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Allelopathic impact of different parts of *Nicotiana plumbaginifolia* Viv. and *Amaranthus viridis* L. on seed germination of a weed and crops.

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Abstract

Following study was managed to carefully examine the phytotoxic outcome of various segments of *Nicotiana plumbaginifolia* Viv. *and Amaranthus viridis* L. be that leaf, stem and root on seed germination and seedling growth of crops like *Solanum melongena* L., *Daucus carota* subsps. *sativus* and weed, *Eclipta alba* L. Both *Nicotiana plumbaginifolia* Viv. *and Amaranthus viridis* L. suppressed the seedling growth in weed and crops so, aqueous extracts were prepared. Sapling germination (shoot length, root length and dry biomass) of both weeds, crops reduced at different concentrations (4%, 2%, 1%, and 0.5%) of aqueous extracts of root, stem and leaf in contrary to compared to control and the concentration dependent reduction was seen. The leaf aqueous extract (LAE) proved to be more harmful in case of *Amaranthus* as compared to extracts of stem/root while stem aqueous extract (SAE) in *Nicotiana*. The results of this study suggest that *Nicotiana plumbaginifolia* Viv. *and Amaranthus viridis* L. might possess phytochemicals which are capable to restrain the growth of weed (*Eclipta alba* L.) and crop (*Daucus carota* subsps. *sativus* and *Solanum melongena* L.). Since, contribution of leaf in *Amaranthus* and stem in *Nicotiana* accounts heavy biomass for plant proportionately more towards phytotoxicity and has potential to be applied as natural herbicide in agro-ecosystems thus, creating green biosphere.

Key words : Allelopathy, aqueous extracts (leaf, stem, root), phytochemicals, phytotoxicity, agroecosystem, green biosphere.

Weeds create predominant organic blockages to crop yields causing enormous profit-making deprivation round the world year after year cost for billions[25]. They grow undesirably and parasitically with desired crops by competing for nutrients, moisture, light and space therefore, reducing productions. Crop productivity is also affected by weeds interfering with water management, reducing the yield & substantially increasing the processing cost[39]. In agro-ecosystems, weeds interfere in crop handling, reducing crop yield and declining crop quality & thus, results in huge financial losses[16]. Considering their concerning features and their destructions, it has become important to control them so, different mechanical and chemical techniques are being in, against them[16]. Excessive use of synthetics to control weeds has worsened the soil, water, human health, food and other life supporting systems at qualitative scale. More emphasis has been given on natural phytochemicals to find out a cheap and easily accessible substitute to manage weeds. Thereby, allelopathic plants and their products have become a part of much attention to survive agriculture in sustainably[8]. Allelopathic plants produce natural products which may aid in reducing dependence on chemical weedicides for managing the weeds therefore, creating less pollution and producing safe agricultural products, lightening human health worries[13]. Also, becomes worthy to explore the potential plants with strong allelopathic reactions which manage agricultural weeds. There are different processes in nature through which allelochemicals are released as shown in figure 1.:

The selection of target plants, *Nicotiana plumbaginifolia* Viv. and *Amaranthus viridis* L. is for their wide distribution in Aligarh (the district of Uttar Pradesh) so was surveyed to get confirmation of the presence of the selected weeds which are supremely established in and around humid soils. Tex-Mex Tobacco is the common name for *Nicotiana plumbaginifolia*, an annual herb with 1-3 feet tall height having slender stem[15,19] possess various constituents of classes of saponins, phenols, polyphenols and tannin chiefly as glycosides[1,3]. The leading

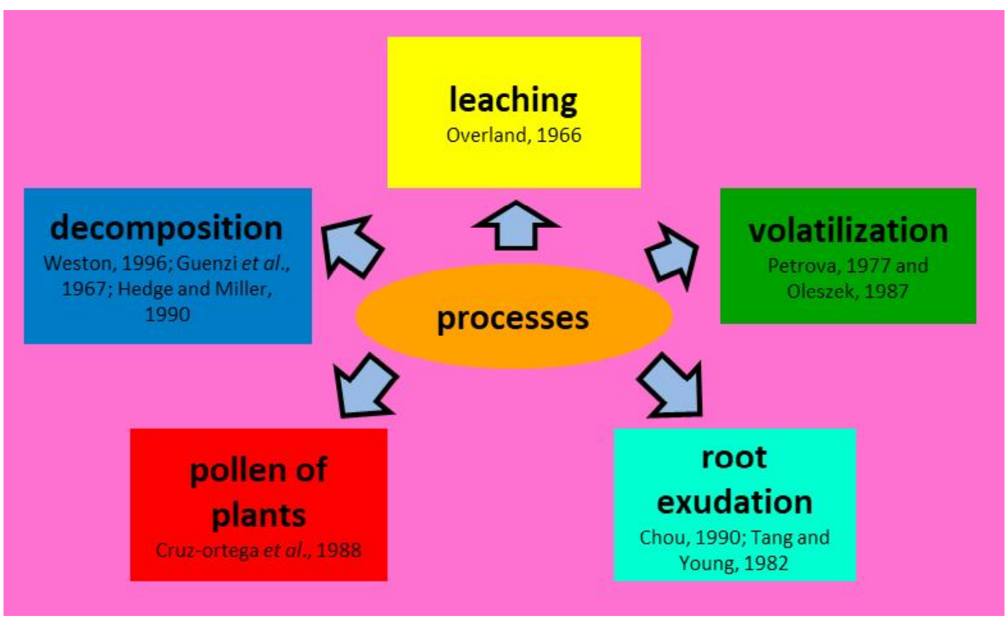


Figure 1. Different processes of release of allelochemicals.

polyphenols are rutin and chlorogenic acid, quinic acid, shikimic acid, quercetin, isoquerceterin and kaempferol glycosides[27].

Amaranthus viridis L. is a cosmpolatian species distributed in the hotter sections of the world**.** It is short-lived perennial herb up to 1 m tall or erect annual/glabrous, angular bearing branches, stem is slender to sparsely pubescent in upper part with multicellular hairs. It is consists of alternate leaves blade. The chief aim of this investigation to find out if *N. plumbaginifolia* and *A. viridis* own phytotoxic properties in various segments of the plant by releasing the phytochemicals thus, speculates that mentioned plants produce potential allelopathic compounds which influence the surrounding plant development obtaining competitive dominance.

Plant material collection :

Nicotiana plumbaginifolia Viv. and *Amaranthus viridis* L. are common weeds that are found easily in dampish soils next to the roadsides, building shelters or large trees and in crop farmlands. A survey was conducted to collect the fresh plants found growing naturally in campus of University, AMU. The plants are collected at flowering stage, identified by the expert, brought to lab, washed thoroughly with water to remove dirt and soil particles. The plant parts (root, stem, leaf) are separated manually and kept to shade dry for 10-15 days. Each part is grinded separately with the help of the grinder after oven dry at 25- 30 degree Celcius for 10-12 hrs.

Preparation of aqueous extracts of different concentrations with different parts of Nicotiana plumbaginifolia Viv. *and Amaranthus viridis* L.

Four grams of the root, stem and leaf powder of both plants are taken and soaked in 100 ml of distilled water for 24 hrs. After soaking them at room temp., filter by Whatman filter paper No. 1 after preliminary filteration by the muslin cloth. Filterate is collected and further diluted to get the concentrations of the aqueous extracts as follows 0.5%, 1%, 2%, 4%.

Determination of pH *:*

The pH taken by using a digital pH meter (EcoScan) for each extract. The three replicates of root length, shoot length and dry biomass of both the plants treated with different conc. of their parts were taken to get the mean.

Physical parameters :

After half a month, the seedling root length (RL), shoot length (SL) in centimetres with the help of the ruler while the dry weight (DB) in milligrams with 4 digit digital balance was taken manually, Model ZSA 120, Colorado (USA).

Statistical analysis :

After half a month, the seedling RL (cm), SL (cm) and DB (mg) were collected[34] and calculated using SPSS/PC software ver. 16 (SPSS Inc., IL). The bars in Fig. 1-6 denote the standard deviation of measurements. The treatment means are separated from the control at $p < 0.05$ and comparisons were made using DMRT[9] and ANOVA.[20].

The aqueous extracts of leaf and stem with 2% and 4% among the various concentrations (0.5, 1, 2, 4%) of the different parts (root, stem and leaf) of the plants, *Nicotiana* and *Amaranthus* showed the major allelopathic effect as compared to the control (absolute pure water) but more promising effect were shown by 4%, inhibiting the seedling growth and germination. However, leaves were the most phytotoxic in case of *Amaranthus* while stem in *Nicotiana* might be because of more biomass while roots were found to be the least allelopathic in both cases. The inhibitory effect was observed to be concentration dependent (can be seen in Figure 1-6). The seedling growth was inversely propotional to the concentrations of the different aqueous extracts (RAE, SAE, LAE) means on increasing the concentrations from (0.5, 1, 2, 4%) 0.5% towards 4%, there was retardation in these test crops and weed[31,32]. The radicle length, plumule length and the dry weight reduced significantly in response of *Amaranthus viridis* and *Nicotiana plumbaginifolia* aqueous extracts.

The allelopathic effect of different concentrations of root, stem and leaf (0.5%, 1%, 2% and 4%) extract of *Nicotiana plumbaginifolia* Viv.and *Amaranthus viridis* L. on the germination of test crop and a weed as shown in fig. 2- 7 below:

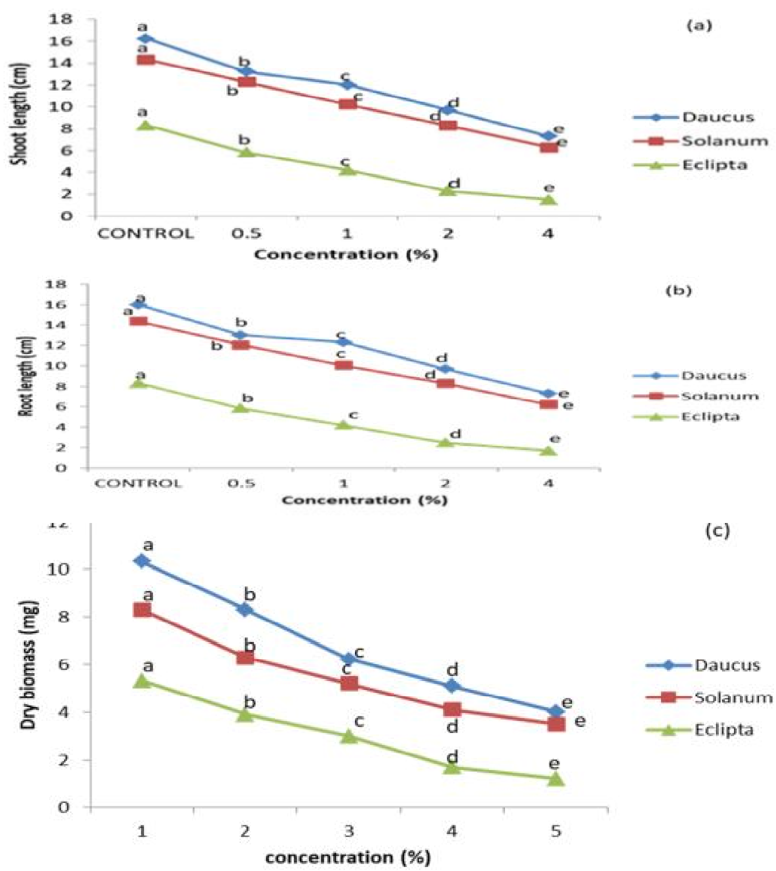


Figure 2. Effect of different concentrations of aqueous extracts of root at flowering season of the plant *N. plumbaginifolia* on (a) root length (b) shoot length and (c) dry biomass of test plants.

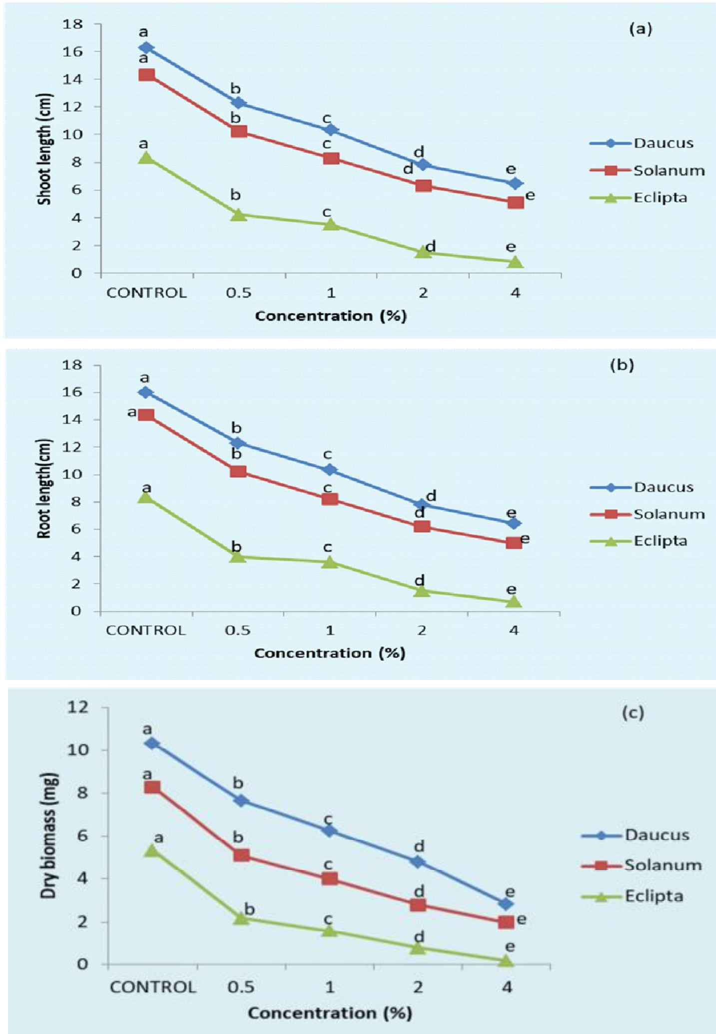
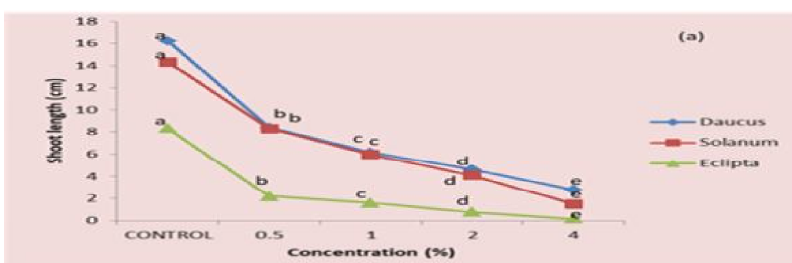


Figure 3. Effect of different concentrations of aqueous extracts of stem at flowering season of the plant *N. plumbaginifolia* on (a) root length (b) shoot length and (c) dry biomass of test plants.



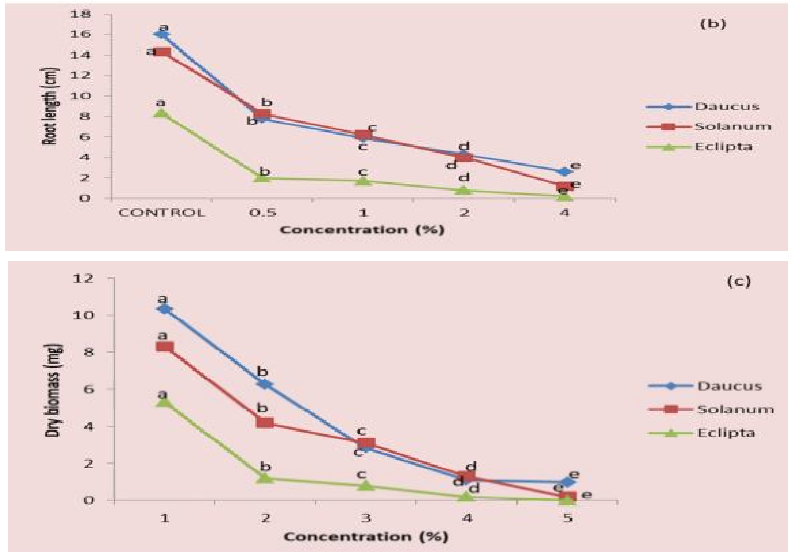
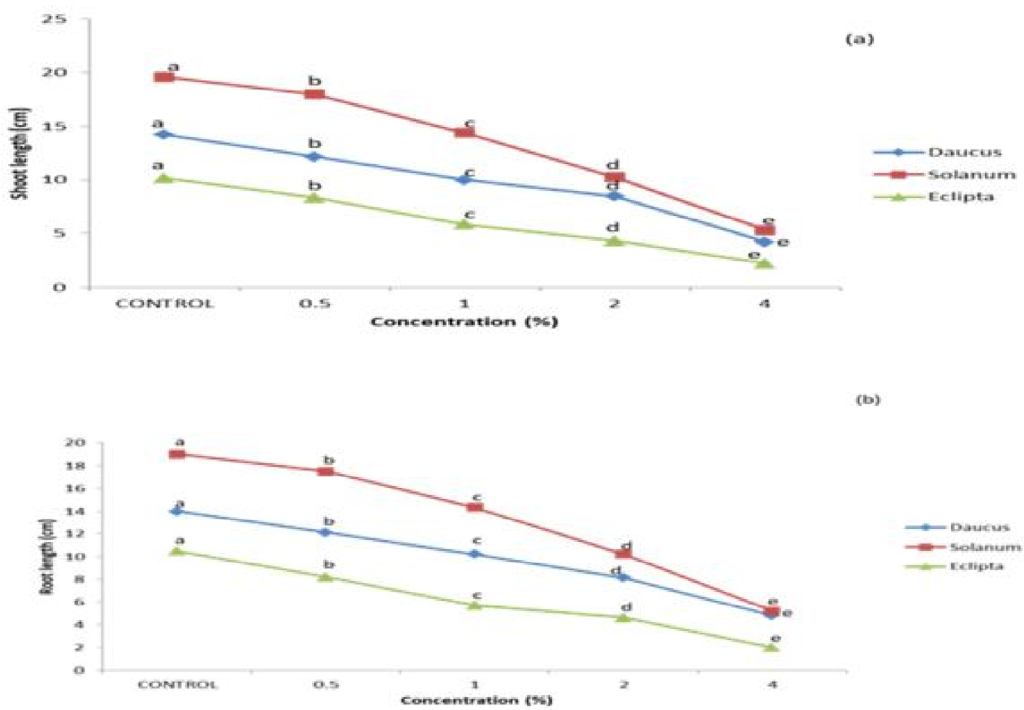


Figure 4. Effect of different concentrations of aqueous extracts of leaf at flowering season of the plant *N. plumbaginifolia* on (a) root length (b) shoot length and (c) dry biomass of test plants.



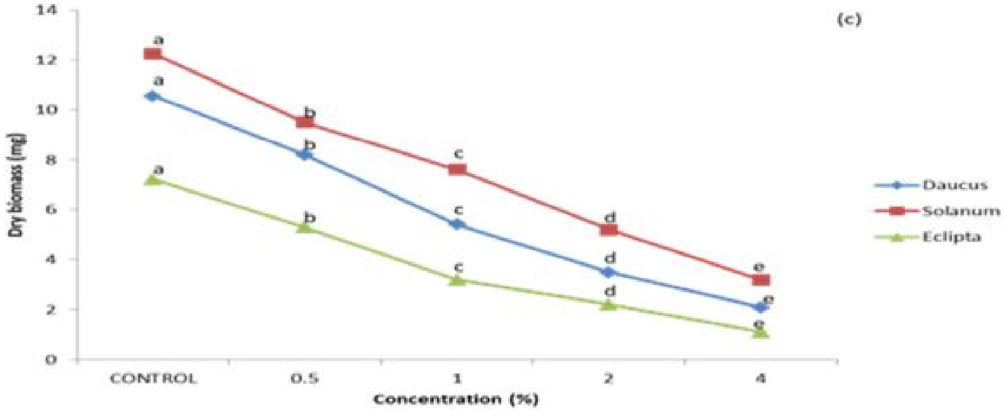


Figure 5. Effect of different concentrations of aqueous extracts of root at flowering season of the plant *Amaranthus viridis* L.on (a) root length (b) shoot length and (c) dry biomass of test plants.

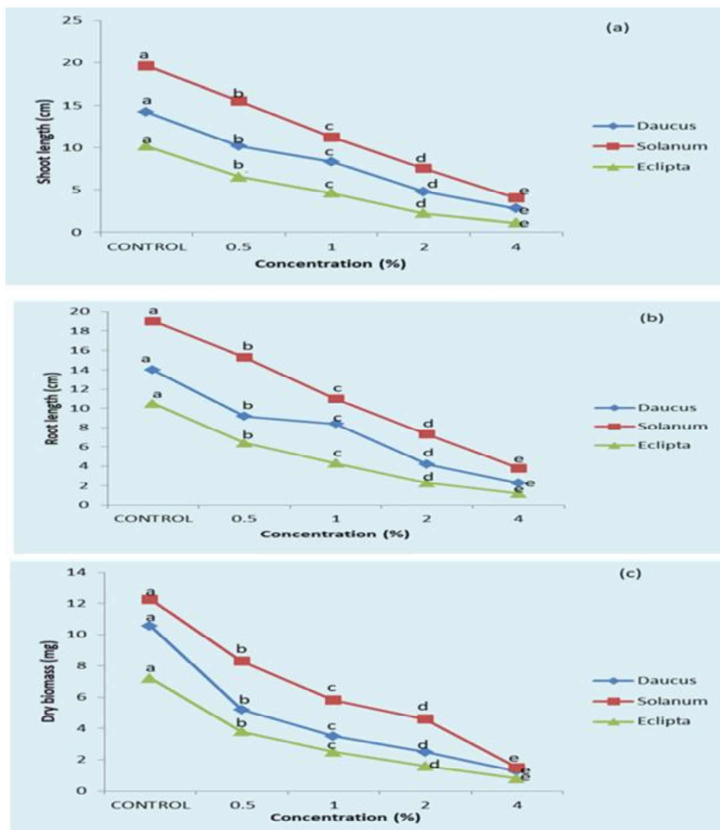


Figure 6. Effect of different concentrations of aqueous extracts of stem at flowering season of the plant *Amaranthus viridis* L.on (a) root length (b) shoot length and (c) dry biomass of test plants.

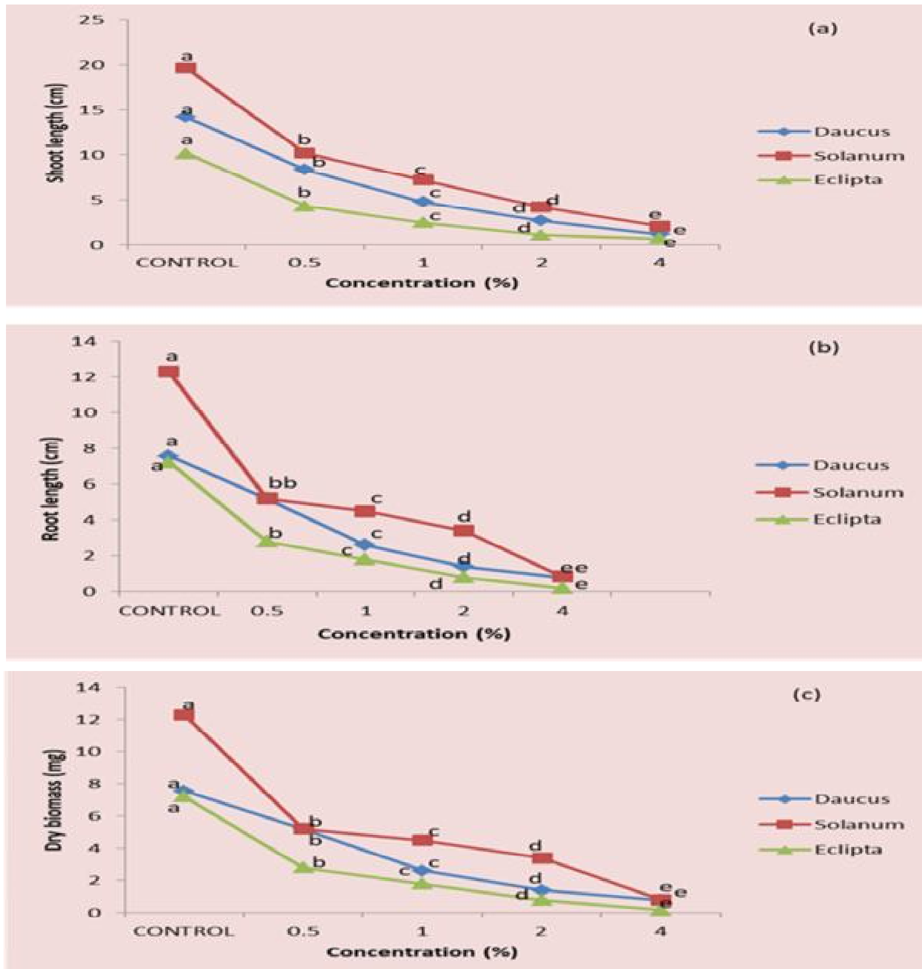


Figure 7. Effect of different concentrations of aqueous extracts of leaf at flowering season of the plant *Amaranthus viridis* L. on (a) root length (b) shoot length and (c) dry biomass of test plants.

After performing the experiments and having thorough observations, the conclusion could be made that the different aqueous extracts own some inhibitory phytochemicals in them that are showing retardatory effect on the test crops and weed, where maximum effect is shown by the leaves (*Amaranthus*), stem (*Nicotiana*) and the least by the roots. The observed various allelopathicity of *Nicotiana* and *Amaranthus* might be because of different levels of allelopathic compounds available in different segments of both of them that drain out under natural conditions. Foliar leachates considered to be the most phytotoxic in nature[38] likely having more quantity of biomass so greater availability of phytochemicals[38]. Some studies in the also indicate that there is a release of phytochemicals while preparing aqueous extracts[2,4,12,14,21,26,28,29,36].

Based on the above, it was decided to study further to explore the allelopathic impact of *N. plumbaginifolia* and *A. viridis* as they exhibit phytotoxicity on weeds.

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