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Hybrid Sorghum Production in the Sudan

ROGUING AND BLOOMING

by

Lynn McDonald

Hybrid Sorghum Specialist

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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 Durra-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 consideration 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 were blooming when 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 areathis 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 HAWASHA	Off-Type	Shedding	Objectionable 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	15.0	0.0
II	3.0	0.0	11.6	0.0
3)				
I	0.3	0.0	5.0	0.0
II	2.0	0.3	3.0	0.0
4)				
I	0.0	0.0	0.0	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	20.0	0.0
II	0.4	0.03	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	0.0	6.0	0.0
II	0.08	0.05	0.04	0.0
9)				
I	0.6	0.0	49.0	0.0
II	0.6	0.0	47.0	0.0

* Plants per 1000 plants

Table 2. Summary of the First Field Inspection for Certified Hageen Durra-1 Seed Production in Field No. 4, for 1984

BAET HAWASHA	Off-Type	Shedding	Objectionable Weed	Diseased
1)				
I	0.0*	0.0*	2.8*	0.0*
II	1.0	0.0	1.8	0.0
2)				
I	0.0	0.0	7.0	0.0
II	0.0	0.0	15.0	0.0
3)				
I	0.0	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	0.0	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.

Table 3. Summary of First Field Inspection for Certified Hageen Durra-1 Seed Production in Field No. 1, 1984

BAET HAWASHA	Off-Type	Shedding	Objectionable Weed	Diseased
1)				
I	0.01*	0.0*	0.0*	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	100.0	0.0
II	0.3	0.0	20.0	0.0
6)				
I	0.0	0.0	20.0	0.0
II	0.0	0.0	22.0	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 80kg. 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 MEDNNI

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 Durra-1". Seeds of Hageen Durra-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 Durra-1 observed in the Kadugli area were similar in growth and performance and will be discussed as a whole rather than referencing each field serarately.

On 27 May 1984, 120 Kg. of Hageen Durra-1 seeds were received at the research station in Kadugli. Twenty-five farmers (Table 4) from surrounding villages were given approximately 2 Kg. of seed each. An attempt was made by the local agronomist and his technicions to keep track of the seeds as to where they were planted; However, some farmers moved from the region without planting the seed and during our trip into the area we observed less than 10 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 pla ting. 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 1 meter spacing between hills. All plants were in the soft dough stage of maturity and typical of what Hageen Durra-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 appeared to have nutrient deficiences. Where planted adjacent to the local varieties under the same cultural conditions, the Hageen Durra-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 Durra-1 was planted.

In numerous fertility trials throughout the area being conducted by the WSARP agronomist, the Hageen Durra-1 was very responsive to applications of nitrogen and phosphorus. 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 Durra-1 was more susceptable than the local varieties.

SUMMARY: At this point it is difficult to predict the performance

and acceptance of Hageen Durra-1 in the Kadugli area. Several more years of station test and farmer trials have to be conducted and all data analysed before a final decision can be made with any degree of accuracy. The current problems appear 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 Durra-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 a spacing between hills in excess of 1 meter with no more than 1 or 2 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 15 cm 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 Durra-1. Testing should continue in the region during the coming years.

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 Koolid	Shihad Ango
	Gabeker Karakou	Awaesl Saed
	Tuna Tia	
SUMMA	Ralma Kuko	Hamid Abdella
	Yahys Mohamedian	Hamad Ismael
	Naser Balol	Khamis Hasabolla
KULULU	Ibribim Zscaria	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	Mubarek Mareen	3
Shoshaya	Ismail Osman	3
	Hamed El Nil	3
Fertengol	Ali Mohammed	2¼
	Hassan Ismail	2¼
Um Rraada	Mohammed Alkanoon	2¼
Um Araada	Mohammed Ahmed	2¼
Wordas	Mohammed Ali	2
Abu Haraz	Mirghani Hassan	2
	Shiek Ali Zarag	2
Wad Elhileiw	Eisa Osman	2
Um Ramaad	Haroon Ahmed Mohamezien	2
Khor Abyad	Hassan Sulleiman	2¼
Hamadiya	Abdelkadir Ali	2
El-Geifil	Sheik Ali Ahmed	2
Um Hijlij	Sheik Musa Adam	2

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 midbloom between the parent lines. The seed produced should be of good quality as there are only a few days between 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 a 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 DURRA - 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 the 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 manucured 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 Durra-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 Gezira 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.