



## Morphological and Allometric Study of *Calendula officinalis* Species Collected from Gilgit, Pakistan

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**Abstract:** *Calendula officinalis* (Marigold), besides extensive use in ornamentation, is famously known for its valued medicines used in cancer treatments, eye and skin care. It is cultivated in more than 145 countries. It has a multi-million-dollar floriculture industry alone. It has a wide variety of uses ranging from commercial, religious, social, medicinal and ornamental. Being a stress resistant flowering plant grown in all agroecological regions of Pakistan. However, its preferers relatively cold ecological zones including provinces of Gilgit-Baltistan and Khyber Pukhtoon Khaw. This study has attempted to assess the impact of varied climatic conditions (slope, sunshine, day length, moisture and temperature) on the growth (leaves, sepals, petals, stamens and carpels) of *Calendula officinalis*. Samples (N=100) were collected from three different locations in the study area (East, North and West facing). The elevation was kept the same. Results revealed that coloration (gene expression) is independent of any change in the climatic factors. flowers can be found in orange, yellow and a mix of these colors. The mean area of sepals was 0.73 mm ( $R^2 = 0.066$ ), petals 4.84 mm ( $R^2 = 0.0229$ ), stamen 0.085 mm ( $R^2 = 0.837$ ), carpel 7.73 mm ( $R^2 = 0.2728$ ), and leaves 485.22 mm ( $R^2 = 0.0902$ ). The size of petals is 85.5% larger than sepals. Similarly, carpel is 98.9% bigger than the stamens. Sizes of different parts studied showed almost least dependencies on the climatic conditions.

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**Key words:** Morphometry; Allometry; *Calendula officinalis*; Hybridization; Ornamental; Gene Expression.

### 1. Introduction

*Calendula officinalis* is commercially, medicinally and ornamentally high valued plant. It is used in many cancers, skin and eye care. It has far reached utilizations in religious, social and pharma industries. It belongs to a small herbaceous plant genus. Commonly known as Pot Marigold, Scotch Marigold, English Marigold, and Garden Marigold (John, Riffat & Jan, Dr. 2007). Cultivated all over the world. Primarily found in the Mediterranean, Iran, Central Europe, Africa, and Asia (Samatadze et al., 2023). *Calendula* species exhibit significant variation in chromosome numbers, with basic chromosome numbers being 7, 8, 9, and 5. *C. officinalis* is tetraploid, with different chromosome numbers reported  $2n=28$  or 32. According to Esmaeili et al., (2020) *C. officinalis* Linn. is an annual or biennial plant with an angular, hairy, and solid stem. Lower spatulate leaves measuring 0-20 cm long and 0.4 cm wide (Sharma and Kumari, 2002). *C. officinalis* is rich in bioactive molecules like flavonoids, triterpenoids, and carotenoids. Which make it medicinal with anti-inflammatory, antibacterial, and antioxidant effects (Escher et al., 2009).

*Calendula* can be grown in various climatic conditions including greenhouse, pots, or fields

(Kareem et al., 2004). Lipids, flavonoids, and carotenoids are examples of biologically active compounds found in plant tissues, such as leaves and flowers. These ingredients are utilized in extracts and tinctures, as well as in the treatment of burns, gastrointestinal problems, gynecological problems, dental diseases, eye conditions, and skin injuries. (Patil et al, 2022). Pot marigold flowers are utilized in the pharmaceutical sector for their skin-beneficial effects and folk medicine for various herbal treatments (Moghaddasi Mohammad, S., & Kashani, H. H. 2012; Filipovic et al., 2006).

A series of traditional and pharmacological uses have been reported in several sources for care, cure and treatment of various ailments in human. Several topical uses have been appreciated including gangrene and antifungal skin causes. Clinical data to recommend for skin care, cure and treatment seems insufficient. However, there is no evidence to cause any allergic reaction (AshwlayanVD, K. A., & Verma, M. 2018; Kemper, K. J. 1999).

Beyond the ethnobotanical uses, clinical data are insufficient to recommend calendula for internal use as a uterine tonic, antimicrobial or cancer remedy (Kemper, K. J. 1999). However, it can be suggested for wound management, skin care and topic uses as

ointment (Givol, O., Kornhaber, R., Visentin, D., Cleary, M., Haik, J., & Harats, M. 2019).

Research area falls between E = 74.3753 E and N = 35.8894 N at an elevation of 6,518 m above sea level.

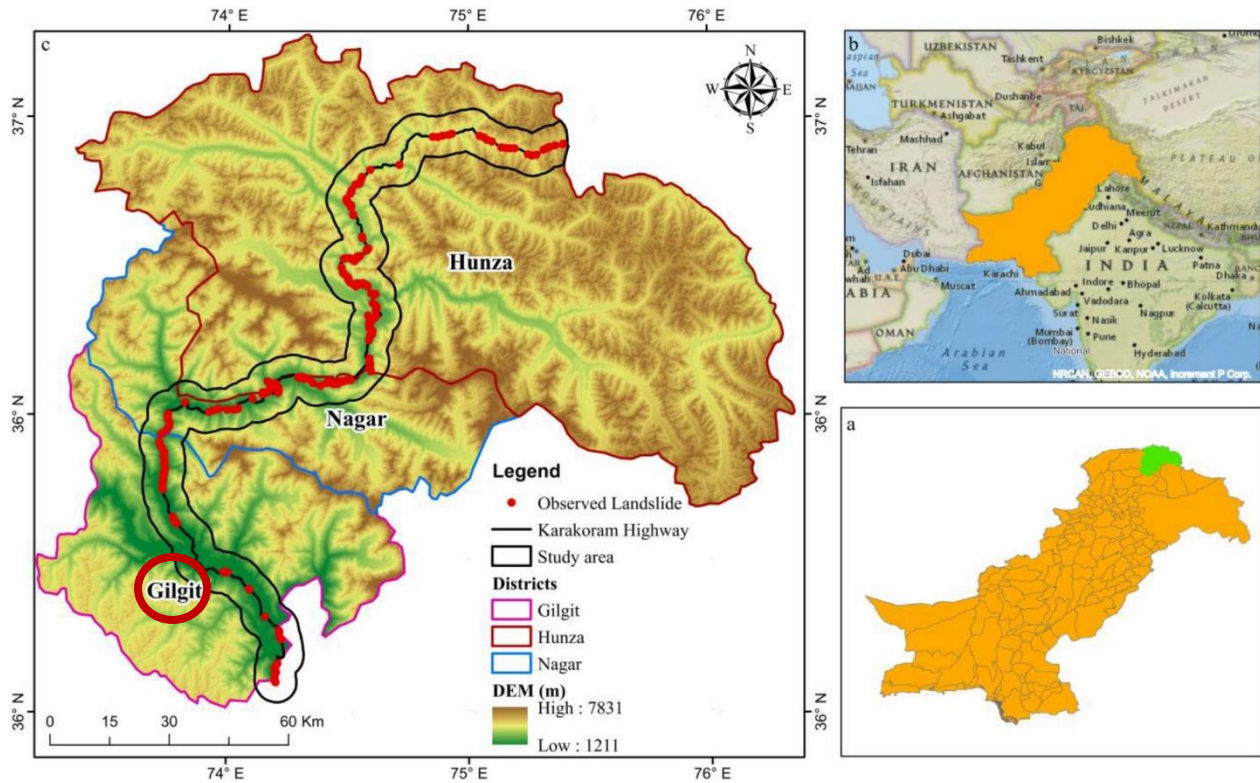


Figure 1 shows research site green color in extreme north of Pakistan and sampling site of Sakuwar valley in Gilgit (red circle above)

## 2. Material and Methods

Plant was identified properly online resources and consulting eFlora of Pakistan (Compositae family, Published by University of Karachi, Pakistan). Three major sites with different slops were identified with plant populations. These sites are within the same elevational zone and fall within the geographical ambit of Sakuwar valley in the administrative district of Gilgit (see figure 1 & 2). These sites were marked as A-east facing slop, B-north facing slop and C-west facing slop. A total of 100 (N=100) plants were identified and scaled for leaves, sepals, petals, stamens and carpels. These dependent variables were measured for their length, width and total size of respective parameters.

Data generated was digitized in MS Excel (365) and processed using Xcel Stat and MS Excel (365). Photographs (figure 3) of samples were also taken for record and samples were deposited in the herbarium at the department of Plant Sciences, Karakoram International University, Gilgit.



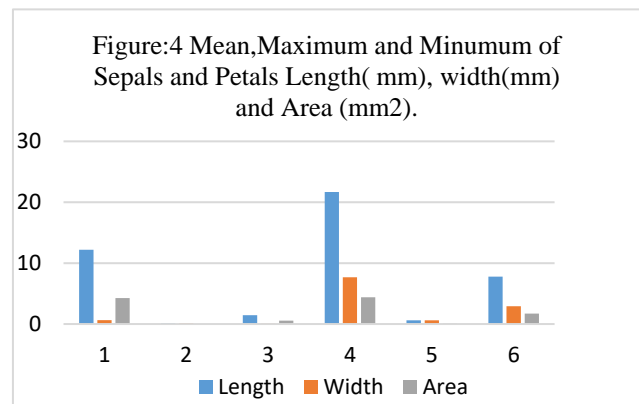
Figure 2 shows specific sample collection sites (shown in red circles A (E facing), B (N facing), and C (W facing) in the Sakuwar area from three different slop facing sites

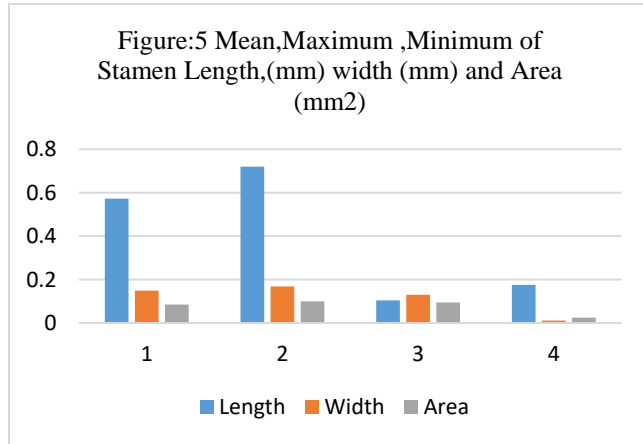


Figure 3 shows floral variation in coloration ( *Calendula officinalis*). Photograph by Sajida Amir

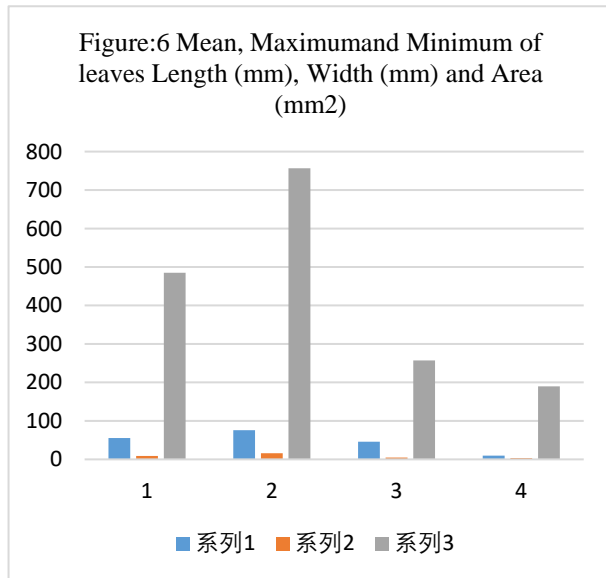
### 3. Results and Discussion

Careful measurement of sepals, petals, stamen, carpel and leaves for length(mm), width (mm), area (mm<sup>2</sup>) was made. It revealed that there are 5 sepals. The mean length of sepals recorded was 5.5708 mm ( $R^2 = 0.0363$ ), followed by width of 0.27866 mm ( $R^2 = 0.686$ ) and the mean area calculated 0.73044024 mm ( $R^2 = 0.066$ ). The range between maximum and minimum for the length and width was 2.2-0.6 mm followed by 0.64-0.6 mm respectively. Figure 4 shows that there is no variation in the number of sepals across the altitudinal gradient, it shows little impact of change.





Similarly, there are 8 petals recorded in all samples. Mean length of petals recorded was 3.999956 mm ( $R^2 = 0.4499$ ). The mean width was 0.35503 mm (is  $R^2 = 0.3079$ ). The mean area calculated was 4.8369548 mm ( $R^2 = 0.0229$ ). The maximum and minimum range for the length and width recorded were 2.67429-0.60375 mm and 7.685375-0.6035 mm respectively. Figure:2. Petals prefer longer sunlight, slightly more water and higher temperatures for better and healthy projection.

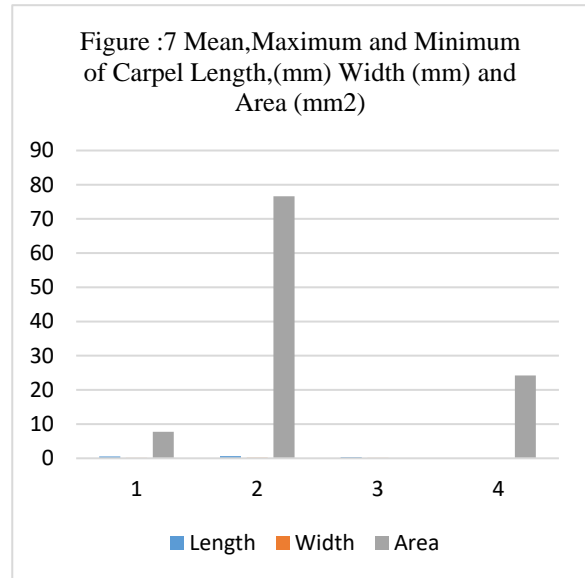


There are 5 stamens in each flower. This number is not fix and show some variations. The mean length of the stamen recorded was 0.5726 mm with a width of 0.4922mm. The mean area recorded was 0.085443372 mm. The mean length, width and area were like all samples collected from same altitudes. Figure: 5

The mean length of leaves 55.63 mm ( $R^2 = 0.765$ ) followed by mean width 8.840983 ( $R^2 = 0.0068$ ). Similarly, their mean area observed was 485.2222 mm ( $R^2 = 0.0902$ ). Leaves showed a greater

influence of climate conditions. There is direct correlation between slop, sunlight and temperature with the size of leaves. Figure 6.

Total number of carpel (N =5). Mean length



of carpel was recorded was 0.5528667 ( $R^2 = 0.30$ ). Mean width of carpel was recorded was 0.443( $R^2 = 0.456$ ). Mean area of carpel was recorded was 7.7348584 ( $R^2 = 0.2728$ ). Figure:7

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**Author competing interest**

Authors declare that there is no competing interest.

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