**Phytotoxic and cytotoxic effects of *Thymus pallidus Batt*. essential oil**

EL Bouzidi L. Ouchtiti H. and Bekkouche K.

Laboratory of Agri-Food, Biotechnologies and Valorization of Plant Bioresources (AGROBIOVAL). Agro Biotech Center, Labeled Research Unit-CNRST N°5, Faculty of Sciences Semlalia, Cadi Ayyad University, P.O. Box 2390, 40000, Marrakech, Morocco

Weeds impact the growth and yield of associated crops by competing for space and nutrients, resulting in significant economic losses. To counteract their negative impacts, numerous synthetic chemicals have been tested and employed. However, these not only pose environmental threats but also raise concerns about human health. Moreover, the repetitive and uncontrolled use of herbicides has led to the emergence of resistant weed strains. Consequently, farmers often have to either increase their application or switch to a different herbicide, further escalating maintenance costs. This underscores the pressing need for an innovative and sustainable approach to weed management.

Natural compounds derived from plants, compared to their synthetic counterparts, offer advantages such as rapid biodegradability, a low risk of inducing weed resistance, and reduced toxicity to non-target organisms. Among these compounds, essential oils, which have been extensively used in food preservation and medicinal practices for millennia, are recognized for inhibiting the growth of competing plants. Thus, they could serve as environmentally compatible alternatives to synthetic herbicides.

This study evaluates the phytotoxic and cytotoxic potential of the essential oil from Thymus pallidus Batt., a species endemic to Morocco. The principal components of this oil were o-cymene (45.13%), borneol (12.56%), and thymol (11.58%). The EO was observed to reduce germination rates, seedling growth (both root and shoot length), mitotic index, and the frequency of viable cells in a dose-dependent manner. It also caused noticeable alterations in nuclear structures, evidenced by chromosomal aberrations. In conclusion, the Thymus pallidus essential oil demonstrates potent phytotoxic and cytotoxic activities, suggesting its potential development into a novel bioherbicide for sustainable weed management in agricultural systems.