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EFFECTIVE MODE OF ESSENTIAL OIL APPLICATION OF *TAGETES MINUTA* L. TO MANAGE *PHALARIS MINOR* RETZ.

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ABSTRACT

Essential oil (EO) of *Tagetes minuta* L. extracted from aerial parts of plant through hydro-distillation was tested for its chemical composition by GC-MS. In order to explore the allelopathic potential of the oil, it was tested under laboratory conditions on a common agricultural weed *Phalaris minor*. The modes of oil application were volatile form (VB), solution form (SB) and oil mixed with agar-agar (AAB). Bioassay studies revealed a dose-dependent inhibitory effect of EO of *T. minuta* on growth of *P. minor*. Most effective mode of treatment was VB followed by AAB and minimum effect was observed in SB. Thus, volatile form of EO is best suitable for managing *P. minor* in agroecosystems.

Keywords: Allelopathy, *Tagetes minuta*, Essential oil, *Phalaris minor*, Growth bioassay.

INTRODUCTION

The genus *Tagetes* belongs to family Asteraceae and comprises 56 species, of which 27 are annuals and 29 are perennials (Soule, 1996). Amongst all species, *Tagetes minuta* L. is most widely studied due to its high-grade oil used in food, perfumery, pharmaceutical, nutraceutical and agricultural industries (Chalchat *et al*., 1995; Singh *et al*., 2003). *T. minuta* is native to South America;however, it grows in wild and arable farming systems as a noxious weed (Holm *et al*., 1997). It is a problematic weed of pastures and numerous crops (Hulina, 2008) as it may colonize waste grounds, roadsides, gardens, orchards and vine yards (Bandana *et al*., 2018). The plant was introduced in India for its essential oil (Rao *et al*., 1988) but it has naturalized itself in Himalayan and sub-Himalayan regions up to altitude of 2000m in waste places, roadsides, rocky hill slopes and cultivated fields of different states *viz.*Uttar Pradesh, Sikkim, Arunachal Pradesh, Nagaland and Meghalaya (Maheshwari, 1972).

Essential oil (EO) of *T. minuta* possesses pharmacological, antibacterial, antiviral, antifungal, nematicidaland insecticidal properties (Ali *et al*., 2014; Shirazi *et al*., 2014). Various researchers have reported ocimene, dihydrotagetone, tagetone, tagetenone as the major components of its oil as revealed through GC-MS analysis (Meshkalsadat *et al*., 2010; Tiwari *et al*., 2016). Rich phytochemistry of essential oil of *T. minuta* have led farmers to grow it under cultivation specially in drug growing areas of the world (Chalchat *et al*., 1995). Despite many reports of ethnobotanical and pharmacological uses of essential oil of *T. minuta*, very few reports have indicated its possible use in controlling weeds in agroecosystems or wastelands (Singh *et al*., 2003; Lopez *et al*., 2009; Arora *et al*., 2015, 2016). There is no report about the mode of application of EO of *T. minuta* for effective and eco-friendly weed management. With this background, present study was undertaken to explore the effect and efficacy of different methods of oil application on *Phalaris minor* Retz., a common agricultural weed of wheat agroecosystems.

MATERIALS AND METHODS

Plant Material Collection and Oil Extraction

Aerial parts of *T. minuta* plant were collected at flowering stage from Solan and adjoining places of Himachal Pradesh, India (30°55'0" North, 77°7'0" East). Shoots were chopped and subjected to hydro-distillation for 2h using a Clevenger-type apparatus. Seeds of little seed canary grass (*P. minor*) were collected from the agricultural fields in and around Chandigarh.

Analysis of Essential Oil and Identification of its Components

Qualitative data pertaining to identification of relative amount of each constituent in essential oil of *T. minuta* was done by Gas Chromatography-Mass Spectrometry (GC-MS). Detailed procedure has been reported earlier (Arora *et al*., 2015).

Growth Bioassay

To test the allelopathic effect of *T. minuta* oil on test weed, growth bioassays were divided into three categories *i.e*., volatile (VB), solution (SB) and agar-agar (AAB) bioassays. In VB, test seeds (surface sterilized

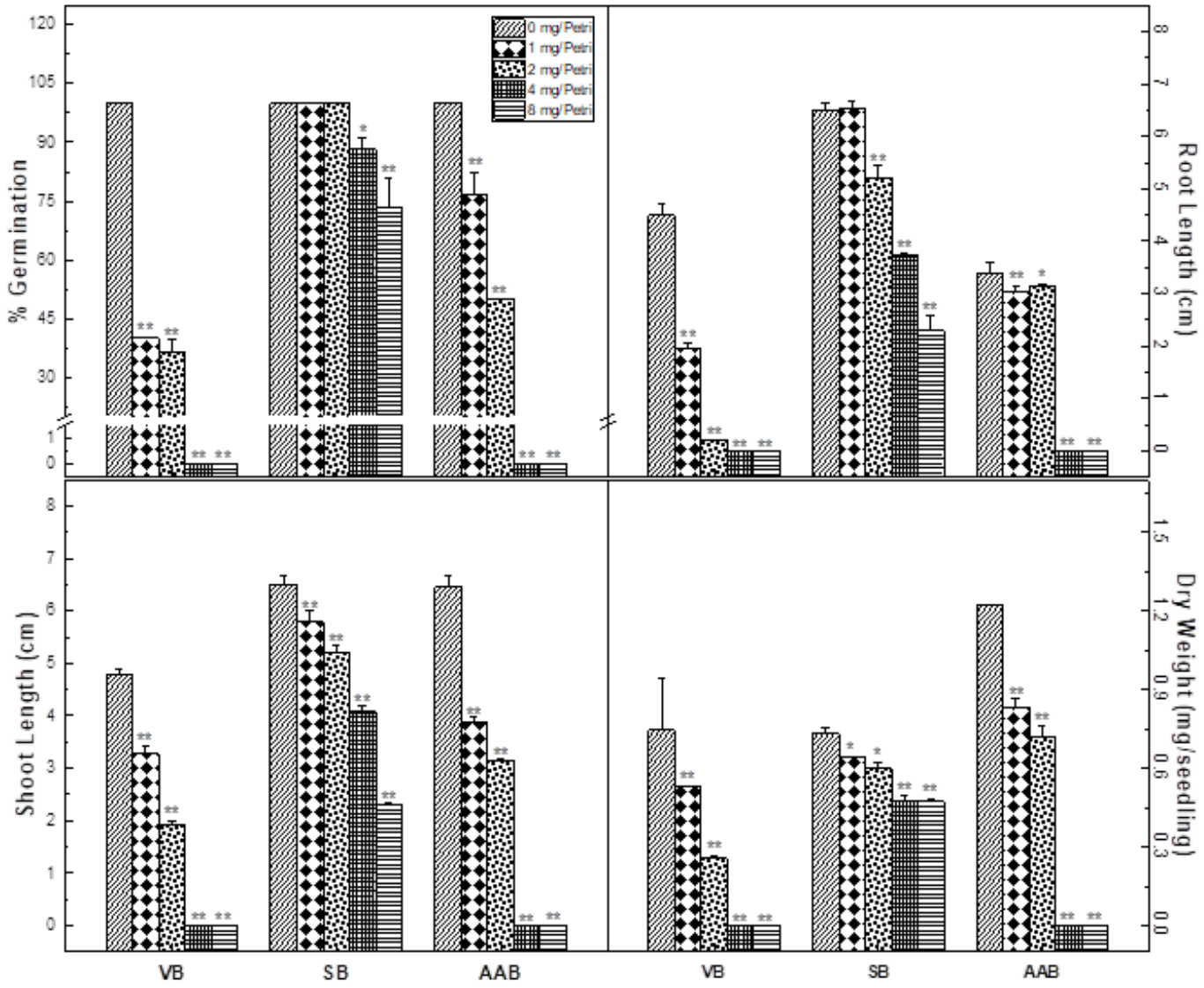

Fig. 1: Effect of different modes of application of EO of *T. minuta* on growth of *P. minor.* Data are represented as mean values. Vertical bars along each treatment indicate standard deviation of means. Asterisks indicate the statistical significance (**P ≤ 0.01; *P ≤ 0.05) applying Dunnett t-test.

and imbibed) were placed equidistantly on 15 cm wide Whatman no. 1 filter paper moistened with 8 ml of distilled water and *T. minuta* oil was applied on lid of Petri dishes using concentrations 1, 2, 4 and 8 µg per Petri dish and sealed immediately with parafilm to minimize the loss of volatile vapours. In SB, same concentrations of oil were prepared using Tween 80 as emulsifier and 8 ml of each concentration was used per Petri dish. Seeds of test weed were placed equidistantly and Petri dishes were sealed immediately. In AAB, different concentrations of EO were applied on Whatman filter paper and immediately poured 30 ml of 0.9% agar-agar solution over it. Test seeds were placed over gelled agar-agar and Petri dishes were sealed immediately with parafilm. A similar treatment without loading of oil and using same volume of distilled water in all bioassays served as control. For each treatment, five replicates were placed in a completely randomized design in growth chamber, maintained at standard conditions of light, temperature and humidity. After seven days, seed germination was noted down for all bioassays and seedling length and dry weights were measured. Dose response curves between concentration of oil and germination response of plants were drawn. Data were subjected to one-way analysis of variance (ANOVA) followed by separation of treatment means from the control at $p \leq 0.01$ and 0.05.

RESULTS AND DISCUSSION

27 Compounds were identified in essential oil of *T. minuta* constituting 95% of the oil. The oil was found rich in monoterpenes both hydrocarbon as well as oxygenated types. In another publication detailed composition of *T. minuta* EO has been published (Arora *et al*., 2015). *cis*-β-Ocimene and dihydrotagetone were the major components of oil. Many reports in past have identified similar compounds in essential oil of *T. minuta* (Meshkalsadat *et al*., 2010; Ghiasvand *et al*., 2011; Amri *et al*., 2013; Ali *et al*., 2014).

Dose response curves (Fig.1) of EO of *T. minuta* on germination and early growth of test plants showed

significant inhibition of *P.* minor. The allelopathic inhibition by EO was statistically significant in all treatments, however, in VB, reduction in germination, root length, shoot length and dry weight was more than SB as well as AAB. At 2 mg/Petri concentration, reduction in root length was 95.6% in *P. minor*. Similarly, reduction in shoot length was 60.2%. Germination and dry weight reduction also followed similar trend.

Thus, present study confirmed allelopathic potential of EO of *T. minuta* which is in accordance with earlier reports related to use of essential oils in weed management (Chaturvedi *et al*., 2012; Alipour and Saharkhiz, 2016; Benchaa*et al*., 2018 etc.). However, the use of *T. minuta* EOin different forms (mode of treatment: VB, SB and AAB) has not been related to its allelopathic potential in any report till date. On the basis of this study, it can be recommended that volatile form of EO of *T. minuta* is best suitable for controlling *P. minor* in agro-ecosystems. Future scope of this study lies in exploring herbicidal potential of foresaid recommendations at field level in correlation with wheat crop that may further confirm the use of EO of *T. minuta* as a bioherbicide.

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