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Effect of Root and Leaf Extract of *Ageratina adenophora* (Spreng.) King &H. Rob on the Germination of Seeds of Okra and Sorghum

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Abstract

Background: *The allelopathic activity of a weed common in the Raigad and Poona districts, the Ageratina adenophora (Spreng.) King & H. Rob was studied as an effect on the germination of seeds of Okra and Sorghum.*
Methods/ Statistical analysis: *A laboratory experiment was conducted using the leaf and root extracts with varying bioassay concentrations. Aqueous extract and Ethanol extracts with the concentrations of 10%, 20%, 40%,80% and 100% of the plant material was prepared. A seed germination test with the aqueous extract and ethanol extracts were carried out. Pure water and 10% ethanol was used as control for comparison. A statistical interpretation was carried out on the basis of number of germination of seeds in the period of 15 days.*
Findings: *This experiment shows that there was a positive impact of root extracts and leaf extracts on the germination of seeds and growth of seedlings. The allelochemicals released by A. adenophora have inhibitory effects on the germination of Okra and Sorghum seeds. The alkaloids and phenolic compounds are responsible to inhibit and reduced the germination of the seeds of Okra and Sorghum. Ethanol extract shows the negative impact on seed germination in the concentration more than 40%. Aqueous extract of the plants also shows more impact on germination of both the plants.*
Applications: *Ageratina adenophora is spreading very fast in the forest and wasteland areas. If the weed invade in the agricultural fields then it may cause a severe impact on the productivity of the vegetable and crops*
Keywords*: Allelopathy, allelochemicals, Ageratina, germination, okra, Jowar, extract*

Introduction:

Allelopathy refers to the direct or indirect, beneficial or harmful effects of one plant on another plant both crop and weed species, from the release of biochemicals, known as allelochemicals. Allelochemicals are a subset of secondary metabolites not required for metabolism (growth and development) of the allelopathic organism. Allelopathic interactions are primarily based on the synthesis and release of the secondary metabolites that initiates a wide array of biochemical reactions, which induce many biochemical changes in the plants. Allelochemicals are present in all the tissues and are released into the rhizosphere by a variety of mechanisms, like decomposition of residue, volatization, and leaching and root exudation. Allelochemicals with negative allelopathic effects are an important part of plant defense against herbivory.

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Allelopathy is a natural and common biological phenomenon. It is described as the interference to plant growth, resulting from chemical interactions among the plants and other organisms.

The term *Allelopathy* was coined by Hans Molisch in 1937 from the Greek words *allelo* and *pathos* (meaning "mutual harm" or "suffering"). It was redefined as, any direct or indirect harmful or beneficial effect by one plant (including microorganisms) on another through, the production of chemical compounds (biomolecules) that escape into the environment (Rice, 1984)

Biomolecules are also termed as allelochemicals; they are subset of secondary metabolites. Allelochemicals as 'non-nutritional' chemicals produced by one organism that affect the growth, health, behaviour or population biology of other species. (Reese, 1979)

Allelochemicals are present in all the tissues and are released into the rhizosphere by a variety of mechanisms, like decomposition of the plant residue in soil, volatization or leaching from the aerial parts and root exudation.

Plant allelopathy is a 'chemical warfare' among the plants imposed by one plant on another to suppress the latter and take advantage from that suppression, thus in this phenomenon allelopathic plant create adverse conditions to the neighboring plants by reducing seed germination and seedling growth. It is a competition for influencing plant growth both in natural and agricultural ecosystems. This occurrence of natural allelopathic activity in crops has important positive and negative implications for cropping systems. Weeds can affect the crops by allelopathic effect as well as compete with them for space, water, nutrients and light.

A lot of work was carried out on the effect of chemicals released by roots, leaves, fruits and other part of the growing plants on the growth of another species. (Rice & Ellory 1984, Narwal and Kaushik 1994)

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Figure 1: Flowering twig of *Ageratina adenophora*

Ageratina adenophora (Spreng.) King & H. Rob commonly known as croton weed growing along the agricultural and waste lands. It is from the family Asteraceae. The most noxious, exotic species often causes great damage to plant diversity. Also known as *Ranmodi* in Marathi.

Okra also known as lady's finger is a common vegetable cultivated everywhere. *Sorgham* commonly known as a millet is a cereal. Both plants are grown in Pune and Raigad district of Maharashtra state.

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Figure 2: Germinated seeds of Okra and Sorghum

An attempt is made for first time to study the allelopathic effect of *Ageratina adenophora* on these plants.

2. Material and methods:

2.1 Sampling of plant material and preparation of extracts:

Plants of *Ageratina adenophora* were sampled from Alibag taluka of the Raigad district and Kothrud region of Pune during flowering and fruiting stages between September and January.

2.2 Preparation of Extract:

Fresh Leaves and roots of the plant material were used to prepare the extract.

2.2.1 Aqueous extract: 100 gm fresh material was grinded and soaked in 1000 ml flask containing distilled water overnight at room temperature. The extract was filtered through 4-layered muslin cloth to separate the residue. This aqueous extract was used for the experiment.

2.2.2 Preparation of Ethanol extracts: To obtain extracts, 100 gm grinded materials were soaked in a

1000 ml flask containing 600 ml absolute ethanol overnight with shaking frequently at room temperature. The extract was filtered through a four-layer muslin cloth to separate solid materials.

The methanol was evaporated at 32°C by using rotary evaporator and then solid residue was dissolved in 10% ethanol to obtain 10% concentration of extract. A series of 10%, 20%, 40%, 80% and 100% concentrations were also prepared. The extract was used for the germination tests.

2.3 Germination tests: Fresh viable seeds of Okra and Sorghum were obtained from one of the Agricultural service centers. Germination tests were carried out with the prepared extracts. Seeds of Okra and Sorghum were surface sterilized with 10:1 water /bleach solution for 2 min before experiment. 9 cm Petri dishes with Whatman filter paper No.1 were used to set the germination

tests. 50 seeds were randomly used for soaking in the extract. Water was used as control for aqueous extract while 10% ethanol was used as the control for the ethanol extract.

Treatments were arranged in a completely randomized design with three sets. The seeds were incubated at room temperature for one weeks. Germination was determined by counting and removing germinated seeds at 2 day intervals over a week and further for one more week at the intervals of 3 days. Seeds were considered to be germinated when the radicle and hypocotyl length was over 2 mm. By counting the germinated seeds percentage of germination is determined.

2.4 Data analysis:

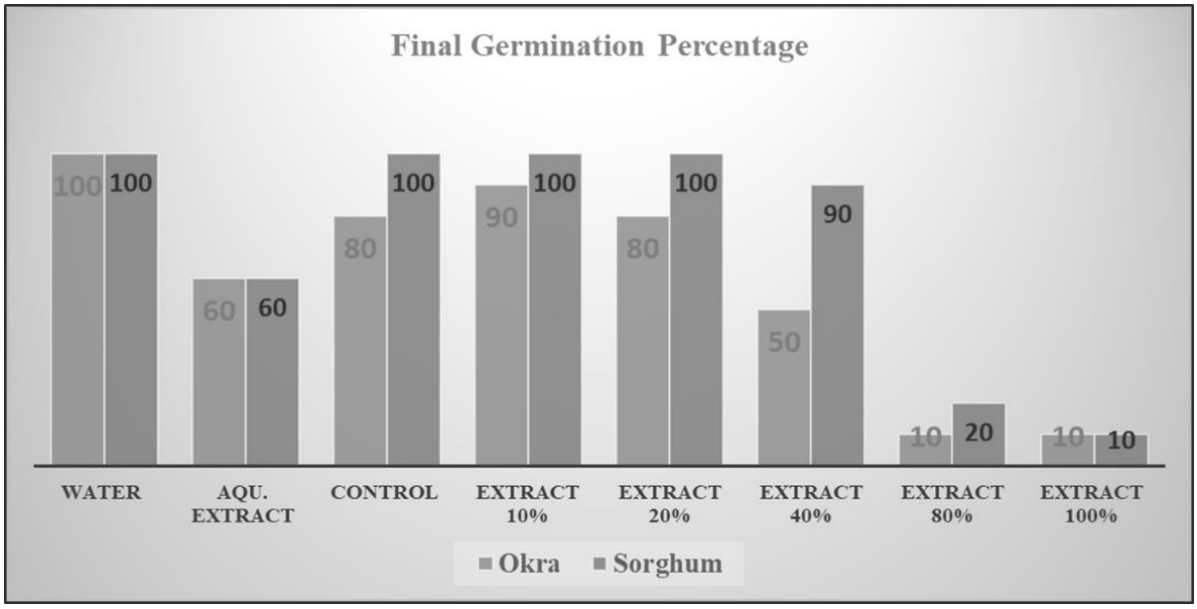

Figure 03: Graphical representation of Final germination percentage of seeds of Okra and Sorghum

Data analysis was carried out with the various germination parameters

- Final Germination Percentage: (FG)- It is the Percentage of germination in the period of 15 days.

- Germination speed: (GS) - It is the rate of the germination of seeds in the period of 15 days.
- Timson's Germination Index (TGI) – It is the index of germination of seeds with reference to time.
- Mean Germination Time: (MGT) – It is the average germination time required for germination.
- Mean Daily Germination: (MDG)- It is the number of seeds germinated in a day.

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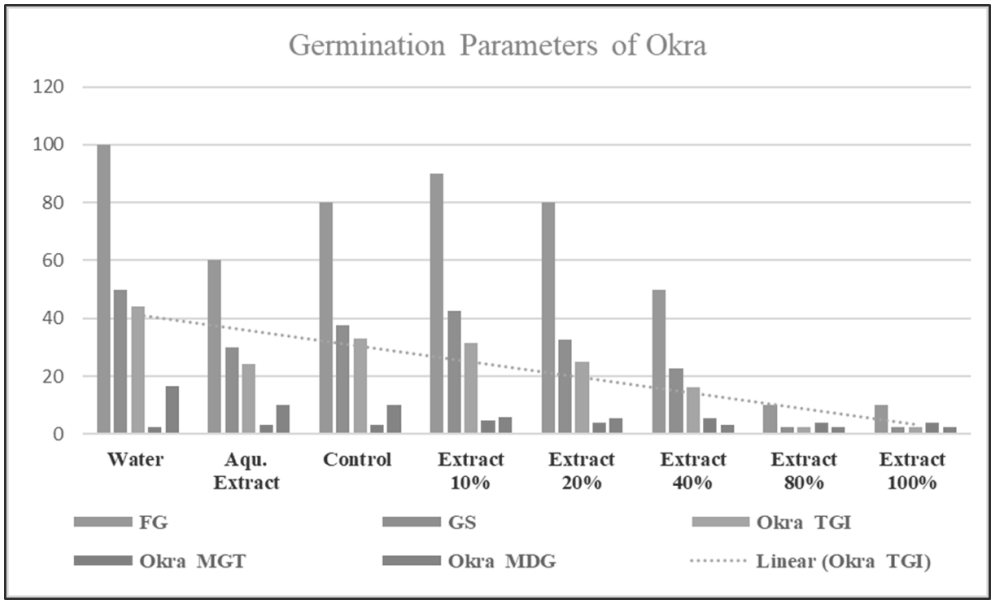

Figure 04: Graphical representation of germination parameters of Okra seeds

2.5 Qualitative analysis of the Phytoconstituents: Qualitative analysis of the Phytoconstituents present in the Ageratina adenophora was also carried out.

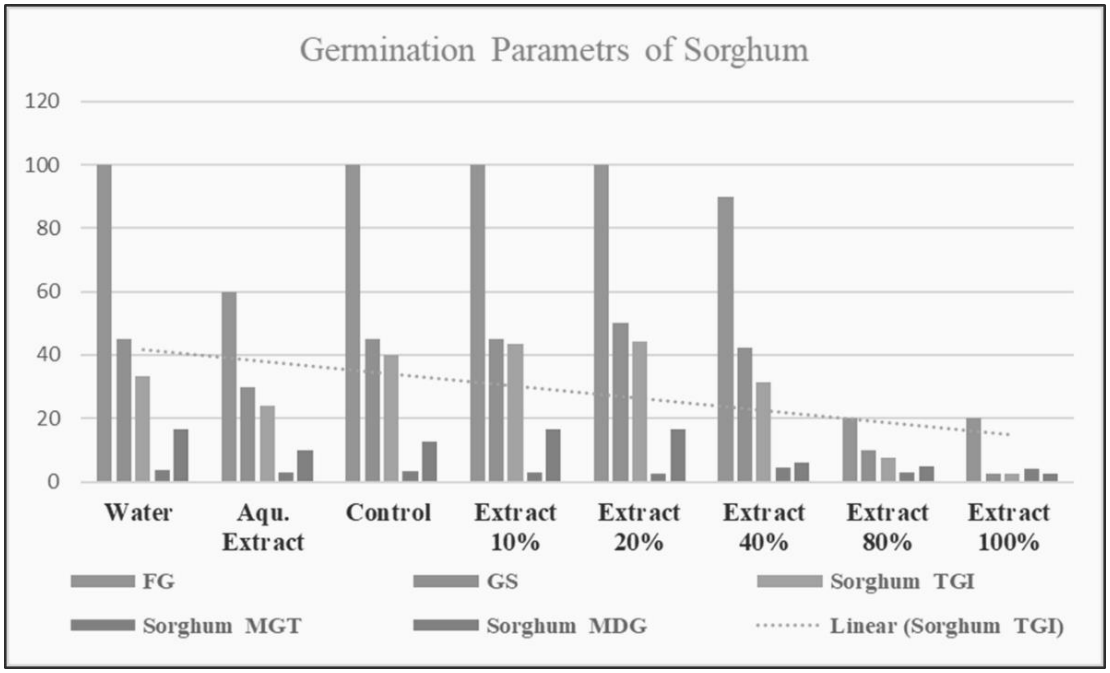

Figure 05: Graphical representation of germination parameters of Sorghum seeds

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3.Results and Discussion:

The effect of the plant extracts in various concentrations on seed germination after 2, 4, 6, 8 and 15 days are given in Table 01.

Table 01: **Effect of Extract of *Ageratina adenophora* plant on Seed germination (%) on Okra and Sorghum Plants**

Crop	**Okra**					**Sorghum**				
Extract / Days	**2**	**4**	**6**	**8**	**15**	**2**	**4**	**6**	**8**	**15**
	% of germination									
Water	80	90	100	100	100	40	80	100	100	100
Aq. Extract	40	50	60	60	60	40	50	60	60	60
Control	60	60	70	80	80	70	80	80	100	100
Extract 10 %	50	60	80	80	90	80	80	100	100	100
Extract 20 %	40	50	70	70	80	80	90	100	100	100
Extract 40 %	25	30	40	40	50	50	60	80	80	90
Extract 80 %	--	10	10	10	10	10	20	20	--	--
Extract 100 %	--	10	10	10	10	--	10	10	10	--

(-- indicates no germination)

Percentage of germination was lowered in the aqueous extract as well as in higher percentage of ethanol extracts. Okra was found to be more sensitive to the allelopathic effects of weed than that of Sorghum. For the plant extract, the inhibition rate of seed germination was time dependent but relatively parallel. As compared to the control, the rate of germination was found to be lower in

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high concentration extracts (40% to 100%) either inhibiting germination and/or delayed germination.

The effect of aqueous extract on the crop seed is well manifested as an allelopathic effect of germination. The chemicals affecting germination are known as germination inhibitors. These chemicals are present in the tissues of the plant, are released into the soil by different mechanisms like decomposition of plant parts, volatization from leaf, leaching and root exudation which have detrimental effects on germination and growth of seedlings of plant.

Data analysis of the percentage of germination shows that the decrease in the final percentage of germination of crop seeds is associated with the lowering the germination speed, mean germination time and mean daily germination. A trend line drawn for Timson's Germination Index (TGI) clearly indicates gradual decrease in the germination parameters in concentrations higher than 40% and in aqueous extract also. Okra was found to be more sensitive to the allelopathic effect of weed *Ageratina adenophora* than that of Sorghum.

4. Conclusion:

Plant extracts of *Ageratina adenophora* weeds affects the germination of seeds of Okra plants as well as Sorghum plants.

Table 02: Phytoconstituents present in the extract of *Ageratina adenophora*

Alkaloids	**Phenols**	**Flavonoids**

The study has shown that the extract of *Ageratina adenophora* in higher concentration is detrimental to germination and growth of seedlings. Based on the above result obtained from the research it can be concluded that the allelochemicals released by *A. adenophora* have inhibitory effects on the germination of Okra and Sorghum seeds. But there is no adverse effect in lower concentration to total inhibition of germination. As the extract concentration increases it inhibits the germination or delays it. Ethanol extract shows the negative impact on seed germination in the concentration more than 40%. Aqueous extract of the plants also shows more impact on germination of both the plants.

Allelopathic effects of the weed may be associated with the presence of alkaloids and phenols present in the plant parts of *Ageratina adenophora.*

Ageratina adenophora is a very common weed with high ecological tolerance and found to be spreading everywhere. It shows the impact on the plants growing in association in the nature and became dominating. With the time period and higher concentration of extract there is increase in the allelopathic effect. Accumulation of such allelochemicals in the soil will have a strong impact on the crops. Therefore, it is further necessary to undertake research to investigate the allelopathic effect on the growth of crop plant. Study shows that it has an adverse impact on the germination of seeds of vegetable Okra and crop Sorghum. It may affect agricultural crops also if invaded in the agricultural field.

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