Carrots hold significant importance as one of the top 10 essential vegetables globally, owing to their nutritional value and industrial applications. Its scientific name is *Daucus carota* L it belongs to the Apiaceae family and has a chromosome number of 2n=2x=18. Vernalization, which involves exposing plants to prolonged cold temperatures, plays a crucial role in the life cycle of carrots by initiating the flowering process. Regarding vernalization requirements, carrots can be categorized into two types: Temperate carrots or European carrots, and Tropical carrots or Asiatic carrots. Temperate carrots are biennial and late flowering in nature, requiring vernalization for flowering initiation. On the other hand, tropical carrots are annual and early flowering, requiring less or no vernalization for flowering initiation. Typically, vernalization temperature requirements for carrots range from 5-10°C. Biennial varieties usually require 11-12 weeks of vernalization at 5°C for flowering initiation, while annual varieties may need 5-30 days of vernalization. Carrots show insensitivity to vernalization until they reach the 8-12 leaf stage, with a root diameter of approximately 4-8 mm. Although both annual and biennial carrots share the same duration of the insensitive stage, they differ in their vernalization requirements. This difference in vernalization requirement poses a major challenge in carrot breeding.

The research aims to investigate the involvement of transposable elements (TEs) in the vernalization requirement of carrots. TEs are mobile genetic elements capable of moving within the genome, and when located near genes, they can acquire their sequences, leading to the formation of chimeric genes. This process plays a pivotal role in evolution, providing a source of novel genes and facilitating the development of new phenotypes and adaptation to different environments. The research is divided into two experiments. The first experiment involves growing F1 hybrid seeds (from crossing between 'Brasilia' and DH1) and performing selfing after flowering to obtain F2 population seeds. In the second experiment, F2 mapping populations will be developed by sowing seeds and growing plants in three different locations. Phenotypic observations of flowering, such as the number of days from sowing to inflorescence formation, will be recorded in the F2 population. Genotyping of the F2 population will be conducted using high-throughput technology, such as whole-genome sequencing of 160 F2 plants. This will involve SNP calling and identification of transposable element-derived structural variants (TEASVs) to be used as markers for constructing a genetic map. Identifying quantitative trait loci (QTLs) governing vernalization requirements can provide valuable knowledge for crop improvement in both temperate and tropical carrots.

Nowadays, TEs are gaining importance due to their role in the evolution of new cellular functions or pathways. Identifying quantitative trait loci (QTLs) governing vernalization requirements can provide valuable knowledge for improving both temperate and tropical carrots. These QTLs can be further explored to understand the causal genes and pathways involved in trait variation. The information generated can be utilized for genomic selection, marker-assisted breeding, gene discovery, and crop improvement. In the future, this research can facilitate the development of early-flowering temperate carrot cultivars that are adapted for cultivation and propagation in tropical regions. Ultimately, this research benefits both the scientific community by expanding our knowledge and the farming community by providing improved cultivars and hybrids for carrot breeding.