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Research Article

ASSESSMENT OF ALLELOPATHIC POTENTIAL OF AN OBNOXIOUS WEED – *HYPTIS SUAVEOLENS* (L.) PIOT. ON THE SEED GERMINATION OF CROPS - *TRITICUM AESTIVUM* L. AND *ELEUSINE CORACANA* GAERTN

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ABSRTACT
The plant, *Hyptis suaveolens* (L.) Poit. commonly known as *Wilayati tulsi* belongs to the family Lamiaceae .The plant has been considered as an obnoxious weed, distributed throughout the tropics and subtropics. It is naturalized in India and is considered as a potent invader. Although it has several medicinal properties and used in folklore remedies but its spread is so fast that in due course of its establishment it disrupts the recruitment pattern in the nearby occupied. Not only it restricts the area for other species but it increases livestock pressure on the native species because of its unpalatable nature due to presence of essential oils. However, no information is available in the literature on the allelopathic activity of this obnoxious weed on the germination of the crop plants like Triticum aestivum L., (wheat) and *Eleusine coracana* Gaertn., (Ragi). The allelopathy of *Hyptis suaveolens* (L.) Piot., was studied by extracting the crude aqueous extracts- leachates from the leaves of this plant and 3 different concentrations – 0.01%, 0.25% and 1% of these extracts were assessed on the germination of test crops - *Triticum aestivum* L and *Eleusine coracana* Gaertn. The linear growth - Root length and Shoot length and the Fresh and Dry matter accumulation were recorded. The Growth equations- Percent Germination of seeds, Percentage Seed mortality, Relative Growth Ratio, Relative Elongation of Shoot, Relative Elongation of Roots, Relative Biomass Ratio and Seed Vigour index of seeds were calculated for the above test crops. The results show that the 1% leachate showed inhibition on all the above mentioned parameters analyzed in Wheat while the same 1% concentration in case of Ragi showed inhibitory effect on Percent Germination of seeds, Percentage Seed mortality, Relative Growth Ratio, Relative Elongation of Shoot and Relative Biomass Ratio While, the Relative Elongation of Roots and Seed Vigour index of seeds were promoted by the same.

Keywords: *Hyptis Suaveolens (L.) Poit., Triticum Aestivum L., Eleusine Coracana Gaertn., Allelopathy, Leachate*

INTRODUCTION
Plants release various compounds into their surroundings that have either deleterious or beneficial effects on other plants in the vicinity. This naturally occurring chemical - interaction between plants is known as allelopathy (Rice, 1984). The non-nutritional secondary metabolites produced by an organism of one species affect the growth and population biology of individuals of other species are known as allelochemicals (Minorsky, 2002; Callaway and Ridenour, 2004) and these allelochemicals impose environmental stress on other plants growing in their vicinity. Allelopathy as an ecological approach and allelochemicals as biological herbicides have been a challenge to current
synthetic chemical approaches (Suma *et al*., 2002; El-Rokiek *et al*., 2006).

Hyptis suaveolens L., a potent medicinal herb, is commonly known as wilayati tulsi and it belongs to the family Lamiaceae. *Hyptis* is a rigid annual herb of aggressive nature (Mudgal *et al*., 1997). It contains several chemical constituents such as carbohydrate, phenol, tannin, saponin, alkaloid, steroid and flavonoid etc. which are responsible for its medicinal properties (Wealth of India, 1964). *H. Suaveolens* L. is being used in traditional medicine to treat various diseases. The leaves of this plant have been used as stimulant, carminative, sudorific and as a cure for parasitic cutaneous diseases whereas the crude leaf extract is used as a relief to colic and stomachache. Leaves and twigs are considered to be antispasmodic

and used in antirheumatic and antisuporific baths, an anti - inflammatory agent and also applied as an antiseptic in burns, wounds and other skin related problems (Chitra *et al*., 2009). The decoction of the roots is highly valued as appetizer and is reported to contain urosolic acid, a natural HIV – integrase inhibitor (Chatterjee and Pakrashi, 1997). Fumes of dried leaves of *H. Suaveolens* L. are also used to repel mosquitoes and control insect pests to control insect pests of stored grains (Mandal *et al*., 2007). The substitution of triclosan an antimicrobial agent used in household and personal care products by the ecofriendly plant phenolics as well as the screening of antimicrobial and antifungal efficiency of *Hyptis suaveolens* L. (Suneetha *et al*., 2013).

The germination studies using the aqueous extract of the aerial parts of *Hyptis suaveolens* (L.) Poit. On five common weeds – *Alternanthera sessilis* R.Br., *Echinochloa colonum* (L) Link., *Tridax procumbens* L., *Parthenium hysterophorus* L. and tubers of *Cyperus rotundas* L. and crop plants- black gram(vigna mungo (L).Hepper), Cluster bean – *Cyamopsis tetragonoloba* Taub., Cotton – *Gossypium hirsutum* L., ladies finger – *Abelmoschus esculentus* L., and rice – *Oryza sativa* showed that the extract inhibited germination of the weed seeds while the seeds of crop plants were unaffected (Rao *et al*., 1987).

The utilization of dry leaf residues of *Hyptis suaveolens* L. rich in allelochemicals as a potential bioherbicide to control the spread of *Parthenium hysterophorus* (Riti, 2011).

The allelochemicals of *Hyptis suaveolens* L. leaf exhibited herbicidal activities on seed germination and seedling growth of *Pennisetum setosum*, *Mimosa invisa* and the authors recommend for more studies on *Hyptis suaveolens* for the practical use in agriculture pest management (Boon *et al.,* 2012). The Allelopathic effects of the leaves of *Hyptis suaveolens* (L.) Poit. on the germination of seeds of *Sorghum vulgare*, radish (*Raphanus sativus* L) and lettuce (*Lactuca sativa* L.) shows that the chromatographic analysis of essential oil present in the leaves of *H.suaveolens* has compounds with allelopathic potential (Rodrigues *et al*., 2012).

The aqueous methanol extracts of *Hyptis suaveolens* L. have strong allelopathic potential and suppress the seedling growth of barnyard grass –*Echinochloa crusgalli* and the crude extract and or the residue of *Hyptis suaveolens* L. could also be recommended to apply directly as bio-herbicide (Islam *et al*., 2013). The phytotoxic substance, Suaveolic acid isolated from the aqueous methanol extract of *Hyptis suaveolens* L. at concentrations greater than 30µM,showed phytotoxicity against the shoot and root length of garden Cress, Italian rye grass ,barnyard grass and lettuce shoots and the phytotoxic activity of *Hyptis suaveolens* L. plant extract may be due to suaveolic acid (Mominul *et al*., 2014).

MATERIALS AND METHODS

Materials

The study was conducted in the Laboratory of the Department of Biological Sciences, Bangalore University, Bangalore. The leaves of *Hyptis suaveolens* (L.) Poit. were collected from the plants growing wild on the Bangalore University Campus.

The leaves were air dried, packed in paper bags and stored. The Leachate was prepared by soaking One gram of air dried powdered leaves of *Hyptis suaveolens* (L.) Poit. in 100ml of glass distilled sterile water for 72hrs at the lab temperature of 25±10c and normal pressure. The solutions were filtered through whatmann No.1 filter paper and stored under refrigeration. From the leachate of 1gram in 100ml, 2 dilutions of 0.01% and 0.25% were prepared . Along with these 2 dilutions, the concentrated leachate of concentration- 1% without dilution was tested against the control (Distilled water) on the growth of the test crops – *Triticum aestivum* L. (Wheat) and *Eleusine coracana* Gaertn (Ragi).

Method

Wheat and ragi grains were surface sterilized in 0.1% Mercuric chloride, washed thoroughly with distilled water. Seven seeds of wheat and ragi each in petridishes of 9cm diameter with 3 replicates were used for control, 0.01%, 0.25% and 1% concentrations respectively. During the experimental period, the mean maximum and mean minimum temperature were 25ºc and 18 ºc respectively. The relative humidity ranged between 53-76%. The aqueous extracts were used regularly to moisture the seeds. The

germination and seedling growth were recorded for 7 days. After 7 days, the morphological parameters – the germination of seeds, the linear growth – plumule –shoot and radical –root length and dry matter accumulation were recorded.

The germination and growth ratio's were obtained through the formula's as below (Bughio *et al.*, 2013).

1. *Percent germination* (Scott *et al.*, 1984)

$G\% = Gn/GN \times 100$

Where , Gn is the number of seeds germinated after 7 days and GN is the total number of seeds set for germination.

2. Percent mortality rate

$MR = MRn/GN \times 100$

Where, MR is the percentage mortality rate, MRn is the number of seeds died after germination and GN is the total number of seeds germinated.

3. *The relative germination ratio* (Rho and Kil, 1986)

$RGR = GRt/GRc \times 100$

Where, RGR is the relative germination ratio, GRt is the germination ratio of plants under treatment and GRc is the germination ratio of plants under control.

4. *Relative Elongation of Shoot* (Rho and Kil, 1986)

$RERs = MLSt/MLSc \times 100$

RERs are the relative elongation ratio of shoot, MLSt is the mean length of shoot of plant under treatments and MLSc is the mean length of shoot of plant under control.

5. Relative Elongation of Root

$RERr = MLRt/MLRc \times 100$

RERr is the relative elongation ratio of root, MLRt is the mean length of root of plant under treatments and MLRc is the mean length of root of plant under control.

6. Relative biomass ratio

$RBR = MBt/MBc \times 100$

Where, RBR is relative biomass ratio, MBt is the mean biomass of plant under treatments and MBc is the mean biomass of plant under control.

7. *Seedling vigour Index* (Abdul – Baki and Anderson, 1993)

SVI = Germination percentage × Radical length.

The results were subjected to statistical analysis and the standard deviations (S.D) among the different treatments were analyzed.

RESULTS AND DISCUSSION

The germination studies on *Triticum aestivum* L. and *Eleusine coracana* Gaertn, with the aqueous leachate of different concentrations – 0.01%, 0.25% and 1.0% of *Hyptis suaveolens* (L.) with reference to various growth equations are discussed below.

The Figure 1 and Figure 2 of *Triticum aestivum* L. and *Eleusine coracana* Gaertn. respectively shows the shoot and root length, Biomass of the seedlings in terms of fresh and dry weight.

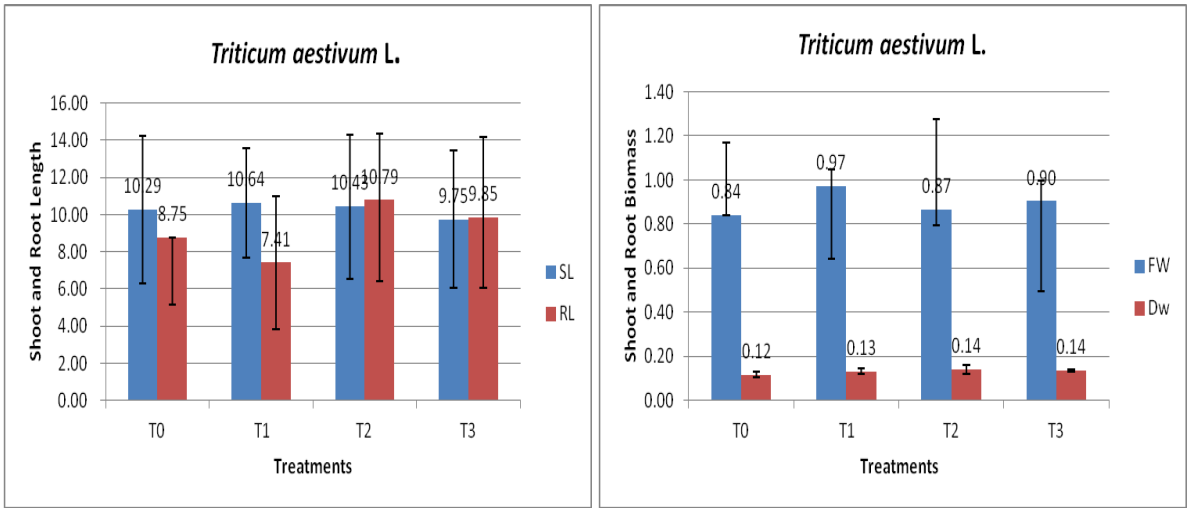


Figure 1: The allelopathic effects of various *Hyptis suaveolens* (L.). Piot., treatments on Plant parameters (shoot and root length and Shoot and Root biomass) of *Triticum aestivum* L. (T0- Control, T1- 0.01%, T2-0.25% and T3-1.0%)

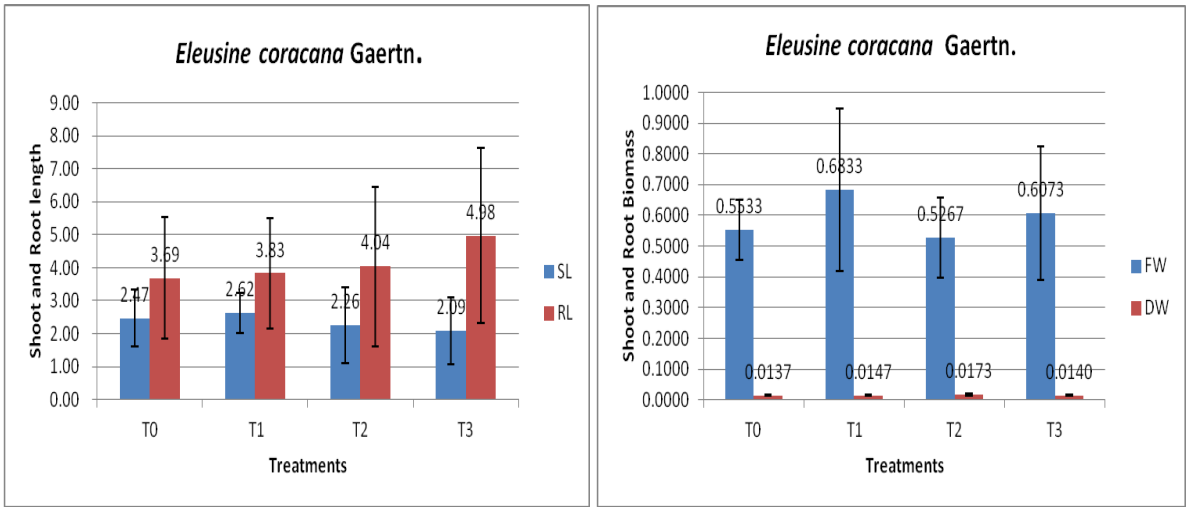
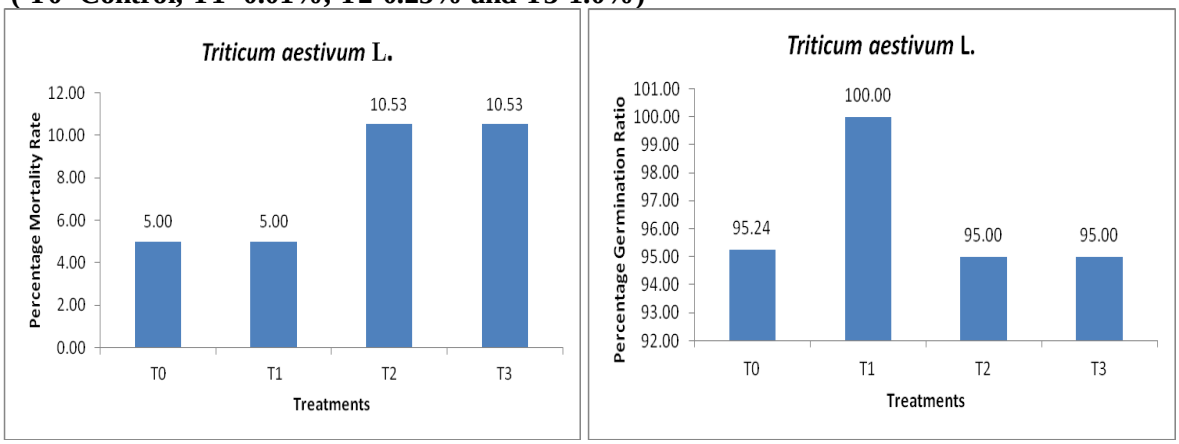


Figure 2: The allelopathic effects of various *Hyptis suaveolens* (L.). Piot., treatments on Plant parameters (shoot and root length and Shoot and Root biomass) of *Eleusine coracana Gaertn*.

(T0- Control, T1- 0.01%, T2-0.25% and T3-1.0%)



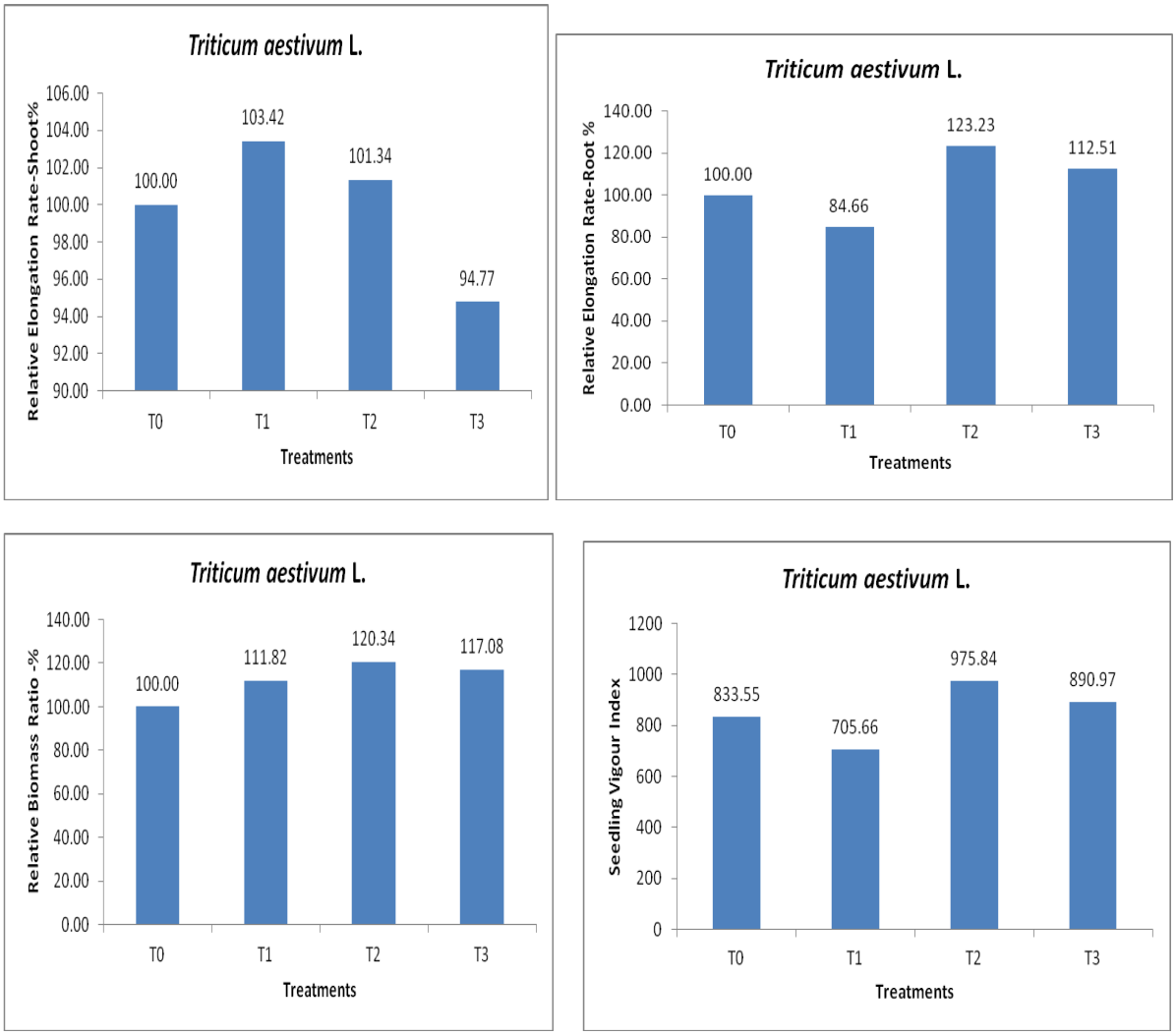
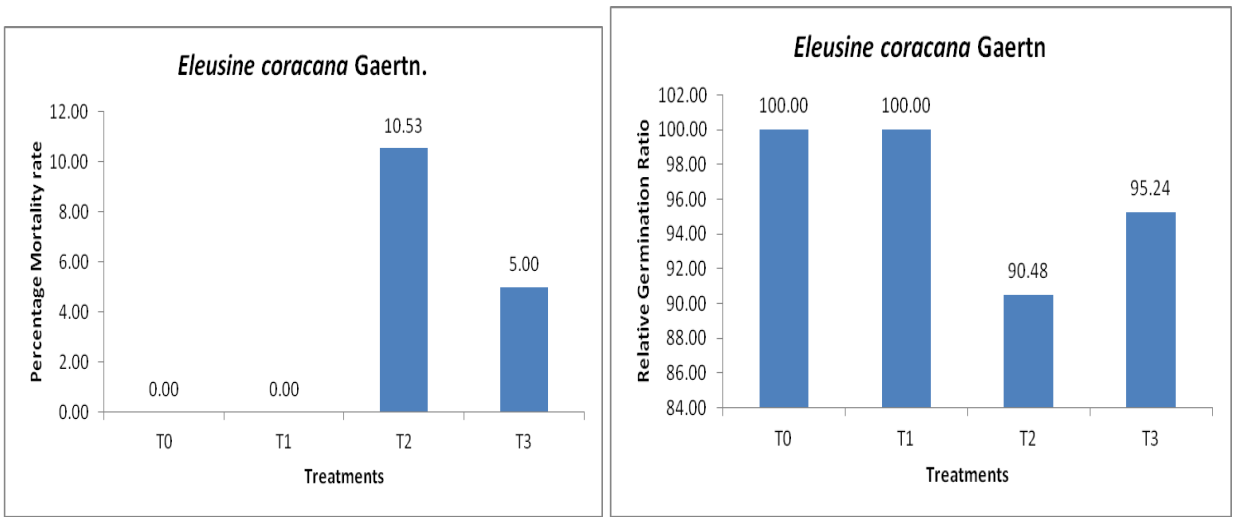


Figure 3: Effect of *Hyptis suaveolens* (L.). Piot. treatments on Relative Germination Ratio (RGR), Percentage Mortality Rate, Relative Elongation ratio of shoot (RERs), Relative Elongation ratio of Root (RERr), Relative Biomass Ratio (RBR) and Seedling Vigour Index of *Triticum aestivum* L.



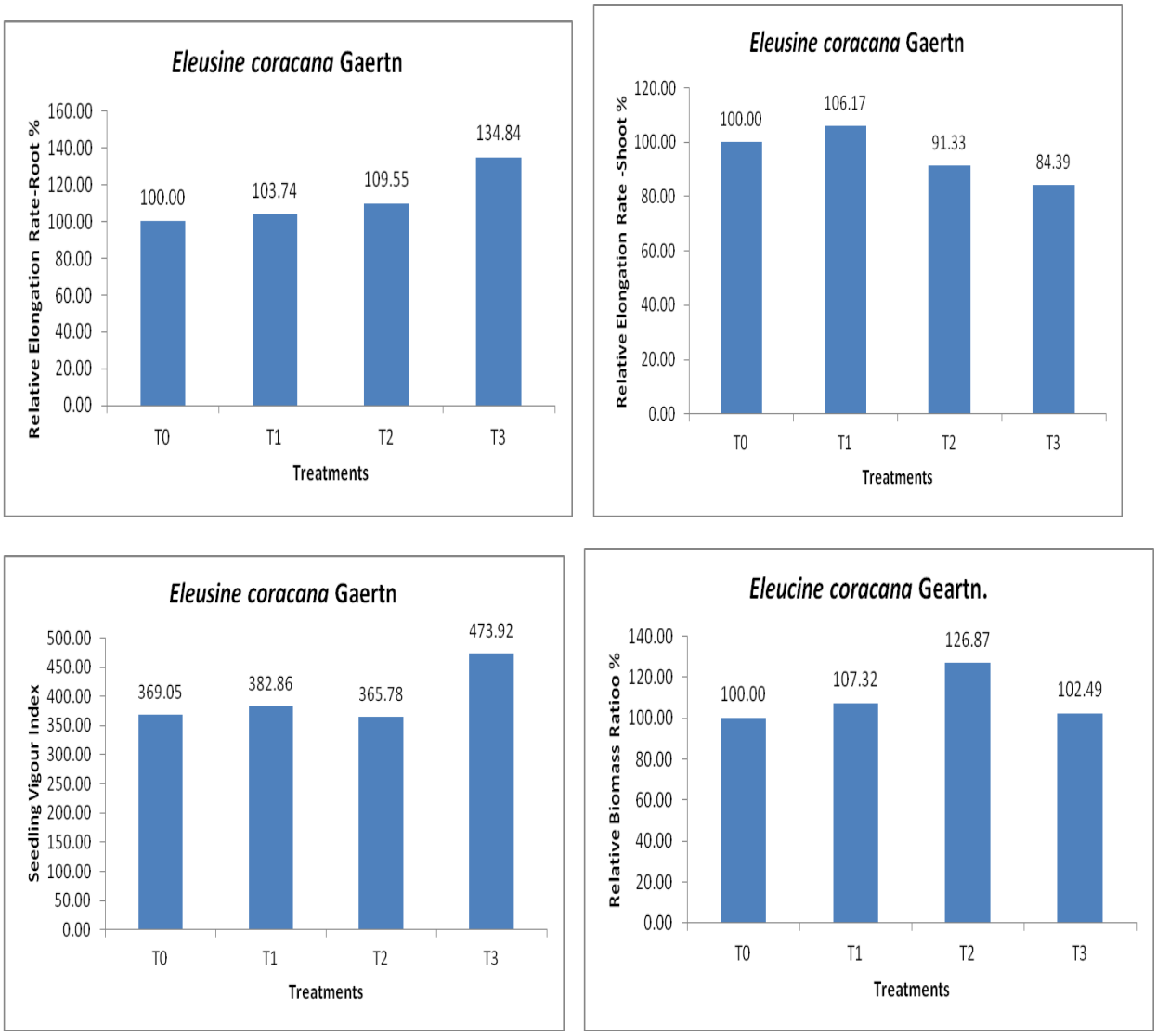


Figure 4 : Effect of *Hyptis suaveolens* (L.). Piot. treatments on Relative Germination Ratio (RGR), Percentage Mortality Rate, Relative Elongation ratio of shoot (RERs), Relative Elongation ratio of Root (RERr), Relative Biomass Ratio (RBR) and Seedling Vigour Index of *Eleusine coracana* Gaertn

The Figure 3 and Figure 4 shows the results of various growth equations in *Triticum aestium* L. and *Eleusine coracana* Gaertn. respectively. The Growth Equations Explain the following-

1. *Percentage Germination*

In case of *Triticum aestivum* L, the maximum percent germination was recorded in 0.01% and minimum in 1% leachate. The percentage germination of seeds in 0.01% and control showed the same results. Therefore 1% leachate concentration shows inhibition in percentage germination of *Triticum aestivum* seeds over 0.01% leachate and control as well (Table 1; Figure 3).

In case of *Eleusine coracana* Gaertn. seed germination, the 0.01% leachate showed maximum percent germination same as control, while the minimum percent germination was recorded in 0.25% leachate concentration. Therefore, 1% leachate concentration shows inhibition in percent germination of seeds over 0.01%, and 0.01% shows same results as that of the control (Table 2; Figure 4).

Table 1: The allelopathic effects of *Hyptis suaveolens* (L.) Poit. Leaf leachate of different concentrations on plant parameters of *Triticum aestivum* L. (Wheat). (T_0- Control, T_1- 0.1%, T_2- 0.25%, T_3- 1%). (The values are the mean of 3 relpications)

Treatments	Parameters				
	Plumule-Shoot Germination	Length(cm)	Radicle-Root Length(cm)	Fresh weight(g)	Dry weight(g)
T_0	100%	2.47	3.69	0.5533	0.0137
T_1	100%	2.62	3.83	0.6833	0.0147
T_2	90.47%	2.26	4.04	0.5267	0.0173
T_3	95.23%	2.09	4.98	0.6073	0.0140

Table 2: The allelopathic effects of *Hyptis suaveolens* (L.) Poit. Leaf leachate of different concentrations on plant parameters of *Eleusine coracana* Gaertn (Ragi). (T_0- Control, T_1- 0.1%, T_2- 0.25%, T_3- 1%). (The values are the mean of 3 replications)

Treatments	Parameters				
	Plumule-Shoot Germination	Length(cm)	Radicle-Root Length(cm)	Fresh weight(g)	Dry weight(g)
T_0	100%	2.47	3.69	0.5533	0.0137
T_1	100%	2.62	3.83	0.6833	0.0147
T_2	90.47%	2.26	4.04	0.5267	0.0173
T_3	95.23%	2.09	4.98	0.6073	0.0140

2. *Percentage Mortality*

In case of *Triticum aestivum* L. the maximum percent mortality rate of the seeds increase as the concentration increases, hence maximum percentage mortality is recorded in 0.25% and 1% leachate concentrations..Therefore, 0.01% leachate concentration and the control records least mortality rate of the seeds over 0.25% and 1% leachate concentration.

In case of *Eleusine coracana* Gaertn. The percentage mortality rate increases as the concentration of the leachate increases. The mortality rate is maximum in 0.25% and decreases with 1% concentration. The 0.01% and the control shows zero mortality of the seedlings and in these cases, all the seedlings germinated.

3. *Relative Germination Ratio (RGR)*

In case of *Triticum aestivum* L. The relative germination ratrio decreases as the leachate concentration increases, the RGR being maximum in 0.01%. While, 0.25%, 1% and the control all the three shows the same RGR ratio.

In case of *Eleusine coracana* Gaertn. The RGR is maximum in 0.01% concentration as well as control and least recorded in 0.25%.

Hence, 0.01% promotes RGR in both *Triticum aestivum* L. and *Eleusine coracana* Gaertn.

4. *Relative Elongation Rate of the Shoot* (RER's)

In case of *Triticum aestivum* L. the RER's is maximum in 0.01% over control and minimum in 1% leachate concentration. Hence as the concentration of the leachate increases, the RER's decreases. Therefore, 0.01% leachate concentration is promoting the relative elongation rate of the shoots over control.

In case of *Eleusine coracana* Gaertn., the RER's is maximum in 0.01% over control and least recorded in 1% leachate concentration. As the concentration increases the RER's also decreases.

Hence, 0.01% leachate concentration shows promotion in the elongation of shoots over control in both the test crops and 1% shows the inhibition in the same.

5. *Relative Elongation Rate of the Root (RER'r)*
In case of *Triticum aestivum* L., the relative elongation of the root records maximum in 0.25% over control. The 0.01% records minimum RGR over 1% concentration.
In case of *Eleusine coracana* Gaertn., as the concentration of the leachate increases, the RGR'r also increases, maximum in 1% and minimum in 0.01%and 1% is promotive over control.
6. *Relative Biomass Ratio* (RBr)
In case of *Triticum aestivum* L., the relative biomass ratio of the seedlings was maximum in 0.25% followed by 1% and least in 0.01%.Hence 0.25% promotes the relative biomass ratio over the control.
In case of *Eleusine coracana* Gaertn., the RBr is maximum in 0.25% followed by 0.01% and least in 1%.Hence 0.25% promotes the RBR over the control.
7. *Seedling Vigour Index*
In case of *Triticum aestivum* L., Seedling vigour index is maximum in 0.25% followed by 1% and records least in 0.01%.Therefore, 0.25% promotes seedling vigour index over control, which shows the lowest minimum values compared with all the three concentrations of the leachate.
In case of *Eleusine coracana* Gaertn., maximum seedling vigour index is shown by 1% and least in 0.25%. Hence 1% shows highest seedling vigour index over control.
The allelochemicals can stimulate the seedling growth at very low concentrations but inhibit the seedling growth at high concentrations (Rice, 1984; Lovett *et al*., 1989; Liu and Chen, 2011; Islam and Kato, 2012). Our studies is in agreement with the above studies and the overall results of the effect of aqueous leachate of 0.01%, 0.25% and 1% concentration of *Hyptis suaveolens* (L.) Poit. on the seed germination of test crops - *Triticum aestivum* L. and *Eleusine coracana* Gaertn., shows that 1% concentration is an inhibitory concentration for all the parameters of growth equations -percentage germination, Percentage Mortality rate, Relative Growth Ratio, Relative Elongation of Shoot, relative Elongation of Root, Relative Biomass Ratio and Seedling Vigour Index analyzed in *Triticum aestivum* L. while in *Eleusine coracana* Gaertn., 1% leachate concentration is inhibitory on percentage germination, Percentage Mortality rate, Relative Growth Ratio, Relative elongation of the shoot and Relative Biomass Ratio , while except Relative elongation rate of roots and Seedling Vigour Index which is been promoted by the same and our studies opine for the presence of allelochemicals in the aqueous extracts of *Hyptis suaveolens* (L.) Poit and our studies shows that 1% to be the inhibitory concentration among the 3 concentrations of the leachate studied on various parameters of wheat and Ragi.

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