Imperial Journal of Interdisciplinary Research (IJIR)
Vol-3, Issue-2, 2017
ISSN: 2454-1362, http://www.onlinejournal.in

Allelopathic Potential of Common Mallow (*Malva sylvestris* L.)

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Abstract*: The present work was conducted to investigate the allelopathic potential of Common Mallow (Malva sylvestris L.) weed growing in Benghazi agricultural fields on seed germination and seedling development of Radish (Raphanus sativus L.). Flowers, leaves, stems and roots aqueous extracts of Common Mallow at 1%,5% and 10% concentrations were applied to determine their effect on seed germination, germination index (GI), speed/rate of germination (SG/RG), seedling vigor index (SVI), root length (RL), hypocotyle length (HL), seedlings fresh weight (FW) and seedlings dry weight (DW) of test plant under laboratory conditions. The aqueous extracts of all plant parts caused inhibitory effects on all measurement, which increased progressively on increasing the concentration of extracts. On the other hand, at low concentration (1%) stimulation of some traits of different plant parts was recorded. These results could be explained in the light of the facts that a higher plants release a diversity of allelochemicals into the environment, which include phenolics, alkaloids, long-chain fatty acids, terpenoids, and flavanoids. The compounds exhibit a wide range of mechanisms of action effect on DNA (alkaloids), photosynthic and mitochondrial function (quinines), phytohorme activity, ion uptake and water balance (phenolics).*

1. Introduction

Allelopathy is derived from the Greek words allelon "of each other "and pathos "to suffer" (Rizvi, Haque, Singh & Rizvi, 1992). Rice (1974) defines allelopathy as any direct or indirect effect by one plant, including microorganisms, on another through the production of chemical compounds that escape into the environment and subsequently influence the growth and development of neighboring plants. These effects can be harmful or beneficial (Rice, 1984). Allelopathy is an important mechanism of plant interference mediated by the addition of plant-produced secondary products to the soil rhizosphere (Weston, 2005). The beneficial or harmful effects of one plant on anther plant both crop and weed species , take place by the release of chemicals from plant parts by leaching , root exudation, volatilization, residue decomposition and other processes in both natural and agricultural systems (Ferguson & Rathinasabapathi, 2009).

Because of human population increase in recent years, the demand on food has also increased. The weed competition is one of the major constraints in food production due to its inhibition of seed germination and seedling growth of crop species through allelopathy and therefore reducing yield. On the other side allelopathy offer potential for biological control of weeds, through production and release of allelochemicals from flowers, leaves, stems, and roots of living or decomposing plant materials (Patil, 2007). Under suitable environments allelochemicals may produce in quantity, which inhibit the growth and development of weed seedlings similar to herbicides (Weston, 1996). Many researchers (e.g. Weston, 2005; Khan, 2005 & Patil et.al., 2007), have suggested that, this phenomenon can be employed in weed management programmers, in particular, allelochemicals may use as alternative to synthetic herbicides.

Therefore, in this work we evaluated the ability of extracts of Common Mallow (*Malva sylvestris* L.) growing in agriculture fields in Benghazi, Libya, which have not been tested before to inhibit or suppress the growth and development of other plants.

2. Materials and methods

Laboratory experiments were conducted to investigate the allelopathic activity of Common Mallow (*Malva sylvestris* L.) weed on Radish (*Raphanus sativus* L.) . The experiments were conducted in Main Research Laboratory, University of Benghazi, Faculty of Science, Botany Department.

The Seeds of Radish were obtained from local market. Seeds were kept in the containers which they were supplied, and stored in the laboratory at room temperature until required for sowing. Common Mallow weed was collected from its natural habitat during the flowering stage to test the allelopathic

activities of the aqueous extract of flowers, leaves, stems and roots. The collected materials were dried in oven at 60C° for 24 hours then ground and stored in glass jars until used. To obtain different concentrations (W/V) of flowers, leaves, stems and roots; 1, 5 and 10 grams of the weed were soaked in 100 ml distilled water for 24 hours at room temperature and stored in the refrigerator at 4°C until used. Growth chamber conditions for germination were 25 C°, in dark, and relative humidity 65 %.

Radish was used as the recipient. Twenty seeds (surface sterilized were sown onto 9 cm Petri-dishes lined with one layer of Whitman No. 1 filter paper. 5 ml of each extract from different concentrations were delivered to each Petri-dish and distilled water (5ml) was used as control. Germinated seeds with a radical were recorded and root and shoot lengths and fresh and dry weights of seedling were measured after 5 days of sowing. A variety of parameters were used in this work to assess the effects of weed extracts on seed germination and seedlings development of test species. These parameters include:

1. **Percent of seed germination**

Germination%=

$$\frac{\textit{No.of seeds with extened radicals}}{\textit{Total number of seeds}} \times 100$$

2. **Seed germination index (SGI)**

Seed germination index (SGI) was calculated according to the following equation (Scott *et al*., 1984).

SGI = [SIGMA]TiNi / S

Where,

Ti*= is the number of days after sowing* ***Ni****= is the number of seed germinated on day* ***S****= is the total number of seeds planted.*

3. **Speed of germination/ Rate of germination:**

Speed or rate of germination was computed by using the following formula, (Patil, 2007).

SG/RG = $N_1/D_1 + N_2/D_2 + N_3/D_3 + \ldots\ldots\ldots\ldots + N_n/Dn$

Where,

SG*=Speed of germination*

RG*=Rate of germination*

N_1, $N2$, $N3\ldots\ldots N_n$*= Number of seedling emerged on* D_1, $D2$, $D3\ldots\ldots D_n$ *days after sowing.*

4. **Seedling vigor index (SVI)**

The seedling vigor index was calculated by using Abdul-Baki and Anderson (1973) formulae.

SVI = (Shoot length+ Root length) ×Germination percentage.

5. **Root and shoot length:**

Length of roots and shoot system were measured in cm using a ruler

6. **Fresh weight:**

. The fresh weight of the whole Seedling was recorded by weighing small tins empty after drying for a few minutes at 80C° in an oven and then with the amount of fresh sample.

7. **Dry weight:**

Samples were dried for 24 hours in an oven at 80 C°, the tins were removed from the oven closed allowed to cool, weighed and put back in the oven for further 24 hours periods until constant weight was reached.

8. **Inhibition of growth:**

Relative reduction or stimulation of seed germination, root length , shoot length and fresh weight and dry weight as affected by the allelopathic substance were calculated according to the general equations, (Nesrine *et al*., 2011).

[1- (allelopathic/control) × 100]

Statistical treatment of data:

Data were subjected to standard one-way analysis of variance (ANOVA) using the COSTAT, 2.00 statistical analysis soft were manufactured by CoHort Software Company (1986).

3. Results and discussions:

1. **Percent of Germination:**

Results indicated that extracts of all plant parts of common mallow at 1% concentration had no significant effect on seed germination of Radish. At 5% concentration leaves extract only recorded significant decrease in germination percentage (57%) compared to control (99%). At 10% concentration significant decrease in germination percentage for flowers, leaves and stems extracts especially leaves extract (30%) compared to control (99%).

Meanwhile roots extract at 10% concentration had no significant effect on seed germination (Fig. 1).

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2. Germination Index (GI):

According to data in Fig. (2) extracts of all plant parts at 1% concentration had no significant effect on GI. At 5% concentration all plant parts extracts significantly decreased GI of Radish seedlings with the highest effect recorded for leaves and stems extracts (1.42 and 2.50 respectively) compared to control (3). Meanwhile extracts of all plant parts at 10% concentration recorded inhibitory effect on GI. The highest effect was for leaves extract (0.78) compared to control (3).

3. Speed /Rate of Germination (SG/RG):

Results showed no significant effect on speed/rate of germination for all extracts at 1% concentration except the leaves extract recorded significant decrease in speed/rate of germination (36.60) compared to control (45.30). At 5% concentration all plant parts extracts significantly decreased germination rate of radish seeds with the highest effect for leaves and roots extracts (17.8 and 11.5 respectively) compared to control (45.30). On other side at 10% concentration all extracts decreased speed/rate of germination significantly especially leaves extract (6.30) in comparison with control (45.30).

4. Seedling Vigor Index (SVI):

The results indicated that the effect of Common Mallow weed aqueous extracts of all plant parts at 1% concentration had no effect on SVI except roots extract which increased SVI significantly (2400) compared to control (1544). At 5% concentration all plant parts extracts significantly reduced SVI compared to control particularly extract of leaves (zero) while roots extract increased SVI compared to control. At 10% concentration all plant parts extracts significantly reduced SVI especially leaves extract (SVI=zero) (Fig. 4).

5. Root Length:

The data on effect of Common Mallow allelochemicals on root length (cm) presented in Fig. (5 & 6). At 1% concentration all extracts of different plant parts had no significant effect on root elongation of Radish seedlings, except roots extract significantly stimulated root elongation (82%) in comparison with control. At 5% concentration, all plant parts extracts reduced root length of Radish seedlings with the highest inhibition caused by extract of stems (46%) compared to control. At 10% concentration, the obtained data recorded significant reduction in root length for all plant parts extracts, particularly the extract of flowers (85%) compared to control. For leaves extracts at 5% &10% concentrations there was no recorded growth for Radish seedlings after germination (zero).

6. Hypocotyle Length:

Data concerning hypocotyle elongation in Radish seedlings showed in Fig. (7&8) significant stimulation of hypocotyle length was recorded for all extracts at 1% concentration especially extract of roots showed significant increase in hypocotyle length (30%). At 5% concentration, the extracts of flowers and roots significantly increased hypocotyle length. The highest increase recorded for flowers extract (33%) compared to control. While extract of stems recorded significantly decrease in hypocotyle length (31%). At 10% concentration the obtained data recorded significant reduction in hypocotyle length for all plant parts extracts, particularly the extracts of leaves, which completely inhibited the growth of hypocotyle at 5% & 10%. Concentrations (zero).

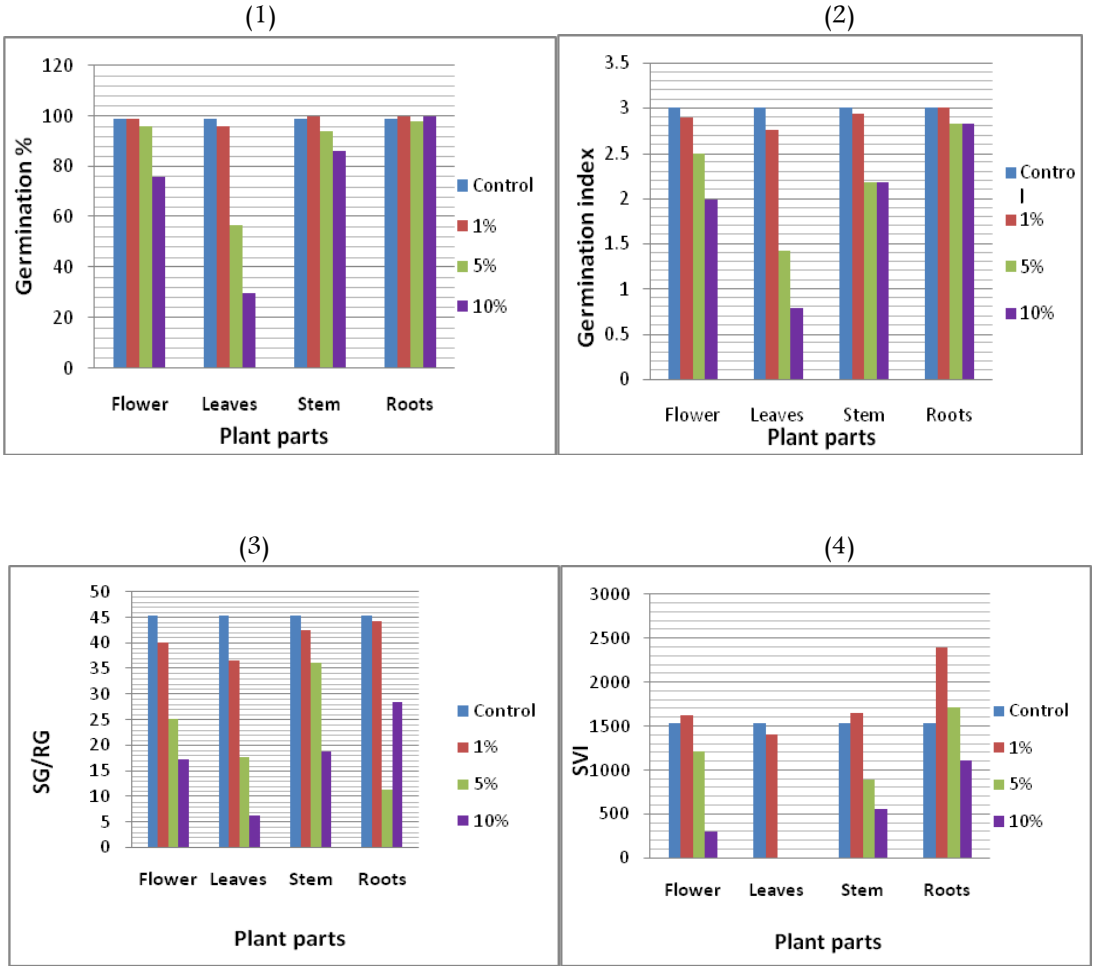
7. Fresh Weight:

The data in Fig. (9 & 10) shows that all concentration of different plant parts had marked effect on seedlings fresh weight in comparison with control. In contrast, stems and roots extracts at 1% concentration showed significantly stimulated effect on fresh weight of seedlings (18% & 39%). Meanwhile flowers and leaves extracts at 1% concentration significantly reduced seedlings fresh weight in comparison with control. Also at 5% & 10% concentrations, extracts of all plant parts recorded significant reduction in fresh weight of Radish seedlings in particular leaves extract in which no growth recorded.

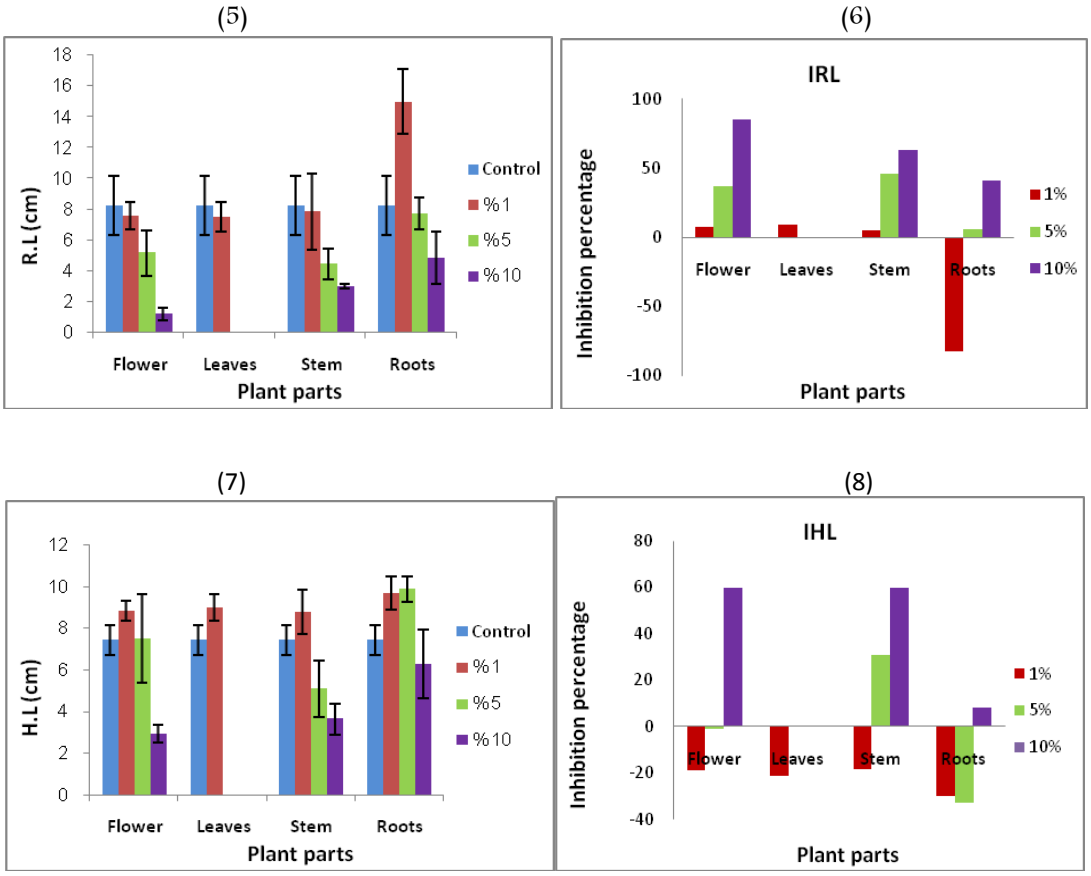
8. Dry Weight:

Dry weight of seedlings presented in Fig. (11 & 12).Data presented in histogram revealed that flowers and leaves extracts at 1% concentration significantly decreased seedlings dry weight (23%). In contrast, extracts of stems and roots recorded stimulatory effect on seedlings dry weight. The stimulatory effect was higher for roots extracts (13%) compared to control. Meanwhile 5% concentration of stems and flowers extracts had no significant effect on dry weight of Radish seedlings. On other had roots extract decreased dry weight significantly (26%) compared to control. Extracts of all plant parts at 10% concentration however, recorded significant increase in dry weight of Radish seedlings except leaves extracts in which no growth recorded at 5% & 10% concentrations.

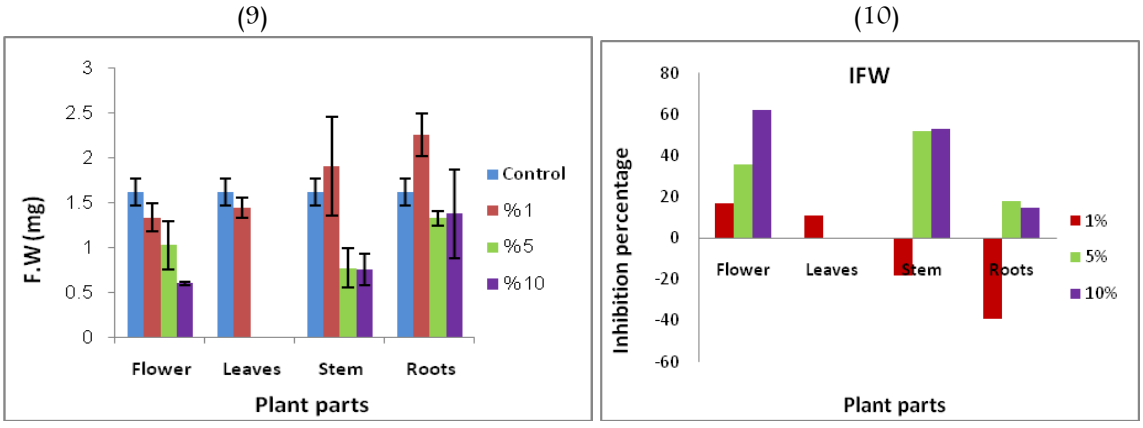
Allelopathic effects of aqueous extracts of different parts of Common Mallow (*Malva sylvestris* L.) on seed germination and seedling development of Radish (*Raphanus sativus* L) has been observed in Petri-dish bioassay. According to ANOVA test, the results showed that germination percentage, germination index (GI), speed/rate of germination (SG/RG), seedlings vigor index (SVI), root length, hypocotyle length, fresh weight and dry weight were inhibited. The inhibitory effect on most traits increased with the increase of extract concentration, this probably as result of increase in the amount of allelochemicals and therefore, Phytotoxcity (Zahed and Ansari, 2011). Negative effects of allelopathic extracts were more clear in root and shoot elongation of Radish seedlings especially at high concentration. This might be due to the presence of inhibiters of cell division and cell growth in extracts (Jalali *et al*., 2013). In general, extract of Common Mallow leaves recorded highest inhibitory effect on all measured parameters compared to other plant parts and this effect was happened because of the highest amount of allelochemicals in leaves.(Sharma *et.al*., 2000).



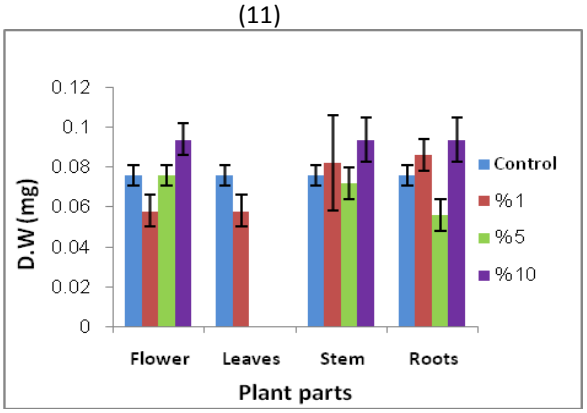
Figures 1, 2, 3 and 4: Allelopathic potential of Common Mallow (*Malva sylvestris* L.) aqueous extracts at different concentrations of different plant parts on seed germination (Fig.1), germination index (Fig.2), speed/rate of germination (Fig.3), and seedling vigor index(Fig.4) of Radish (*Raphanus sativus* L.) after 5 days of planting.



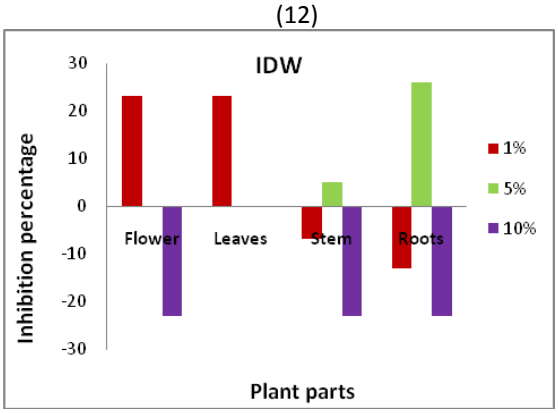
Figures 5, 6, 7 and 8: Allelopathic potential of Common Mallow (*Malva sylvestris* L.) aqueous extracts at different concentrations of different plant parts on RL (Fig. 5), %IRL (Fig. 6), HL (Fig. 7) and %IHL (Fig. 8) of Radish (*Raphanus sativus* L.) after 5 days of planting



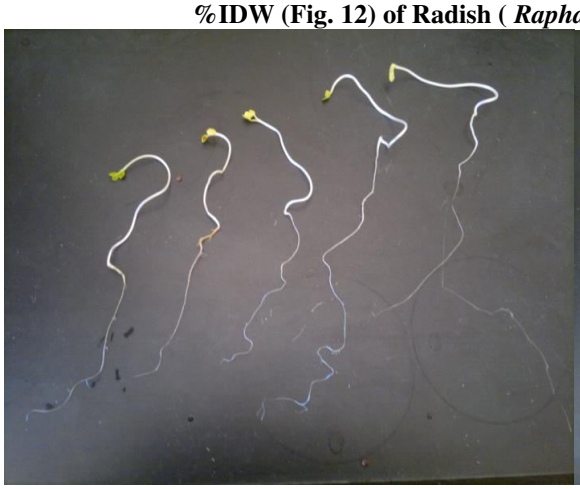
(11)



(12)



Figures 9, 10, 11 and 12: Allelopathic potential of Common Mallow (*Malva sylvestris* L.) aqueous extracts at different concentrations of different plant parts on FW (Fig .9), %IFW (Fig. 10), DW (Fig. 11) and %IDW (Fig. 12) of Radish (*Raphanus sativus* L.) after 5 days of planting



L, F, S, R at 1% concentration, Control

L, F, S, R at 5% concentration, Control

L, F, S, R at 10% concentration, Control

Extract leaves at 1, 5, 10% concentration

Plate 1. Allelopathic potential of Common Mallow (*Malva sylvestris* L.) aqueous extracts at different concentrations of different plant parts on Radish (*Raphanus sativus* L.) after 5 days of planting.

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