MALE STERILITY has been found as a mutant in most higher plants that have received more than a cursory genetic examination. This phenomenon is often associated with physiological upsets, morphological abnormalities, and aberrant chromosome behavior. It may be conditioned by cytoplasmic factors, nuclear genes, and interactions between genes and cytoplasmic factors.

The appreciation of the advantages of hybrid vigor has stimulated plant breeders to look for efficient methods of producing pollen-free inbred lines. Control of pollen production without the difficulty of mechanical emasculation has allowed crosses to be made efficiently in many additional species, and has stimulated research in plants which otherwise would have been disregarded because of difficulties in hybridization. This paper reports the results of research designed to determine the feasibility of utilizing male sterility for the production of F₁ hybrid table beet seed.

LITERATURE REVIEW

The widespread occurrence of male sterility in angiosperms and the distinguishing features of this phenomenon are reviewed extensively by Jain (4). Jones and Clarke (6) reported that the expression of male sterility in onions resulted from the interaction of a single recessive nuclear gene (ms) with a cytoplasmic factor S. They found that male-sterile plants (S ms ms), when pollinated with male-fertile plants which were N ms ms, produced S ms ms progenies. These male-sterile plants have been used extensively and successfully for the production of F₁ hybrid onion seed. The system which utilizes cytoplasmic male sterility for the production of inbred lines was proposed by Jones and Clarke and is commonly used in commercial F₁ hybrid seed production of such crops as corn (5), sorghum (13), sugar beets (10), and sudangrass (2), and has been suggested for use in carrots (1).

The occurrence of cytoplasmic-genic male sterility in sugar beets was first described by Owen (8, 9). He reported that male-sterile plants resulted from the interaction of two recessive genes, x and z, with S cytoplasm, i.e., S xx zz. Partial male fertility was restored to plants having S cytoplasm which were genetically Xx zz, xx Zz, and Xx Zz. Plants containing N cytoplasm were male-fertile regardless of the condition of the two genes. Savitsky (11) reported that the inheritance of cytoplasmic-genic male sterility in tetraploid sugar beets was controlled by a single recessive gene interacting with S cytoplasm.

Hogaboam (3) described the Sh locus, the dominant allele of which enhances the pollen-producing ability of S Xx sugar beet plants such that they appear to be male-fertile. The Sh allele had no effect on male-sterile plants (S xx). Only plants which were S Xx sh sh appeared to be partially male-fertile and phenotypically variable.

MATERIALS AND METHODS

Six genetic lines of red-pigmented beets (W162A and W162, W165A, W169-1, W152A, and W55-1) and the table beet cultivar H28 (Redpack) were selected for studying the inheritance of male sterility. The six genetic lines resulted from crosses of table beet cultivars with sugar beets. The sugar beets were used as a source of both male sterility factors and genes conditioning the monogerm seed character, annual flowering habit, and self-fertility.

The test for cytoplasmic male sterility was initiated by crossing a male-sterile (MS) × W162-1 (male-fertile). Plants from the F₁ were crossed to W162-2 to obtain the first backcross generation (W162A1). Backcrossing to and simultaneous selfing of the recurrent parent were continued through the BC₃ and BC₄ generations, respectively.

Sugar beet stocks containing cytoplasmic-genic factors for male sterility were obtained from the late Dr. F. V. Owen, USDA.

Sugar beet stocks containing genes for monogerm seed character, annual flowering habit, and self fertility were obtained from Dr. V. F. Savitsky, USDA.