Cytomorphological studies in x-ray induced glandless haploids in
*Gossypium hirsutum* L. (cotton)

S S MEHETRE* and M V THOMBRE
All India Co-ordinated Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar 413 722, India
* Present address: Department of Botany, Mahatma Phule Agricultural University, Rahuri, India.

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Abstract. Six haploid plants were obtained in M₁ generation of the 25 kr. x-ray irradiated *Gossypium hirsutum* L. cotton variety H.G. 108. The cytological studies on these plants indicated highly irregular meiosis, giving an average six bivalents, the range being 0–9. Unequal separation of chromosomes and chromatids at anaphase-I and II respectively led to formation of abnormal tetrads and pollens with high size variations leading to high pollen sterility. These plants were characterized by miniature stature, shorter stem and internodes, smaller leaves, flowers and stomata with fewer chloroplasts, male and female sterility and halving of chromosomes. The reduction in morphological characters was nearly in the proportion of 1 : 2 as compared to their diploid counterparts.

Keywords. Induced haploidy; cytological studies; *Gossypium hirsutum* L. cotton.

1. Introduction

Haploids with gametic chromosome complements helped in understanding the cytogenetic structure of various crop plants over the past five decades. Kimber and Riley (1963), Magoon and Khanna (1963), Kirilova (1966) and Chase (1969) have reviewed the various aspects of haploids and discussed their possible uses in genetic and cytogenetical research. Natural or spontaneous monoembryonic haploids have been reported in many plant species. Spontaneous haploids have been reported in 36 species belonging to 26 genera and 10 families including the genus *Gossypium* (Kimber and Riley 1963). Haploids have been reported in cotton by semigamy (Turecotte and Feaster 1974), interspecific hybridization (Lee 1970) and x-ray treatment (Mehetre and Thombre 1977). The detailed cytological studies and morphological observations in x-ray induced haploids are reported in the present paper.
2. Materials and methods

Six conspicuous plants with small leaves with profuse but sterile flowers were detected in M2 generation of the x-ray irradiated *G. hirsutum* cotton variety H.G. 108. The plants though self-sterile were slightly cross-fertile and set few bolls. The various morphological characters were studied in detail in these haploids and compared with their parent. Young flower buds were fixed in Carnoy’s Fluid (6:3:1) and anthers were squashed in 1% propionocarmine.

3. Results

Marked and significant reduction was observed in all morphological characters (table 1). The reduction was approximately in 1:2 ratio. Similar trends of variation were observed at both the ploidy levels except for characters like stomata size, number of stomata/unit area and chloroplasts/stoma. For bracteole teeth non-significant difference was observed.

Few bolls were obtained on haploid plants, the boll number, size, number of seeds, seed (figures 1–6) and lint weight per boll and yield per plant were found to be significantly reduced while the number of motes was found to be significantly increased in haploids than the checks.

4. Qualitative characters

The variety H. G. 108 (*G. hirsutum* cotton) is highly glanded and it had leaf and floral nectaries, dark green leaves, cream pollens, cream petals and light green leaves. However, the mutant plant in X~ II.G. 108-25 M was completely glandless, with floral and extrafloral nectaries while petals and pollens were slightly yellowish and with wrinkled leaves. The haploids plants (1–6) were glandless but similar to that of their mother plant H. G. 108-25-1 in respect of other characters.

4.1. Cytological observations

The observations on the chromosome behaviour during meiosis and pollen development were made (figures 7–12). The analysis of chromosome associations observed during different stages of meiosis presented in table 2 indicates that the range of bivalent and univalent formation was from 1-9 and 22.2 (Hpl4 and Hpl4) to 7-0 and 14-0 (Hpl4) and chiasma/II 0-0-0-7 (Hpl4) to 0-88 (Hpl4).

At second meiotic division the chromosome separation was highly irregular. The analysis of 100 PMC at anaphases-I is presented in table 3.

In addition to abnormal distribution, tripolar separation was also observed in these PMC due to groups of chromosomes lying outside the spindle. The division of univalents was also observed in a few cases at anaphase-I. The tripolar separation also resulted in formation of triads and other higher polyads (table 4). The range of polyads observed was 1 to 6. Monads were observed particularly in haploids 2 and 4 while dyads and other higher polyads were common in all haploids. In general, triads, tetrads and pentads were commonly observed in all haploids while monads, dyads and hexads were comparatively low. The size