

Full Length Research Paper

Allelopathic effect of aqueous extracts of different part of *Eclipta alba* (L.) Hassk. on some crop and weed plants

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The present study was conducted to investigate the allelopathic effects of *Eclipta alba* weed on seed germination and seedling growth weed plants (*Cassia tora* L., *Cassia sophera* L.) and crop plants (*Phaseolus aureus* L., *Oryza sativa* L.). Root, stem and leaf aqueous extracts of *Eclipta* at 0.5, 1.0, 2.0, and 4.0% concentrations were applied to determine their effect on seed germination and seedling growth of test plants under laboratory conditions. The aqueous extracts from root, stem and leaf had no effect on seed germination of test plants. Aqueous extracts from leaf, root and stem inhibited root length, shoot length and dry weight. Root length, shoot length, and dry biomass of weed and crop species decreased progressively when plants were exposed to increasing concentration (0.5, 1, 2, and 4%). However, the more pronounced negative effect on seedling growth and dry biomass was on weeds than on crops. Aqueous extract of leaves shows the maximum inhibition followed by root and stem. The pH of aqueous extracts of different parts of *E. alba* does not show any major change when the concentration increased.

Key words: Allelopathy, aqueous leaf extract, aqueous stem extract, aqueous root extract, *Cassia tora*, *Cassia sophera*, *Phaseolus aureus*, *Oryza sativa*.

INTRODUCTION

De Candolle (1832) was probably the first person to suggest the possibility that many plants may excrete something from their roots which may be injurious to other plants. Molisch (1937) proposed the term 'allelopathy' for expressing the harmful effects that one plant species may have on another through the mechanism of chemical retardants escaping into the environment. The concept of allelopathy was further supported and further developed by Bonner (1950), Grummer and Beyer (1960), Evenari (1961), Whittaker (1970), Putman and Duke (1978), and Fischer et al. (1978). Allelochemicals (inhibitors) are produced by plants as end products, by-products, and metabolites and

are contained in the stem, leaves, roots, flowers, inflorescence, fruits and seeds of the plants. Of these plant parts, leaves seem to be the most consistent producers of these allelochemicals. The four ways in which allelochemicals escape from a plant are:

- (i) Volatilization, during which the terpenes are released from the leaves of some plant species
- (ii) Leaching (which has shown that living or dead leaves of many plants contain growth inhibitors)
- (iii) Exudation in which case roots of several crop and non-crop species release large quantities of organic compounds that inhibit the growth of other plants

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(iv) Decomposition, through which allelochemicals are released from the plant residue.

E. alba (L.) Hassk. family, Asteraceae, grows as a common weed throughout India ascending up to 6000 ft. It is native of Asia but has a general distribution in areas of gangetic plains, in pasture lands, road sides, in marshes, rivers, lakes and on the foot hills of Himalayas (Mithun and Shashidhara, 2011).

E. alba, entirely pubescent herb, stem cylindrical, with longitudinal ridges, 2 to 5 cm in diameter, dark green in colour. Leaves opposite, sessile, usually oblong, lanceolate, margin entire or dentate, capitulum white from 2 to 6 mm in diameter. Achenes elliptical and flattened, 2 to 3 mm long, brown to pale brown. Odour slight: taste, slightly salty. *E. alba* has an important role in traditional Ayurvedic, unani system of holistic health and herbal medicine. The juice of fresh leaves mixed with neem oil and coconut, applied locally promotes hair growth and black pigment of herb makes a grey hair black. The juice is prescribed for skin disease, cough, rheumatism, bronchitis, allergic urticaria, flatulence, colic, and liver infections. The seeds are used in sexual debility and aphrodisiac. Besides the above mentioned medicinal importance, *E. alba* also shows the allelopathic behaviour. Its allelopathic effect has been demonstrated by several workers (Yonli et al., 2010, Nisar and Hussain, 1992, Pawinde et al., 2008)

The main objectives of this research were to study: the effects of aqueous extract of leaf, stem and leaves of *E. alba* on seedling growth and dry biomass of crop and weed species, and to compare the pH values of different plant parts of *E. alba*

MATERIALS AND METHODS

Preparation of aqueous extract

The *E. alba* plants which grew naturally in Aligarh Muslim University campus were uprooted and collected at their mature stage on May 12 and 13, 2010, for the experiment. The plants were brought into the laboratory and were immediately separated into leaf, stem and root parts. Each part of the fresh plant was cut into small pieces, shade dried and then ground separately with help of grinder and made fine powder. 4 g powder of root; stem and leaves of *E. alba* were dipped in 100 ml of distilled water and filtrate through a muslin cloth followed by filter paper (No.1. Whatman International, Maidstone, UK). After 24 h of soaking at room temperature and then further diluted so as to get 0.5 to 4% aqueous extract, respectively, as adopted from Singh et al. (1989).

Treatments and experimental design

Fresh seeds of crops and weeds were collected from the agricultural department and road sides of the Aligarh Muslim University. The seeds were thoroughly washed in running water and soaked in distilled water for 12 h. Petri dishes were given a thorough washing with detergent using hot water as precautionary measures against pathogens and pollutants. Seeds and filter papers were moistened with each of 0.5, 1, 2, and 4% aqueous

extracts. Distilled water was added to the untreated control (0%). Petri dishes of 9 cm diameter lined with filter paper were used for germination trial. There were 15 treatments including four concentration levels (0, 0.5, 1, 2, and 4%) of each leaf, stem, and root extracts. The treatments were arranged in completely randomized design (CRD) with five replicates kept at room temperature on a laboratory bench with 12 h supply of fluorescent light during the night. The whole experiment was repeated once.

Determination of pH

The pH of each extract prepared from different parts of *E. alba* was determined by immersing the electrode of a digital pH meter (EcoScan). The mean of five replicates were taken and presented.

Physical parameters

After seven days, the seedling root length (cm), shoot length (cm) and dry weight were determined (mg). The root and shoot length were determined manually while the dry weight with the help of 4 digit digital balance of Scientech, Model ZSA 120, Colorado (USA).

Statistical analysis

The data were subjected to one way analysis of variance and the mean values were separated at $P < 0.05$ applying 2-sample t-test. The statistical analysis was done using SPSS/PC version 10 soft

RESULTS AND DISCUSSION

As compared to the control (0%), the aqueous extracts of *Eclipta* from root, stem and leaf parts at 2 and 4% concentration levels exhibited significant ($P < 0.05$) inhibition on seedling growth. The effect was in general, more severe on *C. tora* in case of weed and on *Phaseolus aureus* in case of crops. Among the different parts, leaves were the most allelopathic and stems were least allelopathic. The inhibitory effect was concentration dependent (Figures 1 to 3). The inhibition effect was found to increase with increasing concentrations of different aqueous extracts (Sisodia and Siddiqui, 2008, 2009). The radicle length, plumule length, and dry weight of seedlings were reduced significantly in response to all the *E. alba* extracts.

At 4% concentration of the leaves extract, in case of *C. tora*, the radicle length and plumule length were reduced by nearly (94 and 85.81%) and in case of crop *P. aureus*, the radicle length was reduced by (34.36%), respectively (Figure 1). Generally, in studies with aqueous extracts, the observed inhibitory effect are attributed to change in pH thereby raising concern about allelopathy and its ecological existence and relevance (Harper, 1977; Conway et al., 2002; Sisodia, 2008).

In the present study, pH of extracts (that is, root, stem and leaves) ranged from 6.39 to 7.68 (Table 1). After making these observations, it could be concluded that, extracts might possess growth inhibitors. The observed different phytotoxicity of *E. alba* may be attributed to the

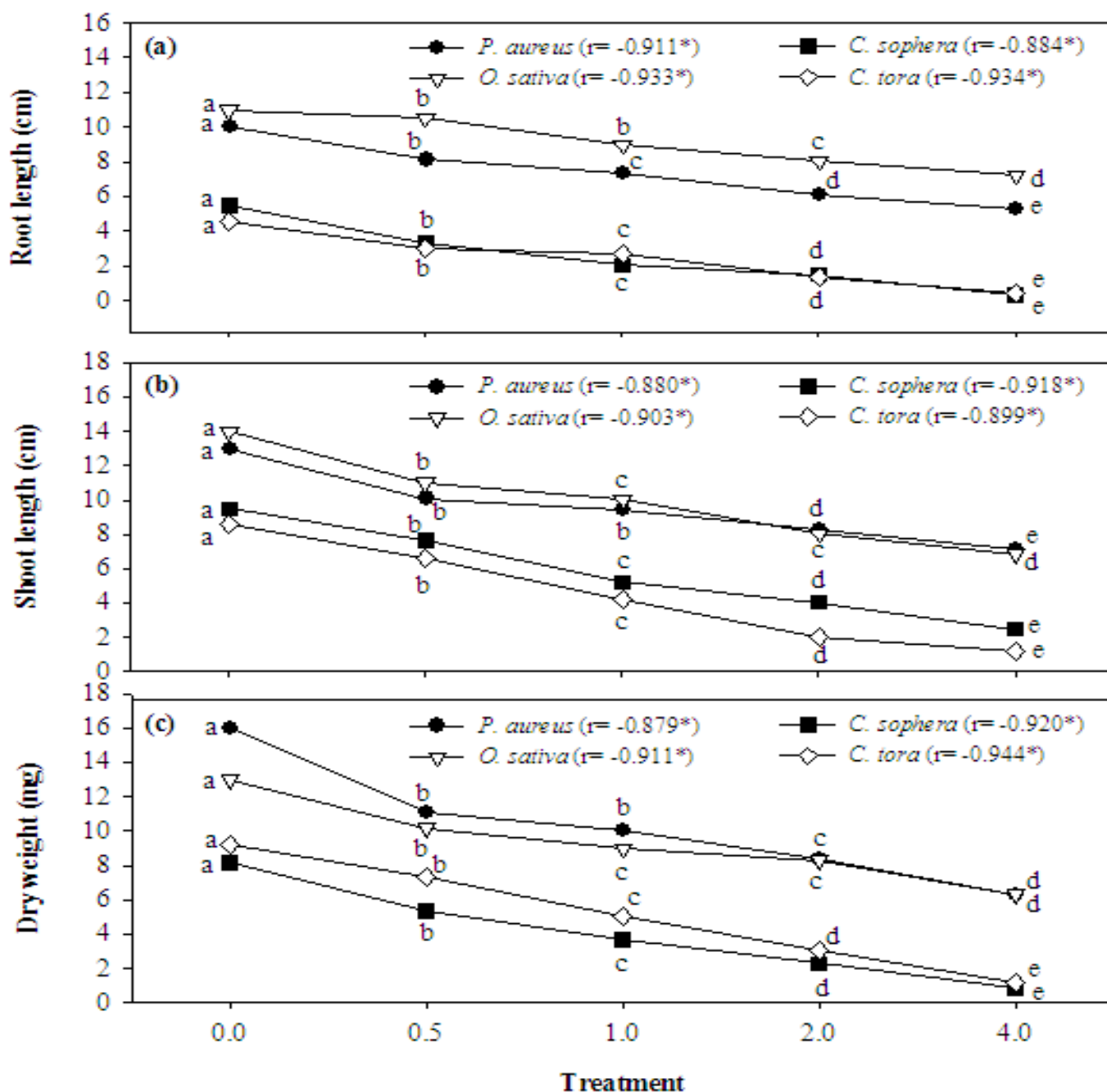


Figure 1. Effect of different concentration of aqueous extract of leaf on (a) root length (b) shoot length and (c) dry weight of test plants. Different superscript symbols along a curve represent significant difference among themselves at $P < 0.05$ applying DMRT, r ; correlation coefficient, *, significant correlation at $P < 0.05$ and $P < 0.01$ respectively.

different parts that leach out under natural conditions. Foliar leachates have been regarded to be most phytotoxic in nature (Xuan et al., 2004) probably owing to their proportionately greater biomass and with greater metabolic activity or production of more metabolites (Xuan et al., 2004). Some recent studies indicating the phytotoxic/allelopathic effect of aqueous extracts of

weeds include *Mikania micrantha* (Ismail and Kumar, 1996), *Vulpia sp.* (An et al., 1999), *Cyperus rotundus* (Quayyum et al., 2000), *Cardaria draba* (Kiemnec and McInnis, 2002), *Parthenium hysterophorus* (Batish et al., 2002a; Singh et al., 2003a), *Brassica nigra* (Tawaha and Turk, 2003), *Raphanus raphanistrum* (Norsworthy, 2003), *Ageratum conyzoides* (Batish et al., 2002b; Singh et al.,

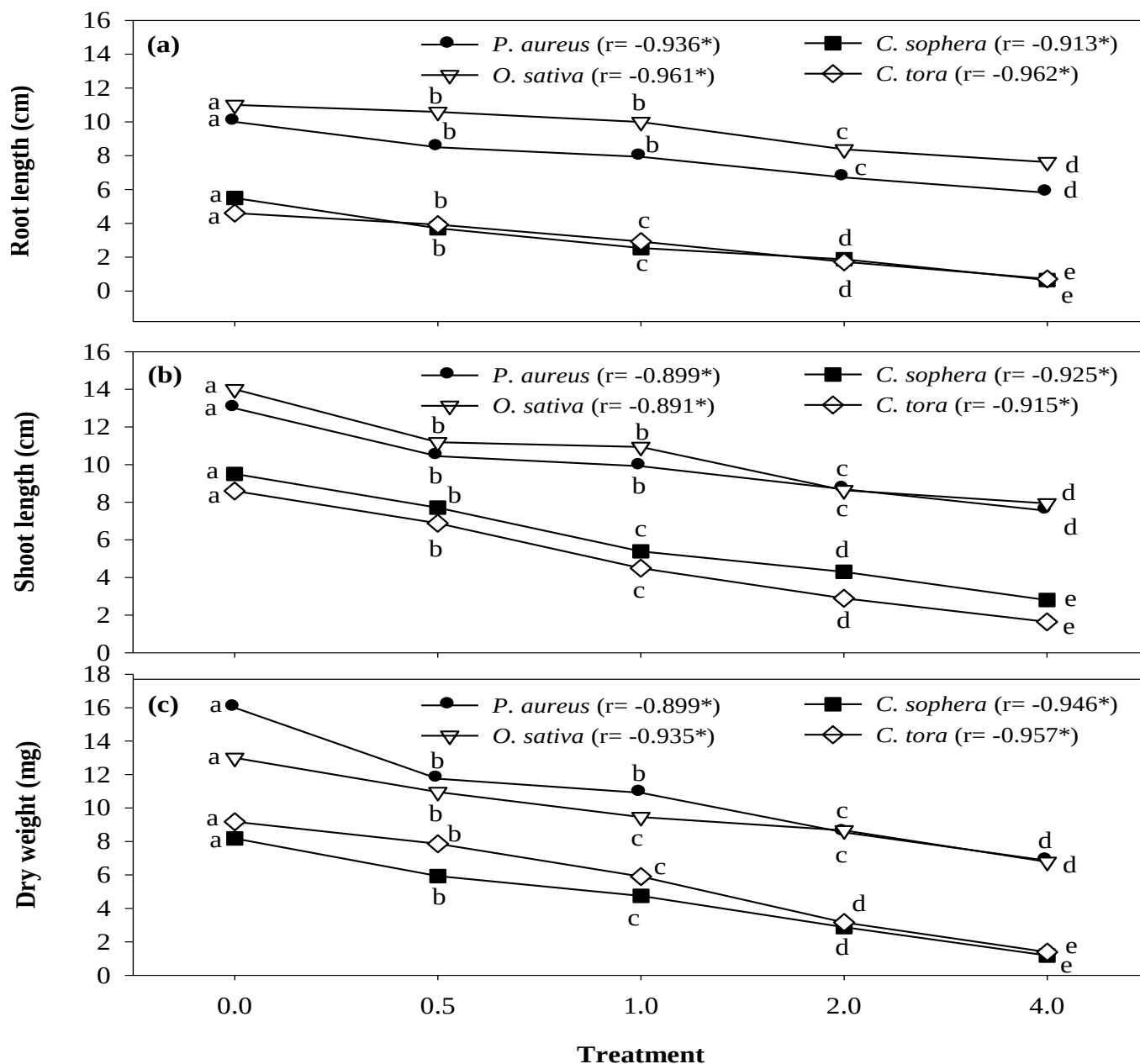


Figure 2. Effect of different concentration of aqueous extract of stem on (a) root length (b) shoot length and (c) dry weight of test plants. Different superscript symbols along a curve represent significant difference among themselves at $P < 0.05$ applying DMRT. r ; correlation coefficient, *, significant correlation at $P < 0.05$ and $P < 0.01$ respectively.

2003b, c), *Terminalia arjuna* (Gulzar and Siddiqui, 2013) .

Conclusion

In conclusion, the allelopathic effect from aqueous extracts of *E. alba* showed an inhibitory effect on seed germination and seedling growth of weed (*Cassia tora* L., *Cassia sophora* L.) and crop plants (*P. aureus* L., *Oryza sativa* L). Hence the allelochemicals extracted from aqueous extract of *Eclipta* can be employed for the

natural control of the tested weeds, thus, achieving the aim of environmental safety. There is need for further studies to be carried out on identifying the inhibiting allelochemical in the parts investigated.

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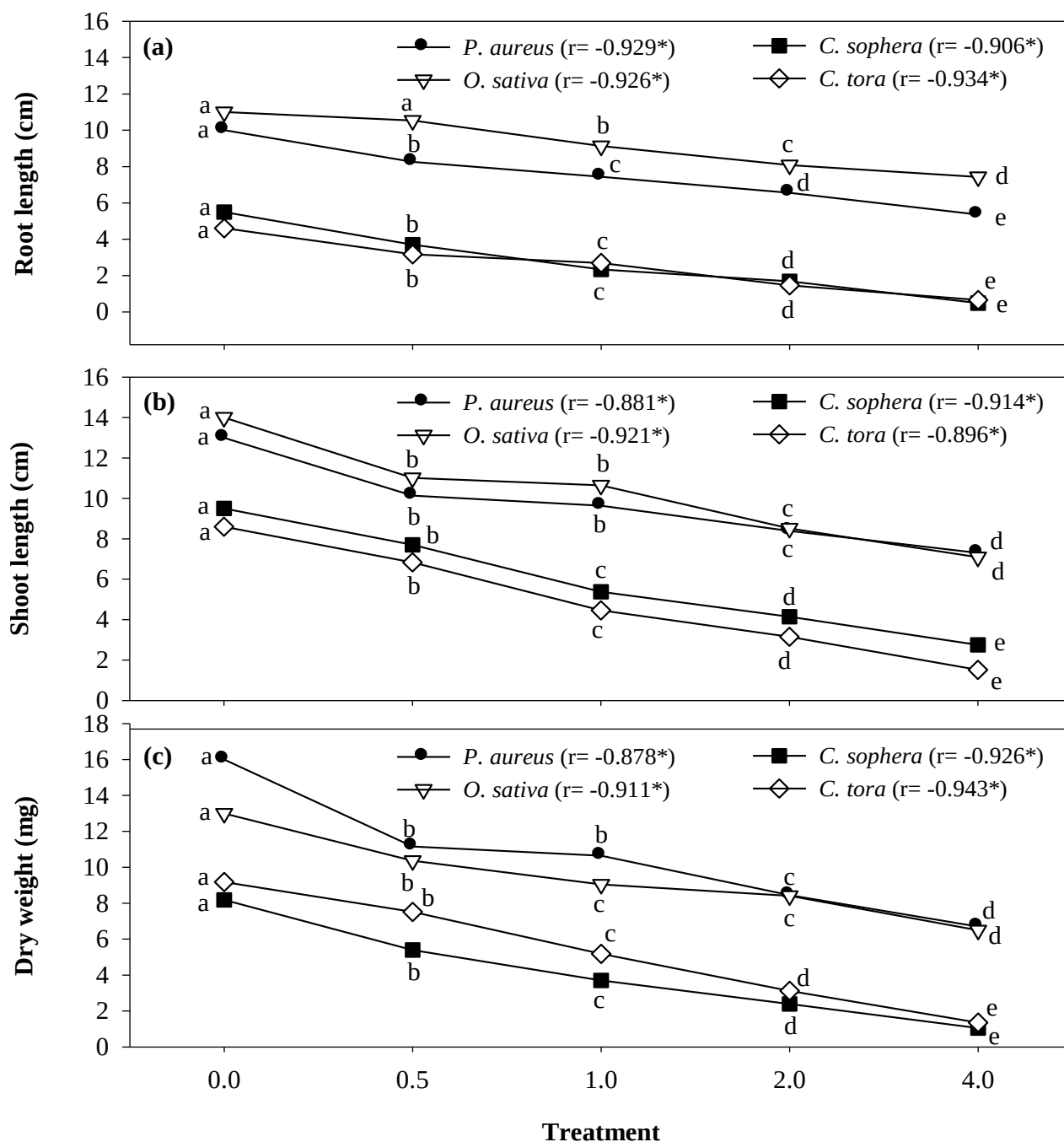


Figure 3. Effect of different concentration of aqueous extract of root on (a) root length (b) shoot length, and (c) dry weight of test plants. Different superscript symbols along a curve represent significant difference among themselves at $P < 0.05$ applying DMRT, r; correlation coefficient, *, significant correlation at $P < 0.05$ and $P < 0.01$ respectively.

Table 1. Values of pH in different concentration of extracts of leaves, stem, roots of *E. alba*.

Extract concentration	Leaves	Stem	Root
0.5	7.68	6.57	7.29
1.0	7.60	6.49	7.24
2.0	7.63	6.46	7.21
4.0	7.59	6.39	7.19

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