



# COMPARATIVE PHYTOTOXIC EFFECT OF THE ESSENTIAL OIL OF *CHENOPODIUM AMBROSIoidES* AND *MENTHA LONGIFOLIA* ON *AVENA FATUA*

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## ABSTRACT

Present study was conducted to explore the herbicidal effect of volatile essential oil of *Mentha longifolia* (L.) L. and *Chenopodium ambrosioides* L. against *Avena fatua* L. weed. A significant effect of essential oil was observed on early seedling growth, chlorophyll content and cellular respiration over a concentration range of 0.01 – 0.25 mg/ml as compared to control ones. More inhibition was observed in shoot length as compared to root length. Greater inhibitory effect was observed in *M. longifolia* oil followed by *C. ambrosioides* oil. The Essential oil of both the plants caused loss in chlorophyll content and also causes impairment in cellular respiration, thus, affecting the overall physiological growth of test weed. The study concludes that these essential oils has bio-herbicidal property and can be used as environmentally safe bioherbicide.

**Keywords:** Bioherbicide, Chlorophyll, Essential Oil, Respiration Volatile,

## I INTRODUCTION

Essential oils obtained from plants are secondary metabolites which help plants in their defense mechanism against predators and also help plant survival in case of competition with other plants [1]. These essential oils are aromatic, volatile and complex in nature having monoterpenes as major constituents and these components are reason for their unique aromatic smell and biological properties [1]. From plants, these can be obtained mainly through steam distillation process along with some solvent extraction methods. In general, essential oil has a common use in perfumeries, cosmetics along with pharmaceutical practices. These also used as flavoring agent in various food products and drinks. Essential oils possess various biological properties such as antioxidant, antibacterial, antifungal, antiviral, insecticidal, nematocidal and insect repellent properties [2] [3] [4]. Beside these, essential oil also shows phytotoxic and allelopathic activity [5] [6] [7]. As these are ecological safer in nature (easily biodegradable), these can be used as a novel bioherbicides [8] [9].



*Chenopodium ambrosioides* L., an annual herb of family Chenopodiaceae is a native species of tropical South America, principally Mexico; distributed globally in the tropical, sub-tropical and temperate regions. Plant is erect having oblong, lanceolate leaves and purplish flowers. The essential oil of *C. ambrosioides* shows antibacterial, antifungal, insecticidal and antioxidant properties [10] [11] [12].

*Mentha longifolia* (L.) L. commonly known as wild mint or horse mint belongs to family Lamiaceae. It is an herbaceous perennial plant with a peppermint-scented aroma grown wild along riverside and moist places throughout the temperate regions of the world. It has an erect stems 40–120 cm tall. The leaves are oblong-elliptical to lanceolate, 5–10 cm long and 1.5–3 cm broad. The flowers are 3–5 mm long with lilac, purplish, or white colors. Essential oil of *M. longifolia* possesses antibacterial, antifungal and antioxidant properties [13] [14]. In Iran, various part of plant is used orally for vomiting, stomachache, hypertension, diarrhea, poisoning, asthma and fever [15].

## II MATERIAL AND METHODS

### 2.1 Extraction of oil

The Essential oil has been extracted from the fresh leaves and floral buds of *C. ambrosioides* and *M. longifolia* using Clevenger's apparatus through hydro-distillation. It was stored at 4°C for further use in bioassay.

### 2.2 Pre-emergent activity of oil under laboratory condition

*Mentha* and *Chenopodium* essential oils were assessed for the phytotoxic activity ranging from 0.025mg/ml – 0.25mg/ml under laboratory condition. Seeds of *Avena fatua* were imbibed in distilled water for 24 h. To determine the phytotoxic effect, solution of oils were prepared with the help of Tween 20 (a surfactant). Seeds of weed were equidistantly placed in petri dishes (15 cm) lined with a thin layer of cotton and Whatman #1 filter paper. Filter papers were treated with oil solution of different concentration. Petri dishes were then sealed with brown tape. A similar set up but without essential oil served as control. For each concentration, five replicates were maintained. Entire set of *A. fatua* were kept at 15±2 °C in growth chamber. After seven days, seedling length of germinated weeds was measured.

### 2.3 Estimation of chlorophyll content

Chlorophyll was extracted from fresh leaves (25 mg) in 4 ml of dimethyl sulphoxide (DMSO) following the method of [16]. Its concentration was determined spectrophotometrically [17] and the amount was expressed in terms of tissue dry weight as suggested by [18].

## 2.4 Determination of cellular respiration

The cellular respiration value was determined indirectly using 2,3,5-triphenyl tetrazolium chloride following the method of [19]. In this method, cellular respiration was observed by the formation of red coloured compound named as formazan which traps the oxygen molecules released through respiratory chain. The absorbance was read at 530 nm and the values were expressed with respect to control.

## 2.5 Statistical analysis

The experiment was conducted in a completely randomized block design with five dependent replicates for each treatment (including control). Statistical analysis of data was done using one way ANOVA (Tukey's test at  $P \leq 0.05$ ) using statistical software SPSS (version 16.0). Data is presented as mean  $\pm$  S.E.

## III RESULTS AND DISCUSSION

In the present study, inhibitory effect of two essential oils extracted from *C. ambrosioides* and *M. longifolia* plants have been studied on the growth of weed *Avena fatua*. A significant (at  $P \leq 0.05$ ) decline in seedling growth, chlorophyll content and cellular respiration has been observed. In comparison, *M. longifolia* essential oil was found to be more effective as compare to essential oil of *C. ambrosioides*.

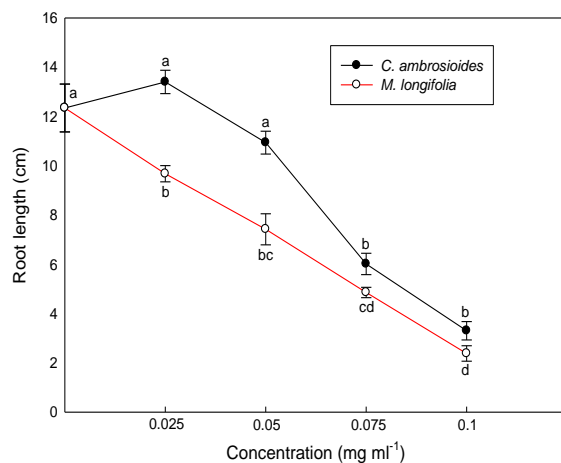


Fig 1 = Effect of the essential oil of *C.ambrosioides* and *M.longifolia* on root length of *A. fatua*. Bars along each data point represent the standard error of the mean and different alphabets along each value represent significant difference from their respective control  $P \leq 0.05$ .

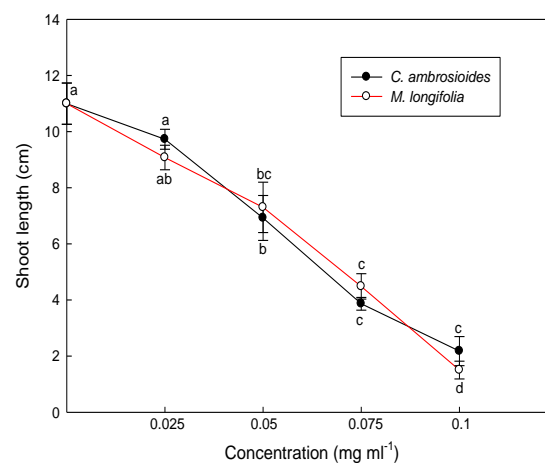


Fig 2 = Effect of the essential oil of *C.ambrosioides* and *M.longifolia* on shoot length of *A. fatua*. Bars along each data point represent the standard error of the mean and different alphabets along each value represent significant difference from their respective control  $P \leq 0.05$ .

At highest concentration ( $\geq 0.25\text{mg/ml}$ ) both the essential oils completely inhibited the germination of *A. fatua*. Further, at concentration ( $\geq 0.1\text{mg ml}^{-1}$ ), 80.72% decline in root length has been observed when treated with *M. longifolia* oil while 73.44% decline was observed as compare to control ones on treatment with emulsion of *C. ambrosioides* essential oil (Fig 1). Similar significant (at  $P \leq 0.05$ ) declining effect on shoot length has also been observed at higher concentration ( $0.1\text{mg ml}^{-1}$ ). It showed 86.32% and 80.18% reduction in shoot length over control on treated with *M. longifolia* and *C. ambrosioides* essential oil respectively (Fig 2).

In earlier studies, it has been reported that the essential oil inhibits the growth of seedling causing morphological and physiological change in the plant seedling [9] [20] [21] [22] which is in agreement with the present study. In the present study, the observed inhibitory effect may be either due to synergistic or additive effect of various components of essential oil. However, the exact mechanism of inhibition of germination and growth of seedling is still unknown. However, such inhibitory effect have been reported in previous studies which concludes that such inhibitory effect may be due to inhibition in cell proliferation at the apical meristem [23] [24].

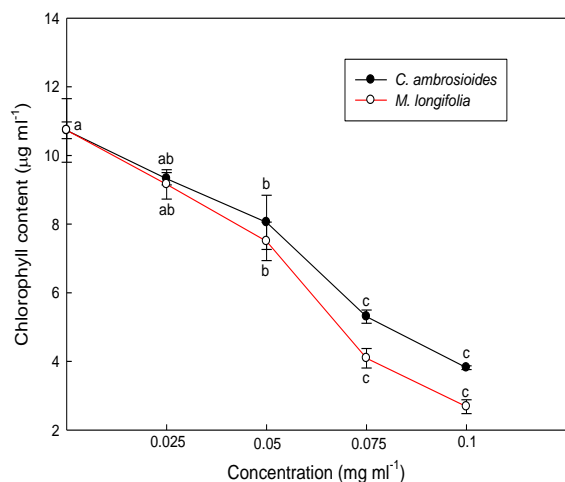


Fig 3 = Effect of the essential oil of *C.ambrosioides* and *M.longifolia* on chlorophyll content of *A. fatua*. Bars along each data point represent the standard error of the mean and different alphabets along each value represent significant difference from their respective control  $P \leq 0.05$ .

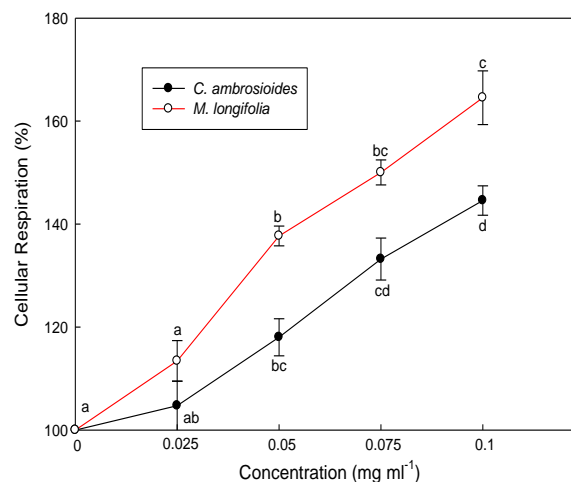


Fig 4 = Effect of the essential oil of *C.ambrosioides* and *M.longifolia* on cellular respiration of *A. fatua*. Bars along each data point represent the standard error of the mean and different alphabets along each value represent significant difference from their respective control  $P \leq 0.05$ .

Further, a significant (at  $P \leq 0.05$ ) reduction in chlorophyll content has been observed in response to  $\geq 0.1\text{mg/ml}$  in both the cases. It showed 75.02% (*M. longifolia*) and 64.41% (*C. ambrosioides*) decline as compare to control (Fig 3). However, there is no evidence of direct inhibition of chlorophyll synthesis. It could be either due to its inhibitory



effects on chlorophyll synthesis or by enhancing degradative pathways of chlorophyll or both [24] [25] [26]. In any case, the loss of chlorophyll affects photosynthesis and thus effects the overall physiological growth of weed.

The essential oil not only caused reduction in chlorophyll content but also caused increase in cellular respiration. A significant (at  $P \leq 0.05$ ) increase in percent cellular respiration was observed. The weed *A. fatua* showed significant (at  $P \leq 0.05$ ) increase in percent respiration in response to concentration  $\geq 0.1$  mg/ml. As compare to control, the cellular respiration increased by 64.54% and 44.57% on treatment with the essential oil of *M. longifolia* and *C. ambrosioides* respectively (Fig 4). This fact is also supported by some earlier studies demonstrating an increase in cellular respiration in response to monoterpenes, possibly to meet the increased demand of energy by the plant [27].

#### IV CONCLUSION

From the present studies, it can be concluded that both the essential oil have phytotoxic effect on seedling growth of *A. fatua*. They inhibit the growth of weed by chlorophyll destruction or by inhibiting chlorophyll synthesis or both. It also interferes with respiration. Although the phytotoxic effect of essential oil of *Mentha longifolia* is comparatively more than the effect of essential oil of *Chenopodium ambrosioides*. These oils can also be used as a potential source for weed management. Further, herbicidal activity of the essential oil can be increased with the use of adjuvant or the development of different formulation. More studies are required to explore their herbicidal or phytotoxic potential against under field condition.

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