Meiotic Behaviour and Morphological Variation in *Chrysanthemum Paludosum* Under Different Light Conditions

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ABSTRACT

The present investigation was undertaken to study morphological variation and meiotic behaviour in *Chrysanthemum paludosum* grown under different light conditions. The work forms a part of the M.Sc. dissertation carried out during November-2023 to March-2024. Plants were grown in pots under full sunlight, control (normal light), and shady light conditions. Morphological parameters such as plant height, number of branches, and number of flowers were recorded and statistically analyzed using mean and standard deviation. Cytological investigations were restricted to meiosis in pollen mother cells (PMCs) using conventional acetocarmine (2%) squash techniques. Meiotic abnormalities such as chromosomal bridges at anaphase I and laggard chromosomes at anaphase II were observed predominantly in sunlight-grown plants. Student's *t*-test analysis revealed significant variation in flowering behaviour under different light conditions ($p < 0.05$). The study demonstrates that light intensity influences both morphological traits and meiotic stability in *C. paludosum* and highlights the continued importance of classical cytology in evaluating genomic behaviour in ornamental plants.

Key words

Chrysanthemum paludosum; Meiosis; Light conditions; Chromosomal abnormalities; Morphology; Cytogenetics

INTRODUCTION

The genus *Chrysanthemum* (family Asteraceae) represents a significant group of ornamental plants, highly valued for their wide range of floral forms, colours, and adaptability. Cytogenetic research in *Chrysanthemum* has greatly enhanced our understanding of chromosome dynamics, genomic stability, and evolutionary relationships within the genus. Meiosis, a key biological process, is essential for maintaining chromosome number and generating genetic variability through the precise pairing and segregation of homologous chromosomes. Disruptions in meiosis can result in chromosomal abnormalities and diminished fertility (Singh, 2018).

Meiotic investigations serve as a fundamental tool for evaluating chromosomal pairing, segregation, and overall genomic stability. Various abnormalities, including univalents, multivalents, lagging chromosomes, bridges, and sticky chromosomes, have been reported in cultivated plants and are often linked to genetic imbalance or environmental stress (Sharma & Sharma, 2014; Kumar & Rai, 2020).

Among environmental factors, light plays a critical role in influencing plant growth, flowering, and reproductive processes. Variations in light intensity can affect both morphological traits and cellular activities, including meiotic

events (Datta, 2019). Observations such as chromosomal bridges and laggards often indicate spindle disturbances or chromatin stickiness, which may subsequently impact pollen fertility (Bennett et al., 2021).

Despite the ornamental and economic significance of *Chrysanthemum*, there is limited information regarding the combined influence of light conditions on both morphology and meiotic behaviour in *Chrysanthemum paludosum*. Therefore, the present study was designed to generate baseline morphological and cytogenetic data for this species under controlled pot culture conditions.

Objectives

1. To study morphological variation in *Chrysanthemum paludosum* under different light conditions.
2. To analyze meiotic behaviour in pollen mother cells.
3. To identify and record meiotic abnormalities.
4. To statistically evaluate the effect of light conditions on morphology and meiosis.

MATERIALS AND METHODS

Plant material and experimental design

Healthy and uniform plants of *Chrysanthemum paludosum* were grown in earthen pots under three light conditions: full sunlight, control (normal light), and shady light. Standard agronomic practices were followed throughout the experimental period.

Morphological study

Morphological parameters including plant height (cm), number of branches, and number of flowers were recorded at the flowering stage. Data were statistically analyzed and expressed as Mean ± Standard Deviation (SD).

Cytological study (meiosis only)

Young floral buds of appropriate size were collected between 8:30 and 10:00 AM to obtain actively dividing pollen mother cells. The buds were fixed in Carnoy's fixative (absolute alcohol : glacial acetic acid, 3 : 1) for 24 h and preserved in 70% ethanol. Anthers were dissected and squashed in 2% acetocarmine stain. Temporary slides were prepared and examined under a compound microscope to observe various stages of meiosis. Photomicrographs were taken for documentation.

OBSERVATIONS

Morphological observations

Plants grown under different light conditions showed noticeable variation in growth and flowering behaviour. Sunlight-grown plants exhibited moderate plant height with relatively higher flowering, whereas shaded plants showed reduced flowering and comparatively lower plant height.

Table 1. Morphological parameters of *Chrysanthemum paludosum* under sunlight condition

Parameter	Mean ± SD
Number of branches	7.75 ± 4.49
Number of flowers	9.25 ± 8.92

Plant height (cm)	27.37 ± 5.39

Table 2. Morphological parameters under control condition

Parameter	**Mean ± SD**
Number of branches	7.07 ± 5.83
Number of flowers	8.21 ± 12.44
Plant height (cm)	27.00 ± 10.36

Table 3. Morphological parameters under shady light condition

Parameter	**Mean ± SD**
Number of branches	6.66 ± 3.82
Number of flowers	4.66 ± 2.65
Plant height (cm)	24.50 ± 5.71

Cytological observations

Normal meiotic behaviour with regular bivalent formation was observed in several pollen mother cells. However, plants grown under sunlight conditions exhibited distinct meiotic abnormalities. Chromosomal bridges were observed during anaphase I, while laggard chromosomes were noticed during anaphase II. These abnormalities were comparatively less frequent in control and shaded plants.

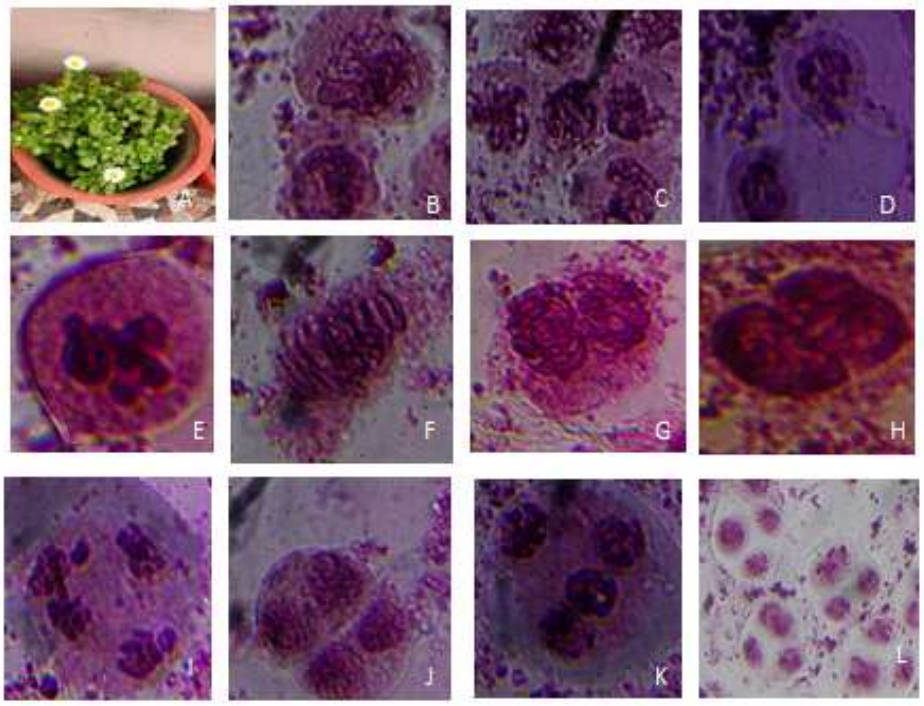

Figure-1 A–Plant of *Chrysanthemum paludosum.* (B) Interphase (C-D) Prophase-Leptotene(E) Dikinesis(F) Metaphase I showing normal bivalent formation. (G) Normal Anaphase (H) Anaphase I showing chromosomal bridge in sunlight-grown plant. (I) Anaphase II showing laggard chromosomes in sunlight-exposed plant. (J) Telophase-I (K) Telophase II showing disturbed orientation (L) Tetrads

Results and statistical analysis

Statistical analysis of morphological data indicated variation among different light treatments. Student's *t*-test analysis revealed that variation in flower number was comparatively more pronounced under different light conditions ($p < 0.05$), whereas differences in plant height and branching pattern were not statistically significant.

Results and Discussion

The present study demonstrates that light conditions significantly influence both morphological traits and meiotic behaviour in *Chrysanthemum paludosum*. Plants grown under sunlight conditions exhibited improved flowering but also showed meiotic irregularities such as chromosomal bridges at anaphase I and laggards at anaphase II. Chromosomal bridges are generally associated with improper chromosomal separation or delayed terminalization of chiasmata, while laggards indicate spindle disturbances.

The observed meiotic abnormalities suggest that light intensity may act as an environmental stress factor affecting meiotic stability. Similar associations between environmental conditions and meiotic irregularities have been reported in other plant species. Such abnormalities may ultimately affect pollen fertility and genomic stability, emphasizing the importance of meiotic analysis in cytogenetic studies of ornamental plants.

Further studies correlating meiotic abnormalities with pollen fertility and seed set are recommended. Advanced molecular cytogenetic techniques may complement classical meiotic studies. Long-term investigations under varying environmental conditions may provide deeper insights into genomic stability in *Chrysanthemum paludosum*.

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