GENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY

1. SUBJECT CLASSIFICATION

A. PRIMARY
Agriculture

AF30-0170-0000

B. SECONDARY
Plant breeding--Cereals--Sorghum

2. TITLE AND SUBTITLE
Sorghum breeding nursery management

3. AUTHOR(S)
Oswalt,D.L.

4. DOCUMENT DATE
1970

5. NUMBER OF PAGES
4p.

6. ARC NUMBER
ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
Purdue

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

9. ABSTRACT

10. CONTROL NUMBER
PN-RAA-449

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Environmental tests
Sorghum

13. PROJECT NUMBER

14. CONTRACT NUMBER
CSD-1175 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

SORGHUM BREEDING NURSERY MANAGEMENT*

Site selection factors to consider are soil uniformity, water and air drainage, directions of slope, wind and light, general soil fertility level, previous insect, disease, weed and cropping history, rainfall patterns, water holding capacity of the soil, availability of irrigation water, velocity of wind, frequency of storms, and adequate area for the total program objectives. The accessibility of the site from the main offices and laboratories and all-season road conditions must be compatible for frequent and timely completion of critical work with a flexible supply of workers as the work load changes.

The design of the field lay-out should be fit to considerations allowing maximum use of light by placing rows perpendicular to the sun's path, adequate bordering of plots with 75 - 100 cm from alley ways, height and maturity differences of adjacent plots, the amount of seed required to plant the plots and the use of the harvested seed. Yield and sample production for chemical analysis should be in a plot containing a minimum of three rows with yields and samples taken from only the center row. If heights and maturity groups cannot be planted in groups then five or six row plots should be used. Length is somewhat more flexible with 70 - 100 cm borders required between alley ways or other varieties depending on heights. The taller the plants the greater the length of the border required for reliable yield determinations and quality sampling.

The close proximity of lines to be intercrossed and closeness to male sterile plantings facilitates efficient crossing using cytoplasmic or some other type of genetic male sterility by routine and simplified pollinating procedures. Staggered planting dates or cutting back a section of a plot will allow for nicking of varieties that flower at different times.

Breeding programs may be limited to the quality and performance of available male sterile lines or segregating populations. Use of only one or two male sterility sources can result in common qualities and resistance factors that potentially are liabilities as well as assets. Also, individual male sterile selections perform differently in varying climates. Therefore, a first task may be the development of suitable sources of male sterility for a given purpose and location.

The establishment of a cytoplasmic male sterile line adapted and selected for a specific location can be accomplished by backcrossing of a cytoplasmic male sterile A-line to a suitable B-line for five or six generations and making desirable selections for the B-line type in each generation.

The use of cytoplasmic male sterility for hybrid seed production on a commercial basis requires the careful selection or development of a plant that has a large head with good seed set. Planting in isolation four or five rows of the sterile A-line with two rows of an R-line results in production of fertile hybrid seed. The maintenance of a sterile A-line is accomplished by pollinating it with its fertile B-line.

---

* by Dallas L. Oswalt, Assistant Project Director of United States Agency for International Development Contract csd-1175 entitled "Inheritance and Improvement of Protein Quality and Content in Sorghum bicolor (Linn.) Moench" located at Purdue University, W. Lafayette, Indiana 47907.

The use of cytoplasmic male sterile plants for test crosses is easily accomplished. Cytoplasmic male sterile plants should be uniformly bagged with dated bags when the panicle is one-half exerted from the flag leaf. If carefully bagged at a uniform stage this will permit rapid selection of a given dated bag for pollination by prior inspection of a few selected bags to assess stage of stigma development. Pollen can be collected by bagging male plants in the late afternoon with marked bags and the next morning carrying collected pollen to the receptive female plants. It is essential that the pollen be handled in bags that are dry. Cutting panicles to be carried, when sufficient plants are available, insures a larger supply of viable pollen and permits a greater lag of time between pollen collection and use of the pollen, also cut panicles can be placed under pollinating bags on receptive female selections in vials of water in the afternoon. These can then be shaken the next morning as the cut panicles shed pollen. This increases the time of pollinating and reduces chances for contamination from wind-blown pollen or loss of pollen due to brisk winds after pollen starts shedding.

Utilization of genetic male sterile (ms_3) selections to allow random or controlled intercrossing of isolated populations results in a minimum amount of record-keeping with assurance of potentially maintaining a maximum of variability. Identification of male sterile plants in isolation plantings at pollinating time and harvesting of only those male sterile plants grown in association with selected male entries assures cross pollination. Selections from subsequent isolation block plantings based on maturity, height, quality or phenotypic characteristics as well as disease, insect and climatic adaptation permit rapid evaluations for individual plant selections. The selected individual plants grown in head to row plantings followed by subsequent selfing and screening requires a minimum of labor, large land areas and a relatively small storage facility. Being unable to identify consistently and rapidly the phenotypic traits associated with quality is a limiting factor and requires extensive chemical evaluation of large numbers of single plant samples or quality evaluation must be delayed until strains are established.

Isolation areas are difficult to locate due to Johnsongrass pollen being able to travel distances of 40 kilometers or more. Direction of wind, saturation with desirable pollen, and controlled planting dates are all adaptations insuring less contamination for commercial seed production or the use of smaller or adjacent plantings for segregating population studies. Early identification of male sterile plants and their systematic selection for harvest with the insurance that the early and late maturing varieties in segregating male sterile populations are included is important and can be influenced by staggered planting dates.

Overplanting viable seed at a uniform depth of two to three cm (five to six grams per six-meter row) in a well-packed seedbed will provide adequate plants which can be thinned to the desired stand count. Stand counts should range from 17 to 22 plants per meter in 75 cm rows, when yields are being evaluated under adequate rainfall or irrigated conditions. Maximum seed yields per plant by increased tiller production and head size would be obtained by space planting individual

seeds. Planting success is increased by adequate seed treatment to prevent disease and insect damage to seeds and young seedlings. The simplest equipment that will uniformly space, plant seed at a uniform depth and compact the soil around the seed at a rate to complete the schedule of the nursery is essential. This may range from hand planting to expensive tractor planting machines. Soil temperatures should be above 68°F or 20°C for rapid germination.

Detailed maps and planting instructions facilitate packeting, checking for errors, and accurate planting operations. Packet layout and careful checking insures rapid and efficient planting. This is critical in breeding nursery operations which depend on accuracy and location of selected materials to insure efficient pollinating, note-taking and harvesting procedures. Placing male lines end to end or adjacent to female lines reduces writing on bags at pollination and harvest as well as reduces the distance required to transport pollen. Arrangement of different height and maturity groups is critical for obtaining valid notes, yield ratings and chemical samples. Allowances for end borders of 50 to 100 cm in a minimum of three-row plots is essential between alleys and varieties with greater border allowances required between varying height and maturity entries. Provision for harvesting a minimum of three meter row sections on one or more rows from a three-row or larger plot will insure more reliable yield and chemical estimates in replicated trials on uniform sites. Border rows can be utilized for selfing or seed increase but only the center row open-pollinated plants should be used for yield and chemical data.

Timely weed control by hand, mechanical or chemical method in conjunction with early careful thinning is very essential to obtain uniform and comparable data. Thinning should be done prior to plant heights of 10 cm if tillering is to be permitted and evaluated. Observations and treatment related to disease and insect infestations or timely preventative control measures will insure successful production of select materials. Roguing outcrosses and off-types prevents plant competition and contamination of plots and soil. A study of weather patterns, previous crop management, crop rotation, and weed plants in the area will indicate potential insect and disease problems. Midge, nematodes, webworm, shoot fly, cut worm, army worms, stalk borers and greenbugs are some of the potential insects while rusts, anthracnose, bacterial stripe, smuts and mildews are diseases that may be confused with physiological coloration of sorghum plants.

Grasshopper damage to pollinating bags can be controlled by treating the bags with an insecticide. Aphids, webworm and corn ear worm damage inside bagged heads can be controlled with Dieldrin sprayed or dusted into the selfing or crossing bag.

Facilities such as nets, mechanical devices, borers or chemical materials to prevent bird damage of select materials is essential. Planting date selection is critical for bird control in most areas.

Use of a number scoring system for field note-taking facilitates averaging duplications and computer calculations. Some of the factors to evaluate are: days to flower, height, leaf length, leaf width, leaf angle, restoration, tillering potential, mid-rib color, head shape and type, peduncle length and shape, awn evaluation, glume color, seed color, weathering resistance, lodging resistance, bird damage and environmental responses.

Timely harvest can also prevent insect, weathering, mechanical and bird damage from destruction of critical materials which are often very susceptible in small plot areas. Harvest of grain at 25 to 30 percent moisture followed by drying to below 12 percent moisture at about 45°C will enable viable grain to be removed from the field for early protection. It is essential to dry the grain to below 12 percent moisture and to store in a dry and cool storage facility (30 percent relative humidity and 70°F) to insure maintenance of germination and prevention of insects. The use of a small head thresher will expedite threshing procedures for single or small numbers of head samples. The collection of panicle branches and the use of plastic bags are very useful in identification and storage of seed. Contamination and errors by mis-identification must be prevented at this time by careful handling procedures and instructions.