# SELECTION OF STOVEPIPE LINES FROM CHEMICALLY MUTATED COTTON

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## Abstract

Cotton (*Gossypium hirsutum* L.) lines exhibiting stovepipe growth habit (short fruiting branches, shortened internode length, and reduced number of vegetative branches) were selected from a population of HS 200, which had undergone chemical mutagenesis. Mutagenesis was accomplished by exposing imbibed seed to a 3% v/v concentration of Ethyl Methanesulfonate (EMS). In 1997, a replicated progeny test of two $M_4$ lines which exhibited the stovepipe phenotype was conducted at Lubbock, TX to ensure this trait was genetically stable. Progeny from 13 $M_5$ lines exhibited 100% expression of the stovepipe growth habit and progeny from 31 $M_5$ lines exhibited greater than 90% expression of the stovepipe growth habit. These data indicate that the stovepipe phenotypes selected from a chemically mutated population of HS 200 were highly heritable and after phenotypic selection appeared to be genetically stable.

## Introduction

"Stovepipe" or "columnar" cotton (*Gossypium hirsutum* L.) plants have a unique growth habit that could provide a competitive advantage over current commercial cultivars in broadcast and ultra-narrow row planting (Dever et al., 1993). This phenotype was first reported as an apparent spontaneous mutant found in 1986 in experimental breeding stocks of the cotton improvement program at the Texas A&M University Agricultural Research and Extension Center at Lubbock. In short-season production areas such as the High Plains of Texas that are stripper harvested, minimizing vegetative growth is often a management priority. Stovepipe lines have very short fruiting branches, small internode length, and a reduced number of vegetative branches. Each of these properties contributes to a higher fruit-to-vegetation ratio and could increase lint yield under high plant populations. Initial trials conducted in 1m (40 inch) rows show this phenotype had similar yields to HS 26 under dryland conditions but did not produce the higher lint yields observed in HS 26 under irrigation (Brashers et al., 1993). This phenotype did have fewer sticks and barky graded samples when stripper harvested. Cotton from the stovepipe phenotype had similar ginning properties as conventional cultivars grown on the Texas High Plains (Ethridge et al., 1995).

Stovepipe phenotypes were initially observed in 1996 in two $M_4$ lines developed through chemical mutagenesis. Chemical mutagenesis was used in combination with phenotypic selection to increase the genetic variability within cotton cultivars adapted to the Texas High Plains. Since mutagenesis usually induces a change in only a small number of genes, the mutant plants will often maintain the yield and adaptation of the parent cultivar (Auld et al., 1997). Chemical mutagenesis can increase phenotypic variation, but it cannot be proven that phenotypic characteristics found in mutated populations are not due to natural variation.

## Materials and Methods

On 6 June 1993, 10 kg lots of two commercial varieties (HS 26 and HS 200) were treated with 1, 3, and 5% v/v rates of Ethyl Methanesulfonate (EMS) using a procedure described by Auld et. al., 1992. The $M_1$ seed were planted at New Deal, TX, and one boll was collected from each surviving plant in the fall of 1993 and the seed was bulked to produce $M_2$ seed. The $M_2$ seed was planted during the 1994 growing season near New Deal, TX, and one boll from approximately 5,000 $M_2$ plants was harvested to obtain $M_3$ seed. The $M_3$ seed were planted on the Texas Tech University campus in Lubbock, TX in the spring of 1995. Four bolls were harvested from 100 plants which showed a reduced level of boll weevil damage. Seed from each of these $M_4$ lines were planted in a replicated progeny test using a randomized complete block design with three replications in 1996.

Two of the $M_4$ lines (3075 and 3078) selected in 1995 had a high percentage of plants exhibiting the stovepipe phenotype in the 1996 trial. Seed of 40 $F_5$ plants from these lines were harvested and progeny tested in 1997 for uniformity of expression of the stovepipe phenotype. HS 26, HS 200, and PM 280 were included in this study as normal growth habit controls. Cluster 2525, a line developed by Associated Farmers Delinting, Inc. at Littlefield, TX from germplasm obtained from the Texas A&M University Agricultural Research and Extension Center in Lubbock, was used as a control cultivar for the stovepipe phenotype. The $M_5$ seed were planted in plots consisting of four rows spaced 25 cm apart (10 inches) and were 3.6 m (12 ft.) in length. Several plots did not establish because of poor weather conditions following seeding. During the growing season, the plots were flood irrigated to provide an additional 200 mm of water. At maturity, the $F_6$ plants in 84 plots were individually classified as stovepipe, semi-stovepipe, or normal growth habit. The average stem length between the main stem and the first position boll were considered as well as the overall appearance of the plant in determining phenotypic classification. Data were collected from 22 $M_5$ lines from 3075 and from 18 $M_5$ lines from $M_4$ 3078. $M_5$ lines with high levels of expression of the stovepipe phenotype were harvested, and fiber samples analyzed for fiber quality using HVI quality analyses.

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## Results and Discussion

Two of the 100 mutant lines selected for boll weevil tolerance in 1995 had a high percentage of plants which exhibited the stovepipe phenotype in the 1996 trial. Nine $M_5$ lines from 3075 and 4 $M_5$ lines from 3078 had 100% of their plants express the stovepipe phenotype in the 1997 progeny test (Table 1). Nineteen of the 22 $M_5$ lines of 3075 and 12 of 18 lines from 3078 had greater than 90% of the $M_6$ plants express the stovepipe phenotype. Most of the $M_5$ lines had a higher level expression of the stovepipe phenotype than the stovepipe cultivar included as a control. Only 80% of the plants from this cultivar exhibited the stovepipe phenotype. Seed of selected $F_5$ lines will be increased and evaluated to determine lint, yield, and quality under different row spacing and plant populations. Both allele tests and genomic evaluations will allow us to determine if this is the same mutation or a different mutation the original stovepipe phenotype described by Dever et al., 1993. These lines will also be used to develop stovepipe isolines for HS 200. These lines could provide valuable tools for physiological and plant population studies on ultra narrow row cotton production.

## References


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Table 1. Percent of $M_6$ plants exhibiting the stovepipe phenotype of 22 $M_5$ lines from 3075 and 18 selected from $M_5$ lines from 3078 selected from mutated HS 200.

| | $M_4$ Line | |
|---|---|---|
| Stovepipe Phenotype | 3075 | 3078 |
| -------% $M_6$ Plants------ | ----------No. $M_5$ Lines-------------- | |
| 100 | 9 | 4 |
| 97 | 7 | 6 |
| 92 | 3 | 2 |
| 87 | 2 | 3 |
| 82 | 0 | 1 |
| 77 | 1 | 1 |
| 72 | -- | 0 |
| 67 | -- | 0 |
| 62 | -- | 0 |
| 57 | -- | 0 |
| 52 | -- | 0 |
| 47 | -- | 0 |
| 42 | -- | 0 |
| 37 | -- | 0 |
| 32 | -- | 0 |
| 27 | --- | 1 |
| Total | 22 | 18 |