seed in promoting the use of improved seeds in general.
4. To utilize the hybrid seed program as a vehicle for promoting better management practices for sorghum production.
5. To train technical staff from both the public and private sectors in various aspects of the seed program (production, processing, certification and distribution).
6. To arrange a study tour of the seed industry, for a relevant

team of Sudanese representing the Ministry of Agriculture, the NSA, (PPA and SCA), the Agricultural Research Corporation (ARC) and seed producers, in countries where it is now functional.

7. To develop plans, based on experience gained during the Pilot Project, for the establishment of a Sudan Hybrid Sorghum Industry Involving both the public and private sectors.

C. Project Organization

1. Participating Organizations.

The government units participating in the project are:

(a) The National Seed Administration (NSA). NSA will provide leadership to the project. NSA will also be responsible for production of foundation seed, seed testing, processing and certification and would provide technical assistance to SGB, MFC and private companies in seed production. The principle of the separation of production and quality control should be clearly implemented resulting in an autonomous independent quality control organization.

(b) Agricultural Research Corporation (ARC). ARC will provide NSA and other foundation seed producers with breeder's seed and will assist in technical matters related to production and certification.

(c) Sudan Gezira Board (SGB). SGB will assume the responsibility of producing certified seed to be marketed within, and if possible, outside of the Gezira. SGB will also plan and execute programs to promote utilization of the hybrid, particularly by their tenants.

(d) Mechanized Farming Corporation (MFC). MFC will take the

responsibilities of producing certified seed and promoting hybrid seed utilization by sorghum growers in the rainfed mechanized areas.

(e) Private Seed Industry. The seed industry should be encouraged in all aspects of seed production, processing, and marketing which also will promote utilization of hybrid seed.

2. The Project Leader.

A senior member of the NSA has been designated to be the leader of the Pilot Project and participate on the Advisory Committee. He will be stationed at Wad Medani to work in close association with ARC, SGB, and other interested parties.

3. Project Advisory Committee:

To coordinate activities and facilitate communication between the different units and to assist the project leader in handling technical and administrative matters, an advisory committee of representatives from the participating administrations has been formed as follows:

1) Director General (NSA) - Committee Chairman
2) Project Leader
3) Counterpart Project Leader
4) Agricultural Manager, Sudan Gezira Board
5) Agronomist, Mechanized Farming Corporation
6) Head, Plant Breeding Section, Gezira Research Station
7) Sorghum Breeder, Gezira Research Station
8) Seed Project Coordinator
9) One or two private entrepreneurs (yet to be appointed)

4. Counterpart project leader, and short term consultants. Although national specialists in individual pertinent fields of knowledge are available, expertise in planning, executing and evaluating comprehensive programs for production, quality control, and marketing of seed of hybrid varieties is lacking. The services of an expatriate counterpart, for the life of the project, with experience and knowledge from a country with an established seed industry, as a participant in this project, could valuably interact as questions and problems arise. He could also assist in providing a continuity of activity and in the identification of consultants making their contribution more effective.

D. Hybrid Sorghum Seed Production, Processing, Certification and Distribution.

A provisional schedule of seed production for the various categories is depicted in Table 2.

1. Production.

(a) Breeder seed.

The responsibility of continually providing nucleus seed of parental lines (A, B & R) for released hybrids is generally the responsibility of plant breeders of the developing agency - in this instance the Gezira Research Station (GRS), Agricultural Research Corporation. Enough breeder seed should be made available to supply the needs of all foundation seed producers approved by the advisory committee of the Pilot Project. Adequate quantities of seed should be produced for two or more years and held in good storage conditions. This will protect the availability of breeders seed in the event of crop failure.

(b) Foundation seed.

The availability of adequate amounts of good quality foundation seed must be insured in support of commercial production. The production of foundation seed is initially the responsibility of the National Seed Administration but private producers should also be encouraged to produce as required.

2. Processing.

Under the new investment project (Sudan Seed Project) credit will be extended to seed producing agencies for the procurement of seed processing equipment. Therefore, all seed produced by the agencies including the PPA will be processed directly by the producers. In addition, the NSA will assist private growers with processing of their seed during the project period on an equal opportunity basis. The establishment of processing plants for the private sector including the importation of equipment should be encouraged.

3. Quality Control.

The Seed Certification Administration has the responsibility of operating a certification program and seed quality laboratory to encourage the production of good quality seed by the corporations as well as the PPA and private producers.

4. Marketing and Distribution.

Breeder seed will be supplied by the ARC to the Plant Propagation Administration on a continual basis. Foundation seed will be made available to all growers of certified seed at a premium price. There should not be any subsidy element for

foundation seed marketing and distribution. Certified hybrid seed produced by the corporations will be marketed to their respective tenants and others according to a pricing policy covering production, processing, and marketing costs and including a margin of profit. It is anticipated that the NSA will concentrate its efforts on the production, processing, and marketing of foundation seed. Private producers will be encouraged to develop their brand names and sell certified seed grown on their farm or farms organized by them at the price of hybrid sorghum seed competitive in the market.

E. Extension and Demonstration

Although production of good quality seed will be a major activity, yet success of the project will basically depend on farmer's acceptance of the hybrid. Prospective growers need to be educated and informed about the hybrid. A carefully organized program employing appropriate and effective information and educational techniques to positively influence farmers perceptions about the attributes of the new hybrid, will be launched. In addition to seed, recommended and sound management practices will be promoted. Well-managed, well-distributed demonstration plots will be the primary extension tool.

F. Training

It is planned to have short-term training opportunities available for technical assistants from the participating agencies both locally and abroad. A total of 7 technicians will be sent abroad, each for a period of 6 months, to obtain training in the areas of seed production and processing (6), and certification (1). In addition,

internal courses will be arranged at Wad Medani or Sennar on aspects of seed production, processing and certification.

III. BUDGET

A. Estimation

While establishing this pilot project a projection was developed for the production of breeder, foundation, and commercial seed (Table 2). The various public and private inputs into these projections have been estimated. This level of production is considered adequate to enable the pilot project to contribute toward the various organizations taking up defined activities. It also provides resources for study tour and training. Already, hybrid sorghum seed is being produced using the producers resources, a development that is expected to expand and that should be encouraged during the project period. Money provided by the donor(s) of this project should be kept separately identified by the various participating agencies only in support of this project.

B. Personnel

A counterpart project leader knowledgeable and experienced in seed industry development is to be hired. The services of a consultant during each year of the life of the Pilot Project for a period of about 13 man months is to be sought. In addition, allowance has been made for overtime of support staff and per diem expenses for all members involved in the Pilot Project.

C. Training

Budget has been allocated for training of a total of 7 technicians abroad, as well as organizing local training programs for about 60 other technicians in the areas of hybrid seed production, processing,

quality control and certification.

D. Equipment

Provision has been made for the purchase of 3 vehicles for use by NSA, SGB, MFC and ARC staff involved in the Pilot Project.

E. Operational Inputs

Budget estimation for labour includes support for MFC, SGB, NSA, and ARC according to size of area of production tentatively scheduled. Provision has also been made for fuel (600 gallons per vehicle per year), oil, lubricants and spare parts for project vehicles. The use of nitrogen fertilizer at the rate 2N (80 kgN/ha) as well as recommended herbicide (sorghoprim) has been advised and budgeted. Allowance has also been made for purchase of materials for effective extension support as well as packaging materials. Provision has also been made for the transport and processing of all categories of seed from the production sites to the processing plants and stores, including the cost of labor and seed dressing material required. Contingencies to cater for insecticides, hand tools, stationary, etc. were also budgeted for in this proposal.

ANNEX 5

HYBRID SORGHUM SEED WORKSHOP

5-8 November, 1983

Wad Medani, Sudan

RECOMMENDATIONS

I. PRODUCTION AND PROCESSING

A. The Pilot Project for hybrid sorghum seed production, distribution, and utilization was discussed and modified.

B. The interest expressed during the meeting for involvement of private individuals in the production of seed was good. It is recommended that a meeting of interested individuals be called in the next few weeks so that they can learn from the production on the Gezira this season. Foundation seed to plant 2-15 feddans should be made available to interested individuals to enable them to gain experience in seed production.

C. The sorghum breeder(s) of the Agricultural Research Corporation (ARC) in addition to the maintenance of breeders seeds, should be associated with the production of foundation seed. If possible, arrangements should be made with the Sudan Gezira Board (SGB), NSA, MFC or others to produce foundation seed in close liaison with ARC staff.

D. It is suggested that a Sudanese study team be organized to visit various aspects of the seed industry in other countries in August - September of 1984 when their crops are in the field. Members of this team should include individuals from the Ministry of Agriculture, National Seed Administration (NSA), Plant Propagation

Administration (PPA), Seed Certification Administration (SCA), Agricultural Research Corporation (ARC), Extension Services, and seed producers to a limit of 10 people. The team might travel to India and the U.S.A. to visit seed companies, quality control laboratories, certification and seed law enforcement agencies, public and private research programs, extension services, training activities, and seed trade associations.

E. It is recommended that the hybrid be used as a vehicle to encourage better management practices.

II. QUALITY CONTROL

A. It is recommended that use of certified seed of all classes involved in hybrid seed production be encouraged to insure purity, trueness-to-type, and high quality. In time, farmers will purchase seed from producers in whom they have confidence.

B. It is recommended that the "Texas Seed Certification Standards" be adopted as a functional guide in establishing standards in the Sudan for the production of each class of seed (breeder, foundation, and certified) related to the production of hybrid seed.

C. Isolation requirements need to be arranged with neighboring farmers so that the specified standards are maintained. Fallow land (where weed sorghum may be growing) around the production field must be handled as crop land for isolation purposes. Where possible, isolation in time can be achieved by sowing so that the crops in the seed field and in surrounding farmers fields flower at different times.

D. Weedy-wild sorghum, known as "Adar", is a serious problem and difficult to control. It is recommended that crop rotation

herbicide application and other agronomic practices be specified in the certification standards.

E. We recommend the acceptance of the Tatwawadi (1979) report on seed labelling that permits 0.2 percent weed seed; however, it is urged that 0.01 percent or less seed of "Adar" be permitted in certified seed of hybrid sorghum.

F. It is highly recommended that 'grow-out tests' of each lot of breeder, foundation, and certified seed, should be made to check quality prior to sale.

G. We recommend that samples of the 1983 production of each lot of seed from each 5 feddan production field of AXR, AXB, R and B lines should be grown out in the 'Off season' to test purity and to demonstrate the results of contamination even as an educational activity.

H. We recommend that all 'planting seed' of sorghum be treated/dressed with appropriate fungicides and/or insecticides at least as recommended by competent authority.

I. We recommend that due to the urgency of next year's production that an outside consultant in hybrid sorghum seed production by hired to come to the Sudan to train production technicians in the science and technology of hybrid seed production, i.e. planting, rogueing, nicking, harvesting, schedule of rogueing etc.

III. GOVERNMENT POLICY

A. We recommend that the National Seed Law, presently under consideration by the Central Government, should be finalized, enacted, and put into effect promptly.

B. Suitable regulations and guidelines for developing an effective

seed industry should then be promulgated by the Ministry of Agriculture and Irrigation.

C. The difference between seed and grain must be recognized allowing for unrestricted movement of seed in the country.

D. At present there are no laws or no official government policy which either encourage or discourage seed industry development. It would be useful to have an official policy which encourages such development, giving due regard to protecting the interests of both farmer/consumers and a legitimate seed industry.

E. This seed policy should cater for operation within Sudan of seed enterprises based outside the country on a competitive basis.

F. Quality control should be organizationally separate from production/marketing activities.

IV. EXTENSION

A. It is most important that an effective and widespread demonstration campaign be carried out in 1984 and following years. This campaign needs to be supported by adequate financing and staff. Leadership of this campaign should involve among others, research workers who are thoroughly familiar with characteristics and requirements of the new hybrid.

B. Special efforts need to be made to involve the Extension Services and Farmer's Unions in the demonstration activities.

C. An extension officer, with reponsibility on hybrid seed production, should be associated with the existing extension office at the Gezira Research Station.

D. The ARC should assist with the training of key extension personnel.

V. MARKETING

A. We recommend that immediate decision be made on the organization and policy for distributing seed of Hageen-Dura-1 produced in 1983.

B. Distribution of this seed should insure that a wide cross-section of the farming community is exposed to effective demonstrations.

C. The pricing policy should set the hybrid seed price initially at least 6 times the prevailing grain price. This is estimated to permit recovery of 1983 production, processing and marketing costs and provide some profit.

D. The extent of seed produced on the Gezira and its general availability and pricing should be determined to be in support of the growing interest in private seed production. It is suggested that they sell seed at a price which allows a fair return on the investment with adequate profit margin.

VI. FINANCING OF PILOT PROJECT

A. It is recommended that a brief description of this meeting be quickly written up and coupled with the participant's recommendations, the Pilot Project proposal, and a copy of the workshop program and be sent to donor agencies such as the following for their consideration of support.

1. Arab Funding Agencies
2. FAO (Food & Agriculture Organization)
3. GTZ (German Agency for Technical Cooperation)
4. IDRC (International Development Research Centre, Canada)
5. ODA (Overseas Development Agency, UK)
6. SIDA (Swedish International Development Agency)
7. The Swiss Development Agency

8. The Rockfeller Foundation

9. UNDP (United Nations Development Program)

10. USAID (United States Agency for International Development)

VII. COMMENTS

The Conference noted with appreciation that the Sudan Gezira Board undertook the production of 30 feddans of hybrid seed this year using their own resouces; and, that they are interested to greatly expand production next year. The Conference also appreciated that interested individuals are coming forward to produce the hybrid using their own resources.

Those at the Conference wish to express a deep sense of gratitude to the ARC for hosting the Workshop and to INTSORMIL for supporting it. They also wish to express thanks to the NSA and the SGB for the field visits.

ANNEX 6

HYBRID SORGHUM PRODUCTION IN THE SUDAN

STAND ESTABLISHMENT

Hybrid Sorghum Specialist Monthly Report

by

LYNN MCDONALD

September 1, 1984

INTRODUCTION

A recommendation of the Hybrid Sorghum Workshop held November 5-8, 1983, at the ARC in Wad Medani, was a need for the services of a Hybrid Sorghum Specialist. The services of the specialist would be needed for the entire crop season to assist in the development of planting plans, planting patterns, roguing techniques and assistance in harvesting and handling of the seeds produced.

Through agreements between the Government of Sudan, Ministry of Agriculture, National Seed Administration, FAO Seed Specialists, Gezira Research Station personnel, and USAID, approval of the Hybrid Sorghum specialist was made and financial arrangements agreed upon.

In May 1984, the name Lynn McDonald, was suggested to those asking for the services of a specialist by Dr. Gebisa Ejeta, Purdue University, Lafayette, Indiana, upon a recommendation from Dr. Darrell Rosenow, Texas A&M University Experiment Station, Lubbock, Texas. I accepted the appointment in June and was able to arrive in the Sudan on July 14, and began work in the Wad Medani on July 29, the day following the completion of the planting of the production fields.

Since my arrival, I have been privileged to travel with Dr. Omer Fadil and become acquainted with many aspects of life in the Sudan and observe the production fields as well as meet most persons involved in the Hybrid Sorghum Program.

List of individuals mentioned within the text of this report:

1. Dr. Ahmed Abu El Gasim, Director General, National Seed Administration, Khartoum.

2. Dr. Abdelmoneim El Ahmadi, Head, Plant Breeding Sector, ARC, Wad Medani.

3. Dr. M. S. Joshi, FAO Project Co-ordinator, Khartoum.

4. Dr. Omer Abdel Fadil, Project Leader, Seed Propagation Dept., SGB, Barakat.

5. Dr. S. K. Banerjee, FAO Seed Technologist, Sennar.

6. Dr. Abdel Latif El Nour, Sorghum Breeder, ARC, Wad Medani.

7. Mr. Ahmed El Bashir, Acting Manager Seed Propagation Dept., SGB, Barakat.

8. Mr. Eric Witt, Senior Agricultural Development Officer, USAID, Khartoum.

9. Dr. George Ghobrial, Agronomist, USAID, Khartoum.

STAND ESTABLISHMENT

Establishment of a good plant population is the most critical factor in the success of a crop production program. Uniform plant population and emergence provide for ease in handling the crop throughout the production cycle and provide each individual plant the same possibility of expressing its genetic composition without undue stress.

Planting of the 1984 hybrid crossing fields for production of "Hageen Dura 1" seed within the Central zone of the Gezira at the Seed Farm Block began on July 10 and was completed July 28. All plantings were made using a new, Stanhay precision belt planter with rows on top of prepared ridges.

Land preparation prior to planting was, in several places very poor and will be the most detrimental factor to final yields. Initially all land was disk plowed with a 14-disk oneway plow. Ridges with 80cm. centers were then prepared with no leveling of the disk cuts. Except for 115 feddans, all fields were pre-irrigated after which the ridges were split in a reridging operation. Ridges were poorly formed with no uniformity in height and very little emphasis on straightness. This non-uniformity and lack of parallelism created extreme difficulty in the planting operation, as the planter unit could not be driven such that the seeds were placed properly in the peak of the ridge.

Following planting, all fields were sprayed with the herbicide "Sorgapreme 50 WP" at a rate of .6 KG, AI per feddan. Each farmer applied ammonium nitrate fertilizer at the rate of 80 KG per feddan. Fertilizer application was by hand and therefore, distribution was not uniform.

Plant emergence was totally dependent upon the application of irrigation water irrespective of planting date. Some farmers applied water within 3 to 5 days after planting while others delayed application up to 10 to 14 days.

The early irrigated plots emerged relatively uniform and began to grow as expected with little need for reseeding. However, the later the irrigation water was applied, the less uniform the stand.

Very few seed were placed in adequate moisture at planting such that the seedlings were able to emerge and establish a root system before the soil dried. Many seeds were placed at planting in moisture sufficient to initiate germination, but the soil profile dried before the plants established a root system and the seedlings died. This problem was prevalent in many fields and was the major factor necessitating reseeding.

Following irrigation and seedling emergence, leaf yellowing and plant death was observed in every field. All plant deaths were observed to have occurred in low areas of the field where water was allowed to completely cover the seedrow. After consultation by all persons involved and Plant Protection personnel of ARC, it was concluded the deaths were the result of herbicide damage and in a few cases the result of improperly applied fertilizer. In most every case where water was allowed to cover the soil surface, the plants died while on adjacent ridges where the seeds had not been submerged, the plant health and stand was excellent. This plant death problem was the result of improper seedbed preparation and not from improperly applied herbicide. In an occasional strip through the field, the herbicide failed to be applied and the stand was very good irregardless of where the seedrow was or whether the seed had been submerged or not.

There were no plant response differences between the A-line and R-line seed rows. However, there needs to be a study initiated to determine the effects of the herbicide on the emerging seedlings that have been submerged with irrigation water and to determine if there is an accumulation of herbicide in the low areas by the moving water.

Reseeding was performed by farmers in almost all fields where there was a reduced plant population. Most of these reseedings were late and will not mature with the majority of the plants. There exists the possibility of a problem at harvest as a result of the multiple stages of plant maturity in each reseeded field. However, as all seeds will be hand harvested, the problem is not likely to be encountered at harvest.

A second field irrigation was required for germination of the reseeded areas. A similar seedling response to the herbicide problem was occasionally observed as the plants began to emerge where water

had been allowed to cover the seed. It would appear from this identical plant response that the herbicide had been moved and high concentrations developed in the low areas.

The present status of the crop indicates the seed production is going to be very favorable with a limited number of feddans currently being subject to rejection. Established stands as of the writing of this report are listed in Table I. All foundation seed plots were subjected to the above mentioned problems but with slightly better seedbed preparation. There was observed some seedling death due to the herbicide damage but no plots were reseeded.

As of September 1, plant stage of growth varies from two weeks post emergence to head differentiation. Roguing has begun in the more advanced fields for tall off-type plants. The anticipated major roguing problem will be removal of Sudan grass and Adar plants.

TABLE I. 1984 Plantings for the Production of "Hageen Dura-1", Hybrid Sorghum in the Sudan.

INSTITUTION, LOCATION	UNITS (Feddans)	CLASS	CROSS
ARC, Wad Medani	1	Breeder	A x B
	.2	Breeder	R-line
NSA, Sennar	5	Foundation	A x B
	60	Certified	A x R
SGB, Barakat	10	Foundation	A x B
	554	Certified	A x R
MFC, Gedaref	25	Certified	A x R
Rahad, FAO	5	Certified	A x R
PRIVATE INDUSTRY			
Khalil Farm Rahad	5	Certified	A x R
Agric. Gedaref	5	Certified	A x R
El Zubair Ibr. Rahad	5	Certified	A x R

TRAVELS FROM WAD MEDANI

During the first month in the Wad Medani area, travel to distant areas and non-local locations to observe the condition of the 1984 sorghum crop have been severely restricted due to the extreme shortage of fuel; however, four trips have been made.

SENNAR

On July 31, Dr. Omer Fadil and I visited the NSA Headquarters in Sennar and were met by Dr. Ahmed Gasim, Dr. M. S. Joshi, and Dr. S. K. Banerjee. We toured the certified seed production fields and observed that they were recently emerged and beginning to experience plant death in low areas from herbicide damage, similar to the situation encountered at Barakat. The developing plant population appeared very good and preliminary indications are for a good seed crop. We next traveled to the Sennar West location and toured the construction of a small grains processing plant being built by Austria. Afterwards, we saw the 30 feddans of certified production which was just emerging and still wet from irrigation.

KHARTOUM

August 8, Dr. A. M. B. Ahmadi, Dr. Abdel Latif, Dr. Omer Fadil, Mr. Ahmed Beshir, and myself attended the Hybrid Sorghum Advisory Committee meeting at the Ministry of Agriculture in Khartoum. The meeting was very informative and I feel the committee has an excellent understanding of the needs to develop the hybrid sorghum program and are progressing toward that goal in a very organized and timely manner.

RAHAD

August 12, Dr. Omer Fadil and I traveled to Rahad, to observe the 5 feddans of certified production. The four A-line rows were planted with a mechanized planter and the two rows of R-line were hand

planted. Following planting, the field was fast watered during which the ridges were not completely wet. The A-line emerged to an acceptable uniform stand, but the R-line stand was extremely poor and not sufficient to provide pollen for seedset. The poor R-line stand resulted from the seed being planted high on the ridge and with the light rapid irrigation, there was insufficient moisture to establish an adequate stand. The A-line was able to establish a good plant population because the use of the mechanical planter had lowered the ridge height enough that the water was able to remain in the area of root development long enough for roots to become established.

Planted in the field adjacent to the Rahad certified production was the 5 feddans being produced by Khalil Co. and another 5 feddans being produced by El Zubair Ibr., representing Pioneer Seed Co. Seeds for the production by Pioneer Seed Co. were provided by Dr. George Ghobrial, USAID. Both the A-line and R-line plant populations were very good and of the same age as the plants within the Rahad Production field. The R-line could possibly provide a pollen source for the Rahad A-line and thus improve the seedset along that side where the fields are adjacent.

HYBRID PRODUCTION

A tour to observe several fields of Hageen Dura-1, was made on August 19, when Mr. Eric Witt and Dr. George Ghobrial visited the Hybrid Production program at Wad Medani. Fields observed were very uniform with an occasional tall off-type plant. All fields had been hand-planted and spacing between hills was approximately twice that for optimum yield. Spacing was that normally used for sorghum, so an accurate performance comparison between "Hageen Dura-1" and traditional varieties under traditional cultural practices should be obtained. All farmers were very pleased with performance of the hybrid with preliminary indications of acceptance and continued use.

ANNEX 7

Ministry of Agriculture
HYBRID SORGHUM SEED PROJECT
P.O. Box 258 Tel.71774
Khartoum

CONTRACT FOR HYBRID SORGHUM SEED PRODUCTION

On (day)_____ (Month)_____ 1984, the following contract is set between Sudan Gezira Board as a first partner and (Tennant) _____ as a second partner. It is agreed that the second partner will produce certified seed of hybrid sorghum "Hageen Durra 1" on his tennace No._____, Block_____, Canal_____, consisting of_____ feddans according to the following conditions.

A. The first partner will:
   1. Provide technical supervision of all agricultural operations.
   2. Provide the second partner with seed, fertilizer, and herbicide free of charge.
   3. Perform the following operations at the expense of the second partner:
      a. Land preparation, i.e. plowing and ridging.
      b. Spray the crop against insects as required.
      c. Provide harvest sacks.
      d. Threshing of the female crop.
   4.4. Buy the female crop (male-sterile) seed produced by the second partner at twice the farm gate price during harvest time on condition that the crop meets the certification standards for that category of seed.
   5. Receive the crop in the field and transport it to the stores at his expense.

B. The second partner will:
   1. Separate the sorghum plots from the groundnut production so that the sorghum plots will be grown in a separate number of approximately 90 feddans.
   2. Not use any seeds from other sources for the purpose of resowing. Only seeds given to him by the Seed Production Department will be used for resowing.
   3. Plant 4 female rows and 2 male rows and prepare his plot for irrigation, i.e. dividing the plot into irrigation units, opening and clearance of ditches.

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Khartoum

4. Provide overall crop husbandry practices, i.e. irrigation, thinning, weeding, roguing and protection from animals and birds.
5. Cut the male crop and remove the produce from the field. Then cut the female crop and prepare it for threshing.
6. Turn over all the female crop (male-sterile) seed to the first partner according to the price indicated in item A-4 and take the male crop for his own use.
7. Follow all instructions given by the technical staff representing the first partner.

C. General rules:

1. The items of this contract will be valid for one season starting on _____ _____ _____.
2. This agreement should be strictly observed by both partners.
3. If the second partner breaks any of the above indicated conditions, the first partner then has the right to hire someone to carry out the required work and charge the second partner.

_____ _____

(Sudan Gezira Board) (Title)

_____

(Tennant)

_____

(Witness)

_____

(Witness)

_____

(Witness)

ANNEX 8

FIELD INSPECTION MANUAL FOR THE SUDAN

(With minimum Seed Certification Standards)

By

Prof. G. R. Tatwawadi
FAO Consultant

March, 1979

Updated by

Dr. S. K. Banerjee
FAO Expert

December, 1983

MINIMUM SEED CERTIFICATION STANDARDS FOR SORGHUM HYBRID (COMMERCIAL)

I. Application and amplification of general seed certification standards:

A. One class of seed-only the class "Certified" is recognized under the hybrid sorghum (commercial) standards.

B. A certified hybrid sorghum (commercial) is one to be planted for any use except seed.

C. Hybrid sorghums (commercial) planting seed, to be certified must be produced from foundation or certified seed stocks approved by the SCA, meeting the requirements of the specific standards of Male sterile seed stock and the specific standards for pollinator line (A and R).

D. The pollinator for the production of a hybrid sorghum (commercial) must originate from seed stock which is designated specifically for use as a pollinator of the hybrid.

II. Land Requirements

Hybrid sorghum (commercial) will not be eligible for certification if grown on land which grew any other cultivated sorghum, including sudangrass and broomcorn the previous year. Exceptions may be made upon written requests to permit the planting of a seed field of a commercial hybrid on land which was planted the previous year to the pollinator of the particular hybrid, provided that the pollinator seed crop grown on the previous year passed the field standards for certification. It is required that all fields planted in a particular open pollinated sorghum of the same variety that is to be used as a pollinator in the production of a hybrid on the same land the following season must be inspected by an approved inspector of the SCA.

III. Handling the crop prior to inspection

A. Application for inspection

1. All applications for inspection of hybrid sorghum (commercial) areas must be filed with the Director SCA at least 30 days after the planting of the crop.

2. Area supervisors must be notified during the early boot stage.

IV. Field Inspection

A. At least three official inspections must be made prior to harvest.

1. At least two field inspections must be made during bloom.

2. A final inspection must be made before harvest after the seed begins to assume mature color.

3. All sorghum hybrid (commercial) seed must be test planted (varietal purity grow-out test). Such test must be conducted under the supervision of the SCA.

V. Field Standards

A. General requirements

1. Unit of certification

The entire area in an isolated seed production plot or in a given seed production field must be eligible and must be inspected.

2. Isolation

a. Combine grain type: for the production of certified seed of hybrid sorghum (commercial) the seed parent shall not be less than (i) 660 feet from any combine grain type sorghum of the same genetic height as the hybrid; (ii) 1,800 feet from sorghum types with the same chromosome number (other than broomcorn and grass types) but with a different genetic constitution for height; (iii) 2,500 feet from broomcorn or grass type sorghum with the same chromosome number.

b. Forage or grass type: for the production of certified seed of forage or grass type hybrids (commercial) the seed parent shall not be less than 660 feet from any other sorghum with the same chromosome number.

c. Modification of isolation requirements: (i) The modification of isolation distances by the planting of additional pollinator rows shall be allowed only in cases in which the contaminating pollen is from plants that do not differ greatly in color, maturity, height, type, or any other important characteristics from the hybrid being produced. Modifications from the standard isolation distance of 660 feet down to a minimum of 330 feet is permitted in such

cases when two additional border rows of the pollinator are planted for each 66 feet of reduction in isolation distance. The requirements for additional pollinator rows apply to all sides of the seed field exposed to the contaminating pollen whether located directly opposite or diagonally from the contaminating field: (to be considered a pollinator row, the pollinator line must be producing pollen during the entire time five percent or more of the female flowers are receptive); (ii) differential blooming dates are permitted for modifying isolation distances provided that the sum of the percentages of plants in bloom in the seed rows and in the contaminating field shall not exceed five percent when more than one percent of the plants in either field is in bloom. Roguing - as given on page

3. Harvesting

Precautions must be taken to insure that seed from the pollinator rows does not become mixed with the seed rows at time of harvesting.

B. Specific requirements (crossing field):

1. Both the seed parent and the pollinator shall be required to meet the following standards:

FACTOR	MAXIMUM PERMITTED AT ANY FIELD INSPECTION (%)	
Other crop:	Blooming	Final
1/ Other varieties (definite) of the same spp.	0.01 (1:10,000)	None
2/ Other varieties (doubtful) of the same species.	0.10 (1:1,000)	None
Species of the genus Sorghum with the same chromosome number not being used as the seed parent or pollinator.	None	None
Plant shedding pollen in seed row.	0.05 (1:2,000)	None
3/ Objectionable weeds chemically controllable seed borne disease	None	None

1/ Other varieties (definite) of the same species shall be considered to include off-type plants that can be differentiated from the variety that is being inspected but not plants of the seed row line that are shedding pollen.

2/ Other varieties (doubtful) of the same species shall be considered to include plants that cannot be definitely differentiated from the variety that is being inspected.

3/ Johnson grass in bloom when seed rows are receptive and field beindweed and Johnson grass at final inspection if they have developed seed.

VI. Seed Standards

FACTOR	STANDARD (%)
Pure seed (minimum)	98.50
1/ Inert matter (maximum)	1.50
2/ Weed seeds (maximum)	0.05
3/ Noxious weed seeds (maximum)	0.01
Other crop seeds:	
4/ Other kinds (maximum) except other species of the genus sorghum	0.01
5/ Other varieties (maximum) of the genus Sorghum species	0.04
Germination (minimum)	80
Moisture (maximum)	12

1/ Inert matter shall not include more than 0.50% materials other than seed fragments of the variety under consideration.

2/ Weed seeds shall not exceed 12 per pound.

3/ Refers to the seeds listed in Fig. 1.

4/ Other kinds except other species of the genus Sorghum shall not exceed 2 per pound.

5/ Other varieties of the genus Sorghum species shall not exceed 10 per pound.

VII. Varietal purity grow-out test standard: Maximum objectionable Sorghum plants permitted in grain type hybrids -

Grass type:		
Rhizomatous outcross plants, broomcorn origin plants, and/or vigorous and/or tillering plants.	0.05%	(1:2,000)
Non-rhizomatous, single stemmed (non-tillering) plants of the same genetic height as the hybrid including mutation heights.	0.10%	(1:1,000)
Hegari types	0.08%	(1:1,250)
Other forage types	0.10%	(1:1,000)
Combination of above three	0.10%	(1:1,000)
Off-type heads of the same genetic height plants: off-types and/or slightly off-colored heads.	5.0%	(50:1,000)
Opposite colored heads	2.0%	(20:1,000)
Combination of above two	5.0%	(50:1,000)

MINIMUM SEED CERTIFICATION STANDARDS FOR MALE STERILE SEED STOCK OF HYBRID SORGHUM

I. Application and amplification of general seed certification standard:

A. Two classes of seed - foundation and certified are recognized under the male-sterile seed stock standards:

1. Foundation - foundation seed must be produced under the direct supervision of SCA tracing back to acceptable sources.

2. Certified - certified seed must be the immediate progeny of the foundation seed.

B. A male-sterile seed stock is one to be planted for use as a seed parent in the production of hybrid sorghum seed.

II. Land requirements - Male-sterile seed stocks will not be eligible for certification if grown on land which grew any cultivated species of the genus Sorghum the previous year. An exception may be made upon approval of SCA when the preceeding crop grown was one or both of the parents of the male-sterile seed stock to be produced.

III. Handling the crop prior to inspection: All applications for inspection of male-sterile stock areas must be filed with the Director SCA within 30 days after the planting of the crop. Area supervisor must be notified during early boot stage.

IV. Field inspection: At least three official inspections must be made prior to harvest.

A. At least two field inspections must be made during bloom.

B. A final field inspection must be made before harvest after the seed begins to assume mature color.

C. All male-sterile seed stock must be test planted under the supervision of SCA.

V. Field standards:

A. General requirements

1. Unit of certification -

(a) The entire area in an isolated seed production plot or in a given seed production field must be eligible and must be inspected.

(b) At least eight pollinator rows (or 132 feet) plus the designated isolation distance are required all around the

field (to be considered a pollinator row, the pollinator line must be producing pollen during the entire time five percent or more of the female flowers are receptive).

(c) The pollinator for the production of a male-sterile seed stock originates from seed stocks which are designated specifically for the use as a pollinator of the male-sterile seed stock and must not be more than two generations removed from stocks in which plants were individually checked for their ability to maintain high sterility.

2. Isolation -

(a) For the field production of certified seed of male-sterile seed stocks the seed parent shall not be less than 1,320 feet from all other sorghums of the same chromosome number. This isolation distance may be modified to a minimum of 990 feet by the addition of four rows of the pollinator line for each 66 feet of reduction in isolation distances. The requirement of additional pollinator rows applies to all sides of the field exposed to the contaminating field. No modifications of the minimum isolation of 1,320 feet is permitted when the contaminant is broomcorn or a grass-type sorghum with the same chromosome number as the seed being produced.

(b) Male-sterile seed stocks may be maintained and increased by hand-pollination without any requirement for isolation distance, subject to inspection for pollination techniques and other field and seed standards.

3. Roguing - Every field for which certification is requested shall show evidence of good management and shall show that reasonable precaution has been taken to control contamination by other kinds and varieties of crops and objectionable weeds, the seed of which are indistinguishable or inseparable with available cleaning equipment from seed of the particular crop being inspected. The constant roguing of chance varietal mixtures, other kinds of crop, weeds and noxious weed plants must be practiced throughout the season in the field. Crops suffering from poor cultural practices, lack of moisture or

general neglect, loss of stand and/or occurence of voluntary seedlings, may be rejected at the discretion of the inspector.

4. Harvesting - Precautions must be taken to insure that seed from the pollinator rows does not become mixed with the hybrid seed in the harvesting process.

B. Specific requirements: Both the seed parent and the pollinator shall be required to meet the following standards for both the foundation and certified seed classes:

FACTOR	MAXIMUM PERMITTED AT ANY INSPECTION (%)	
Other crops:	Blooming	Final
1/ Other varieties (definite) of the same species	0.005 (1:20,000)	None
2/ Other varieties (doubtful) of the same species	0.01 (1:10,000)	None
Species of the genus Sorghum of the same chromosome number not being used as the seed parent or pollinator	None	None
Plants sheeding pollen in seed row	0.025 (1:4,000)	None
3/ Objectionable weeds	None	None
Chemically controllable seed borne disease	None	None

1/ Other varieties (definite) of the same species shall be considered to include off-types, plants that can be differentiated from the variety that is being inspected, but not plants of the seed row line that are shedding pollen.

2/ Other varieties (doubtful) of the same species shall be considered to include plants that cannot be definitely differentiated from the variety that is being inspected.

3/ Johnson grass in bloom when seed rows are receptive and field bindweed and Johnson grass at final inspection if they have developed seed.

VI. Seed Standards:

FACTOR	STANDARDS FOR EACH CLASS (%) FOUNDATION	CERTIFIED
Pure seed (minimum)	98	98
Inert matter (maximum) 1/	2	2
Weed Seeds 2/	None	0.01
Other crop seed:		
Other kinds	None	None
Other varieties	None	None
Germination (minimum)	80	80
Moisture (maximum)	12	12

1/ Inert matter shall not include more than 0.50% of materials other than seed fragments of the variety under consideration.

2/ Refer to annexure 1 (page).

VII. Varietal purity grow-out standard: Maximum objectionable Sorghum plants permitted in the male-sterile stock:

A. Off-type plants other than the male-sterile counterpart shedders and mutations 0.066% (1:1,500)

B. Plants shedding pollen but otherwise indistinguishable from the male-sterile counterpart. 0.10% (1:1,000)

MINIMUM SEED CERTIFICATION STANDARDS FOR THE POLLINATOR LINES (B and R)
(HYBRID SORGHUM)

I. Application and amplification of general seed certification standard:

A. Two classes of seed - foundation and certified are recognized under the pollinator line standard:

1. Foundation - foundation seed must be produced under the supervision of the SCA tracing back to acceptable sources.

2. Certified - certified seed must be produced under the direct supervision of SCA and be the immediate progeny of foundation seed.

B. A pollinator line is one to be planted for use as a pollen parent in the production of male-sterile seed stocks or hybrid sorghum seed.

1. B-lines - are defined as maintainer pollinator lines for use in the production of male-sterile seed stocks.

2. R-lines - are defined as restorer pollinator lines used in the production of commercial hybrids.

II. Land requirements: Pollinator lines will not be eligible for certification if grown on land which grew any cultivated species of the genus Sorghum unless the preceeding crop was of the same line and was inspected and approved for the same certification classification or a higher classification.

III. Handling the crop prior to inspection: All applications for the inspection of pollinator line areas must be filed with the Director, SCA at least 30 days after the planting of the crop. Area supervisors must be notified during early boot stage.

IV. Field inspection: At least two official inspections must be made prior to harvest.

A. At least one field inspection must be made during bloom.

B. A final field inspection shall be made before harvest after the seed begins to assume mature color.

C. All the pollinator lines must be test planted (varietal purity grow-out test) by the SCA.

V. Field standards:

A. General requirements:

1. Unit of certification

(a) The entire area in an isolated seed production plot must be eligible and must be inspected.

(b) The parental stocks for the production of a pollinator line must originate from seed stocks which are designated specifically for use as a pollinator.

2. Isolation: For the production of certified seed of pollinator lines, the seed rows shall not be less than 990 feet from all other sorghums of the same chromosome number with the following exceptions:

(a) The minimum distance from the production of a combine grain type sorghum to broomcorn or grass type sorghum with the same chromosome number shall be 1,320 feet.

(b) A pollinator line may be increased beside a crossing field in which foundation or certified male-sterile seed stock is being produced or a commercial hybrid with the same pollinator is being produced provided that:

(1) The pollinator planted within 990 feet of the pollinator increase block is of an equal or higher class and quality and is so rogued as to meet the same standards as the pollinator line increase during the blooming period.

(2) The increase block of the pollinator line is separated from the nearest seed row in the crossing block by at least 30 feet or 10 pollinator rows and these pollinator rows are removed or destroyed before the increase block of the pollinator line is harvested.

(c) Pollinator lines may be maintained and increased by bagging heads during the pollinating period without any requirement for isolation distance but are subject to inspection for bagging technique and other field and seed standards.

3. Roguing - as given on page .

B. Specific requirements: Both the foundation and certified class shall be required to meet the following standards:

FACTOR	MAXIMUM PERMITTED AT ANY INSPECTION (%)	
	Blooming	Final
Other crop:		
1/ Other varieties (definite) of the same species	0.005 (1:20,000)	None
2/ Other varieties (doubtful) of the same species	0.01 (1:10,000)	None
Other species of the genus *Sorghum* with same chromosome number.	None	None
2/ Objectionable weeds	None	None
Chemically controllable seed borne disease	None	None

1/ Other varieties (definite) of the same species shall be considered to include off-type plants that can be differentiated from the variety that is being inspected.

2/ Other varieties (doubtful) of the same species shall be considered to include plants that cannot be definitely differentiated from the variety that is being inspected.

3/ Johnson grass in bloom when seed rows are receptive and field bindweed and Johnson grass at final inspection if they have developed seed.

VI. Seed Standards:

FACTOR	STANDARDS FOR EACH CLASS (%)	
	FOUNDATION	CERTIFIED
Pure seed (minimum)	98	98
Inert matter (maximum)	2	2
Weed seeds	None	None
Noxious weed seeds:		
Other kinds	None	None
Other varieties	None	None
Germination (minimum)	80	80
Moisture (maximum)	12	12

VII. Varietal purity grow-out test standard:

Off-type plants, other than mutations, allowable in the pollinator lines is limited to 0.066% (1:1,500).

Fig. 1 WEED SPECIES DESIGNATED AS OBJECTIONABLE IN SORGHUM

SCIENTIFIC NAME	COMMON NAME
Sorghum halepense (Chromosome no. 20)	Johnson grass
Sorghum Sudanense	Sudan grass
Sorghum aethiopiquum	Adar
Sorghum arundinaceum	Adar
Intercrosses between various Sorghum Spp.	Adar

ANNEX 9

HYBRID SORGHUM PRODUCTION IN THE SUDAN

ROGUING AND BLOOMING

Hybrid Sorghum Specialist Monthly Report

by

LYNN MCDONALD

October, 1984

INTRODUCTION

This report discusses the two most important phases in the production of quality hybrid sorghum seed - roguing and blooming.

Roguing is of major importance as it is the method by which objectionable plants and contaminating pollen sources are removed from within the seed rows. Synchrony of blooming of the two parent lines is very important as the appropriate pollen for fertilization has to be available at the time the male-sterile florets are receptive.

ROGUING

Roguing of the 1984 Hageen Dura-1 certified seed production fields began on 19 August, with initial emphasis on training of technicians to later serve as roguing crew leaders. Adequate roguing of the 554 feddans was an enormous undertaking for a first year project considering that only one person involved in the roguing process had ever worked with hybrid sorghum production. A few of the technicians had prior roguing experience from roguing of traditional sorghum varieties while working for the Gezira seed production program.

Initially, the major roguing emphasis was on the removal of obvious tall plants and other plants that were morphologically different from the average of the plants within rows. As the season progressed and plants began booting, heading, and flowering, the roguing crews were trained to readily identify plants that did not conform to the characteristics of the parent lines. All roguing personnel demonstrated an ability to identify off-type plants but did have some difficulty in readily spotting pollen shedding plants within the female rows.

Attempts were made to rogue each field weekly from initial roguing until the appearance of first bloom. At the onset of blooming, fields were rogued every other day except in those cases where the fields were being irrigated. During the blooming period, there was a major problem in coordinating roguing with irrigation schedules; however, most all fields were adequately rogued around irrigations.

The more than three week spread in time of emergence across the 554 feddans proved to be very accommodating to the roguing schedule. In progressing from the first planted to the last planted field, all roguing was accomplished with a crew of approximately 40 laborers. Had it not been for the spread in emergence, the total production could not have been properly rogued. Even with the time spread, there were several occasions in which timing of roguing was very tight.

Weather conditions this season were very favorable for roguing schedules. No days were missed because of rain.

Overall, roguing of the 1984 certified production fields was accomplished with a minimum of difficulties. Some observations and recommendations for considerabion in future years would include:

1. The Hybrid Sorghum Production Project Leader should have absolute and complete authority and control of all budget accounts. This would minimize any hassle in obtaining approval for necessary items and would allow him to plan ahead for his projected needs.
2. The project leader should be provided with one assistant, with a vehicle, that is responsible only to the project leader.
3. Farmers should be required to keep their fields clean and not be responsible for removing any plants from the planted rows except those obvious tall off-type plants.
4. All roguing should be performed by trained roguing crews.
5. At the onset of flowering, within each field, a given number of laborers should be assigned to a field and not be removed until after seed set. The number of laborers assigned to a field should be such that it would take no more than two days to completely rogue the entire field.
6. Emphasis must be placed on cooperation between the farmer, assistant project leader, and the canal supervisor for the coordination of roguing and irrigation.
7. There should be a trained technician for each 50 feddans and he be held responsible for keeping accurate records of each hawasha as to:
   a. Dates of roguing
   b. Dates of irrigation
   c. Predominant type of plants removed each roguing
   d. Date of heading of each parent line
   e. Date of first notice bloom of each parent line
   f. Date of 50% bloom of each parent line
   g. General comments about seed set, particularly the amount of sparce, early seed setting.

No amount of intense roguing can assure a set of pure seed from the two parents currently being used to produce Hageen Dura-1. At initial blooming of the female parent there is no R-line pollen. During this season, there have been many mornings in which there were strong

Southwest winds that could have carried pollen from distant fields. Also, there were observed numerous Sudan grass type plants there blooming that were no taller than the exerted male-sterile heads.

Roguing is only a method of removing obvious sources of contaminating pollen from within the fields and has no effect on wind carried pollen. In the Gezira area this wind carried pollen can be a major source of contamination, especially from "Adar" plants, and with the absence of R-line pollen there is a 100% chance for foreign pollen to fertilize receptive ovules, thus creating a built-in contamination factor.

A field inspection of the production fields was made by the crops inspection team from Sennar on 15-19 September. Summaries for each hawasha within three of the eight fields inspected are given in Tables 1,2, and 3. Off-type and shedding plants, as reported, are minimal with no more than 5 off-types per 1000 plants observed. At this field inspection, during blooming, the plants of major concern are those shedding pollen. Only four hawashas were observed to possess pollen shedding off-type plants. This exceptionally low number would indicate the roguing crews are doing a good job and that the sparce seeds being set are from sources outside the field especially in those fields where the R-line pollen is not available.

TABLE 1: Summary of first field inspection for certified Hageen Durra-1 seed production in field no. 3 for 1984.

BAET HAWAZHA	OFF-TYPE	SHEDDING	OBECTIONABLE WEED	DISEASED
1)				
I	5.0*	0.0*	9.0*	0.0*
II	1.6	0.0	35.0	0.0
2)				
I	4.0	0.0	19.0	0.0
II	2.0	0.0	11.6	0.0
3)				
I	0.3	0.0	5.6	0.0
II	2.0	0.3	3.0	0.0
4)				
I	0.0	0.0	0.6	0.0
II	0.3	0.0	2.3	0.0
5)				
I	0.2	0.0	0.04	0.0
II	0.1	0.0	0.2	0.0
6)				
I	6.0	0.0	20.6	0.0
II	0.4	0.05	0.2	0.0
7)				
I	3.0	0.0	0.3	0.0
II	3.0	0.0	3.0	0.0
8)				
I	3.0	0.3	6.0	0.0
II	0.08	0.05	0.04	0.0
9)				
I	0.3	0.0	49.0	0.0
II	0.6	0.0	47.0	0.0

* Plants per 1000 plants.

TABLE 3: Summary of first field inspection for certified Hageen Durra-1 seed production in field no. 11 for 1984.

BAET HAWAZHA	OFF-TYPE	SHEDDING	OBJECTIONABLE WEED	DISEASED
1)				
I	0.01*	0.0*	0.03*	0.0*
II	0.0	0.0	0.0	0.0
2)				
I	0.6	0.0	6.0	0.0
II	2.0	0.0	4.0	0.0
3)				
I	0.1	0.0	1.0	0.0
II	0.0	0.0	2.0	0.0
4)				
I	0.01	0.0	0.2	0.0
II	0.03	0.0	0.2	0.0
5)				
I	0.0	0.0	183.0	0.0
II	0.3	0.0	29.0	0.0
6)				
I	0.0	0.0	20.6	0.0
II	0.0	0.0	22.0	0.0

* Plants per 1000 plants.

TABLE 2: Summary of first field inspection for certified Hageen Durra-1 seed production in field no. 4 for 1984.

BAET HAWAZHA	OFF-TYPE	SHEDDING	OBJECTIONABLE WEED	DISEASED
1)				
I	0.2*	0.0*	2.8*	0.0*
II	1.6	0.0	1.8	0.0
2)				
I	0.3	0.0	7.0	0.0
II	0.0	0.0	15.0	0.0
3)				
I	0.3	0.0	49.0	0.0
II	0.0	0.0	44.0	0.0
4)				
I	0.0	0.0	0.0	0.0
II	0.0	0.0	0.3	0.0
5)				
I	1.6	0.0	15.0	0.0
II	1.0	0.0	21.0	0.0

* Plants per 1000 plants.

BLOOMING - NICKING

Synchrony of bloom between male and female lines is of major importance in the production of certified hybrid grain sorghum seed to obtain both maximum quantity and quality. For purity purposes, this synchrony is extremely critical in the Sudan where there is an abundance of wild sorghums.

Sorghum is a multipurpose crop and farmers are very reluctant to remove any plants and it is common to find sorghum plants scattered throughout cotton and groundnut fields. The sorghum plants are utilized by the farmers as a food by grinding the grain, leaves as fodder for livestock and the stalks for construction of shelter. Therefore, because of the farmers desire to produce as many sorghum plants as possible, this creates an abundance of pollen being produced throughout the area.

Results of previous production blocks and tests have shown the male parent (Karper 1597) to attain mid-bloom approximately 3-4 days later than the female parent (Texas A-623). With this knowledge and because of the existing cultural practices within the Gezira Seed Farm, it was decided that acceptable seed could be produced by planting both lines at the same time if fields were buffered on all sides with extra rows of the male parent.

Planting of the 1984 Hageen-Dura 1, certified production fields began on 10 July and was completed on 28 July. Planting pattern was 2 rows of male and 4 rows of female with 3-6 rows of male parent planted on each side of each hawasha. Farmers were given sufficient seed to plant a buffer zone at each end of his hawasha. Immediately after planting, each hawasha received 80 kg. ammonium nitrate per feddan, hand applied, and sprayed with the herbicide, "Sorgoprim 50WP", at 0.6 kg AI per feddan. Effective planting date was from 2 to 10 days following planting when the first irrigation was made and germination was initiated.

As with any crop, on any parcel of land there is variation and within each field this season, there was much variation resulting from:

1. Poor land preparation
2. Hand application of fertilizer

3. Lack of uniformity of irrigation
4. Differing intervals and number of irrigations
5. Time of weeding
6. Number of times weeding was performed
7. Number of farmers - from 6 to 25 per field

Even though all of these variations were present in each of the eight fields, ranging in size from 30 to 100 feddans, the pattern of blooming of the two lines was similar for all hawashas within a single field.

Development of all plants is not uniform and the total range of blooming of the male parent had not been observed in previous years. Observations of the 1983 certified production field of 30 feddans, indicated there was a 3-4 day difference in time to mid-bloom between the two parent lines. The planting of 554 feddans this season amplified the magnitude of differences in blooming with blooming differences between male and female lines ranging from 2 to 10 days. In all cases, the female parent bloomed first. Results of the blooming pattern this year produced a normal curve pattern of blooming with the mid-range being about 3-5 days difference. Two extremes were observed this year in two fields located approximately 5 kilometers apart with an effective planting date difference of 2 days. Field #23 was planted 10 July and irrigated 13 July. Field #14 was planted 13 July and irrigated 15 July. Both fields (particularly the first hawasha in each field) received the best possible care as both farmers were extremely interested in obtaining maximum yields. In field #23, the female parent was at mid-bloom on 16 September. Simultaneously, only an occasional boot could be seen in the male parent and not a single exposed head. The first pollen to be shed by any male was observed 10 days after mid-bloom of the female. This gap in blooming allowed for an exceptionally high risk to contamination from outside pollen sources. In field #14, the female parent was at mid-bloom on 18 September and the male parent at mid-bloom on 21 September. A difference of 3 days to mid-bloom. The only difference between the two fields was row orientation while cultural practices were as near identical as possible. Field #23 had East-West orientation while field #14 had North-South orientation.

In both fields the female parent attained mid-bloom in 63 days from effective planting date while in field #23 the male parent required 76 days to mid-bloom and in field #14 only 66 days were required.

Discussions, to date, have been numerous among all persons involved in this years production program and ARC personnel closely associated with the development of the hybrid in attempts to explain the bloom date variations. No single factor has thus far been identified while many have been proposed. It is the consensus of opinion of those associated with this years production that the explanation is in variations in environmental factors (soil and atmosphere) and genetic variability within the male parent. The many combinations of these factors across the entire 554 feddans was sufficient to allow the total array of responses to be expressed.

TRAVELS FROM WAD MEDANI

On 18 September, I accompanied Dr. George Ghobrial and Mr. Abdul Rahman Mohamed Hamid of USAID, Khartoum, on a 9 day trip to the Kadugli and El Obeid areas. The purpose of the trip was to observe research activities being conducted by WSARP, ARC and INTSORMIL scientists and to assess the performance of the sorghum hybrid, "Hageen Dura-1". Seeds of Hageen Dura-1 were provided to the research locations by Dr. Ghobrial and distributed to farmers by research agronomists at each location.

KADUGLI

All fields of Hageen Dura-1 observed in the Kadugli areas were similar in growth and performance and will be discussed as a whole rather than referencing each field separately.

On May 27, 1984, 120kgs. of Hageen Dura-1 seeds were received at the research station in Kadugli. Twenty-five farmers (Table 4) from surrounding villages were given approximately 2kgs. of seed each. An attempt was made by the local agronomists and his technicians to keep track of the seeds as to where they were planted; however, some farmers moved from the region without planting the seeds and during our trip into the area, we observed less than 20 farmer planted fields. The plantings observed were of various sizes, various hill spacing, different numbers of seeds per hill and in general, no two plantings were alike. All fields were planted during July, immediately after receiving sufficient moisture for planting. After planting, a dry period of two months duration caused severe stress to the developing plants with the multiple plants per hill and close spacing being the most severely stressed. One field was observed where there were only one or two plants per hill with one meter spacing between hills. All plants were in the soft dough stage of maturity and typical of what Hageen Dura-1 plants should look like. Heads were large, well filled and will give an excellent yield. This field was approximately 1/3 feddan in size. There were numerous off-type plants present which appeared to be crosses with adar and sudan grass. This was the only field observed during the

trip in which the plants were in good physiological condition and exhibited no signs of stress or disease problems. All other fields observed to have nutrient deficiencies. Where planted adjacent to the local varieties under the same cultural conditions, the Hageen Dura-1, in all cases, exhibited a yellowing condition indicating nutrient problems.

All farmers in the area were very concerned about the number of "Adar" plants that appeared in their fields where the Hageen Dura-1 was planted.

In numerous fertility trials throughout the area being conducted by the WSARP agronomist, the Hageen Dura-1 was very responsive to applications of nitrogen and phosphorous. Additional data needs to be collected to determine the response to these elements and whether or not adequate yields can be obtained without the addition of fertilizer.

In all locations where Striga was a problem, the Hageen Dura-1 was more susceptible than the local varieties.

SUMMARY: At this point it is difficult to predict the performance and acceptance of Hageen Dura-1 in the Kadugli area. Several more years of station tests and farmer trials have to be conducted and all data analyzed before a final decision can be made with any degree of accuracy. The current problem appears to be the response to fertilizer and the presence of off-type plants with "Adar" characteristics.

EL OBEID

All crops in and around the El Obeid area are severely stressed this season due to insufficient moisture. As of 24 September, total official rainfall at the El Obeid air terminal was 127mm, less than half the normal for this time of year.

Hageen Dura-1, was distributed to farmers in surrounding villages by the INTSORMIL agronomist in the quantities listed in Table 5. During our tour of the region we observed plantings in 7 fields and all except one field, were exceptionally poor.

One field of approximately 1/4 feddan had been planted in a low area on a sandy soil at spacing between hills in excess of one meter

TABLE 4: Name and village location of farmers receiving Hageen Durra-1 seed for demonstration trials in the Kadugli area in 1984.

VILLAGE	FARMER	
Shaer	Mamon Abdella	Haaj Hassen
	Ali Ahmed	El Barod Mussa
	Yacob Omer	Mahadi Abaker
	Mohamed Ibralium	Mohamed Abdulla
Bilegna	Ali Tuno	Kafi Haloof
	Gimar Kholid	Shihad Ango
	Gabeker Karakou	Awaesl Saed
	Tuna Tia	
Summa	Ralma Kuko	Hamid Abdella
	Yahys Mohamedian	Hamad Ismael
	Nasser Balol	Khamis Hasabolla
Kululu	Ibrihim Ascária	Abdul Bori
	Tisa Bilal	Um Kapom

TABLE 5: Name and village location of farmers receiving Hageen Durra-1 seed for demonstration trials in the El Obeid area in 1984.

VILLAGE	FARMER	SEED QUANTITY(Kg.)
Kazgail	Mubarak Mareen	3
Shoshaya	Ismail Osman	3
	Hamed El Nil	3
Fertengol	Ali Mohamed	2¼
	Hassan Ismail	2¼
Um Rraada	Mohamed Alkanoon	2¼
Um Araada	Mohamed Ahmed	2¼
Wordas	Mohamed Ali	2
Abu Haraz	Mirghani Hassan	2
	Shiek Ali Zarag	2
Wad Elhileiw	Eisa Osman	2
Um Ramaad	Harron Ahmed Mohamezien	2
Khor Abyad	Hassan Sulleiman	2¼
Hamadiya	Abdelkadir Ali	2
El Gaifil	Sheik Ali Ahmed	2
Um Hijlij	Sheik Musa Adam	2

with no more than one or two plants per hill. Most plants were headed and some beginning to bloom. The only plants with seed set were tall, early, off-types. Counts to determine off-type plants were extremely difficult to make because of the lack of plant growth uniformity.

No other field was observed in which there was anything close to a stand of sorghum plants. Most fields were of varying sizes with no more than 10 to 20 observable plants per feddan and none of these plants were in excess of 5 to 15cm tall. All fields were reported to have been planted during July.

SUMMARY: Because of the severe drought in the El Obeid area during the 1984 crop year, no conclusions can be made relative to the performance of Hageen Dura-1. Testing should continue in the region during the coming years.

SENNAR

On 2 October, I traveled to Sennar to visit with the NSA personnel and observe the hybrid sorghum production fields, however, upon my arrival, I found everyone out of the office with no expected date of return. I was able to visit with Dr. S. K. Banerjee and Mr. Mahmoud Jamal Sedon of the Seed Testing and Certification Section. We toured the 5 feddan field of foundation seed production, at the Sennar Main Station, which was very uniform, well rogued, with a good seed set. Yield and quality should be very good. The 30 feddans of certified production was progressing very well with the first 5 feddans planted setting seed while the last 5 feddans planted were just beginning to head. There appeared to be about 2-3 days difference to mid-bloom between the parent lines. The seed produced should be of good quality as there are only a few days between the first bloom of the female and first pollen shed of the male parent. The first 5 feddans to bloom were on the west side of the field and should provide an excellent pollen source for the remaining 25 feddans as the prevailing winds are of Southwesterly direction. The roguing job appeared to have been excellent as very few off-type plants were observed.

The 30 feddan of certified production at the Sennar West Location

were wet and in need of roguing as many tall, off-type plants could be seen. Heading and early blooming was just beginning within the female rows while the male parent was just beginning to boot. There appeared to be approximately 4-5 days difference in blooming between the two parent lines.

HAGEEN DURA-1 DEMONSTRATION PLOTS

Two farmer demonstration plantings within the Central zone of the Gezira have been visited recently. Both fields were similar for yield potential and off-type plants. Harvestable yields are very difficult to estimate at this point because of potential losses to birds, but the existing plantings appear to have a potential yield in excess of 5 times that of traditional varieties in neighboring fields. All farmers are pleased with the performance of hybrid but have an objection to the tall, off-type plants which they refer to as "Adar". All off-types are F_1 plants produced in the previous years crossing field. Farmers, although, mentioning the tall plants readily admit they have never grown a sorghum equal to the hybrid and will continue to grow it.

These tall off-type, F_1 plants are puzzling to all persons that were closely associated with the 30 feddan production field of 1983 as they contend that the field was very closely rogued and manicured to perfection. Extreme precautions were taken to guard against any possible contamination but the growing fields this year are all near identical for type and number of off-type plants. The uniformity among demonstration plots for off-type plants indicate the off-types were from the 1983 produced seed. This being the case indicates two sources of contamination, foreign pollen carried in by wind and/or genetic variation within the R-line.

SUMMARY

Roguing and blooming problems this season have been encountered as discussed. Contamination does exist in the Hageen Dura-1 hybrid seed and cannot be removed while utilizing the present two parent lines. The hybrid has been officially released and appears to meet with farmer acceptance. Existing problems have to be admitted, with major emphasis on pinpointing the problem areas and efforts made to alleviate them. Special emphasis has to be given to the purification of the male parent and to better understand its performance and responses to various growth conditions. Environmental and soil variations can be studied but will always exist, particularly within the Geziar where there is an extreme shortage in available facilities and equipment to adequately prepare the land for uniform planting and water distribution. Under the existing cultural practices of the Gezira, a split planting of male and female lines cannot be made within the field.

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ANNEX 10

National Seed Administration
SEED CERTIFICAITON ADMINISTRATION
P.O. Box - 21, Sennar, Sudan

No.:_____

Date:_____

F_I_E_L_D I_N_S_P_E_C_T_I_O_N R_E_P_O_R_T (Hybrid crops)

1. Crop: 2. Inspection No.: I / II / III
3. Cultivar: 4. Date of sowing:
5. Category of seed produced: Foundation I/II; Registered; Certified I/II
6. Field No.: 7. Seed Lot Reference:
8. Field location:
9. Area of field being inspected: 10. Date of inspection:
11. Previous crop/cultivar grown in the same field:
12. Stages of growth of seed crop:
13. Stages of growth of contaminant (in case it is a problem):
14. Isolation:

	Crop	Distance	Cut-back necessary
North	_____	_____ ft/m	_____ ft/m _____ f
South	_____	_____ ft/m	_____ ft/m _____ f
East	_____	_____ ft/m	_____ ft/m _____ f
West	_____	_____ ft/m	_____ ft/m _____ f

15. Field counts:

Count No.	Number of plant/head per count			
	Off-types	Shedding	Objectionable weed	Diseased
1.				
2.				
3.				
4.				
5.				
6.				
TOTAL				
%				

16. Other information (a) Planting ratio: (b) Plant population:
(c) Estimated yield: (d) No. of heads bagged:
(e) Irrigated: Yes / No (f) Fertilized: Yes / No
17. Has the field been rogued? (Yes/No); at blooming and before maturity - (Yes / No); before harvest - (Yes / No).
18. Area accepted:_____ f 19. Area rejected:_____ f
20. Remarks: (quantity of seed production work; condition of the crop, etc.)

Signature, Name and address of the farmer/producer:

Signature and name of the SCA inspector
Seal and date:

ANNEX 11

Hageen Durra - 1
Seed Production Field
Management Suggestions

1. Site Selection:

   Plot alloted for hybrid seed production should have good fertile and uniform soil type with good drainage. It should be well-leveled with just enough slope to facilitate irrigation. It should be free and far away from fields with wild sorghum (adar) and other noxious weeds. Fields known to have any level of Strige infestation should be totally avoid.

2. Land Preparation:

   A good seed bed preparation guarantees good crop establishment. The routine tillage practices-plowing, harrowing, and levellings if properly done will result in good seed bed.

3. Planting Arrangements:

   Growing of 4 female and 2 male parent rows in successions gave good results at the Gezira Research Station.

4. Spacing:

   (a) Between rows - Ridges 0.6 m apart
   (b) Within row - Maintain 0.15 m distance between plants within the row.

   Plant 2-3 seeds per hole and thin down to one plant per hole at 3-2 weeks after sowing. This will result in a good plant population of 46,620 plants per feddan.

5. Location:

   An isolation distance of 300m. from other cultivated sorghum fields is a minimum requirement. Greater isolation distance must be provided from fields with wild sorghum relatives.

6. Buffer Zone Planting:

   Plant several border rows of the pollen parent on each side of the field to provide a concentration of desirable pollen planting of stub rows at each end of the field also serves the same purpose. Such an arrangement will create a buffer zone of desirable pollen from the

male parent against contamination by undesirable pollen blowing into the seed field.

7. Roguing:

   Off-type plants in either male or female rows should be removed before flowering. If many off-types occur, roguing of a seed field should be undertaken each day on a routine manner during the pollinating period.

8. Fertilizers:

   (a) Requirement: Nitrogen fertilizer at the recommended dose of ZN (80 kg urea per feddan) is required.

   (b) Application: Suggest a split application of 40 kg urea at boot stage.

9. Irrigation:

   A weekly irrigation schedule should be followed. When considerable amount of rainfall is obtained, the schedule could be adjusted accordingly.

10. Weeding:

    The seed field should be free from all kinds of weeds at all times. Use of a recommended pre-emergence herbicide is encouraged. Supplemental hand weeding may still be necessary, however.

ANNEX 12

CULTURAL PRACTICES FOR HAGEEN DURRA - 1

Hageen Durra-1 is the first commercial sorghum hybrid in the Sudan. This hybrid is high yielding, early maturing, adapted to both irrigated and rainfed locations, and possesses acceptable milling and food quality. Similar to other sorghum varieties, the optimum cultural practices for Hageen Durra-1 are as follows:

Land Preparation

The usual operations are:

1. Ploughing once or twice as required. If nagil grass is a problem, ploughing to 12 inches depth is necessary.
2. Clod crushing and disc harrowing to insure soft seed bed.

Seed Treatment

The seed is treated with Aldrix T at the rate of 3 g/1 kg of seed.

Sowing Date

Sowing late June and early July results in high yields and freedom from midge and aphids.

Spacing and Seed Rate

Spacing should be 60 cm between rows and 15 cm between plants within rows. A planting stick may be used for making holes. 2-3 seeds per hole are planted and thinned to one plant per hole 10-14 days after germination. A seed rate in the neighborhood of 4 kg/fed is required.

Resowing

Whenever necessary, resowing is carried out as soon as possible but never later than 14 days after the original sowing.

Fertilization

80 kg urea/fed is broadcasted or side-dressed one month after sowing. The fertilizer should be evenly distributed.

Weeding

All weeds must be thoroughly controlled by hand-hoeing. Striga is controlled vigorously in its early stages wherever and whenever it appears. It is never allowed to set seed. All striga tops are removed from the field as soon as pulled and either fed to animals or burned. Close spacing

and the application of nitrogen help to reduce the number of weedings as the crop forms a quick canopy which smothers weed growth.

If it is available, apply one of the recommended herbicides listed below at the indicated rates.

Sorgoprim 50 w.p.	at 0.6 kg a.i./fed pre-emergence (used 1984 crop)
Gesaprim 80 w.p.	at 0.26 kg a.i./fed pre-emergence
Gesaprim 80 w.p.	at 0.40 kg a.i./fed post-emergence
Basagran 48 e.c.	at 0.72 kg a.i./fed post-emergence

However, supplemental hand weeding may still be necessary.