Studies of Inheritance of Seed Size and Other Characters in a Cross Between an Indian and a North American Variety of Flax

K. H. Chu and J. O. Culbertson

It has been recognized that there is a fairly close association between large seed size and high oil content in flax, and between large seed size and low iodine number of the oil. These relationships do not always exist, however, as evidenced by the fact that the variety Minerva combines unusually high oil content with at least moderately high iodine number, while its seed size is only medium large. In seed flax varieties, grown almost exclusively for the oil expressed from their seeds, it is important that a high yield of seed be combined with both high oil content and high iodine number, as well as with desirable agronomic characters and disease resistance. The Indian flax variety, 1193-2, used in this study, excelled in seed size and oil content. It was susceptible to both wilt and rust, low in iodine number, and short in stature. The North American variety Dakota excelled in most characters except seed size and oil content. The primary purpose of this study was to learn whether or not the desirable characters of both varieties could be combined into a single variety. For this purpose, studies were made to determine the manner of inheritance of seed size, plant height, reaction to wilt, and reaction to rust from a cross of Indian 1193-2 and Dakota. In addition, tests were made for association between some of the characters studied, including reaction to wilt and rust and certain agronomic characters.

REVIEW OF LITERATURE

Previous investigations by Tammes (10), Myers (9), and Moseman (8) have indicated that a relatively small number of major factor pairs governs the inheritance of seed size, with large size partially dominant. In the study of a cross between a tall fiber flax and a short seed flax, Bartels (1) found that two main and several modifying factors were involved in the determination of plant height. Tammes (11), McGregor (7), and Moseman (8) found that plant height was not inherited simply in the material they studied.

A number of workers have reported associations between characters in flax. Dillman (5) in 1936 cited the work of Arný in which he found a rather close linkage between iodine index and seed color. Carnahan (3) reported a physiologic relationship between yellow seed color and iodine number. Lines homozygous for both brown and yellow seed color differed significantly in iodine number indicating that there were more factors influencing iodine number than the single pair which differentiated brown and yellow seed color. Burnham (2) reported an association between cloudy-yellow seed color and percentage of wilt.

Significant negative correlation was found between rust and mean seed size by Moseman (8) in F1, line notations were found by the senior author (4). Johnson (6) found a significant positive correlation between large seed size and oil content, and a significant negative correlation between rust and seed size.

MATERIALS AND METHODS

Two parental flax varieties, Dakota and 1193-2, and their F1, F2, F3, and progenies of these two parents were used in this study.

Crosses between Dakota and Indian 1193-2 were made in the greenhouse during the winter of 1946-47. The F1 generation was grown in the field in 1947. Both parents were grown in the field in 1947-48. In 1948 the available material was divided into separate trials. The first included the two parents and both backcrosses: The parents, F1, and backcross of single-row plots, while the F2 was grown in the greenhouse. Twenty-five seeds were spaced 3 inches apart in each trial consisted of three randomized blocks. Data were taken on an individual plant basis. In the F2 progenies of randomly selected F2 plants and F3 plants were grown in single-row plots space planted to 25 seeds except for a few families of which the amount was insufficient. This second trial was also grown in separate blocks, and each row was harvested in bulk. Any lost because of poor seed viability.

Thirty-seven of these 190 lines harvested in bulk on a basis of seed size covering the range from 1000 seeds. These, together with the two parents, were used for oil content and iodine number.

Eighty-eight F2 plants grown in the field in 1948 seed nearly as large or larger than the average of the two parents were selected without regard to other traits from these selected plants together with the parents and planted in the spring of 1949 in both the agronomy and nurseries. Many of the 88 selected plants did not produce seeds to permit replication, and for this reason, only were grown in each trial.

Progenies grown in the agronomy nursery were grown in bulk and the average seed size determined from these. Mean plant heights were also recorded for each.

Wilt studies of the 88 F2 progenies of selected together with their parents were carried on in the greenhouse. Single row plots were 4 feet long and 1 foot apart. Plants were planted in each row. The percentage of wilt was recorded on May 31.

Rust reactions of the same 88 F2 lines were made in the greenhouse in the fall of 1949. Each F2 line single reaction at the rate of 50 seeds per plot. This experiment was carried out to determine the manner of inheritance...