ALLELOPATHIC EFFECT OF *ACACIA AURICULIFORMIS BENTH.* LEAF EXTRACT ON PHOTOSYNTHETIC PIGMENTS OF SOME MANGROVE AND THEIR ASSOCIATE PLANTS

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Abstract

Allelopathy, a process that regulates the growth of other plants, is a useful way to utilize chemical fertilizers less frequently. The objective of the current study was to determine, in a lab setting, how Acacia auriculiformis Benth. leaf extract affected several mangrove and plants associated with mangroves' photosynthetic products. Analysis of photosynthetic pigments showed that all the plants under study had fluctuating chlorophyll contents as a result of leaf extract treatment. Current research indicates that Acacia auriculiformis Benth. has an impact on the photosynthetic machinery of the plant species under study, both positively and negatively.

***Keywords**: Phtosynthetic pigments, allelopathic effect, Acacia auriculiformis Benth., mangrove, mangrove associate .*

Introduction

Allelopathy is a naturally occurring, observable biological phenomenon in which a nearby organism produces certain biochemicals that influence the development, maintenance, reproduction, and biological functions of other plants and species. Allelochemicals are a term used to describe these biological substances. It has either good (beneficial) or harmful (allelopathic) effects on the targeted species. These allelochemicals, according to Stamp Nancy (2003), are a group of secondary metabolites that are not helpful for the mother organism's developmental phases (growth, development, and reproduction). Allelopathic linkages have been a crucial component of both natural and artificial wilderness.

These partnerships play a crucial role in determining the vegetation's sythesis and in comprehending problems with woodland recovery. The information gathered thus far demonstrated that all types of plants found in forests engage in allelopathic interactions. (Waller, 1987). The sort of interspecific connection may also be influenced by allelopathy, which may potentially play a significant role in intraspecific and interspecific competition. (Setia et al., 2007). Numerous physiological processes and biochemical reactions, including seed germination, cell division, and cell elongation, are impacted by the action of allelochemicals. (Patil and Khade, 2017).

Leguminous plant Acacia auriculiformis of the Mimosoideae family, which is native to Australia, Papua New Guinea, and Indonesia, was brought to Bangladesh in 1990 for the purpose of regeneration and afforestation of degraded and wasteland areas. (Rahman, 1984 and Das, 1985). Although the species is quick-growing and adaptable to a variety of soil types (Davidson, 1985), the ground vegetation beneath its canopy suggested that it may have some allelopathic potentials. These potentials may have been triggered by leachates from plants, exudates from roots, or fallen leaves (through the decomposition of litter). As a result, the introduction of allelochemicals (organic substances) into the soil prevents the emergence of agricultural crops and vegetation from seeds. (Rice, 1979).

Massive amounts of allelochemicals such phenolics, alkaloids, and amino acids are present in the soil and root exudates of Acacia auriculiformis, which inhibit the growth of some weeds. The allelopathic impact of leaf extracts of Acacia auriculiformis on the germination of several agricultural crop seeds was discovered by Bora et al. in 1999. The research on the effects of Acacia auriculiformis or its extracts on the growth of other coastal plants is rather limited, despite the fact that plant has alleopathic potential in other investigated plants. Therefore, the focus of the current study is on how Acacia auriculiformis leaf extract affects mangrove and related plants.

Materials and Methods

Preaparation of leaf leachate and leaf extract.

Acacia auriculiformis L. senescent leaves were obtained from the Mahad taluka, Maharashtra. The leaf litter was kept in polythene bags and kept dry during storage. Weighted, thoroughly washed with tap water, and blotted dry, the senescent leaf litter was then immersed in 200g of distilled water for 24 hours at room temperature. Leachate was extracted using Whatman No. 1 filter paper after 24 hours. The leaf leachate (filtrate) was stored in an icebox until further analysis.

The fresh leaves were carefully cleaned with tap water, cut into pieces that were 1 cm long, and then shredded using a mechanical grater. 200g of pulverized leaf material was weighed, immersed in 1 liter of distilled water for 24 hours, and then filtered through muslin cloth and Whatman filter paper No. 1 before being used. The aqueous extract was kept chilled until it was needed in additional research.Seedling pots received leaf leachate and leaf extract treatments by being submerged in a tray that contained the treatments. Pots are removed from the tray and stored in the polyhouse when the surface soil of the pot is damp. For three weeks, these therapies were continued. Following that, each plant species' leaves are collected, dried, and pulverized for usage.

Photosynthetic Pigments (Chlorophylls)

Chlorophylls have been predicted following the approach of Arnon (1949). Randomly sampled clean leaves from managed and handled vegetation were amassed and brought to laboratory, washed with distilled water and blotted to dry. 500 milligram of plant tissues changed into homogenized in 80% chilled acetone containing 4ml ammonia per litre and the pigments had been extracted. A pinch of $MgCO_3$ become delivered to neutralize the acids launched all through extraction. The homogenated extract become filtered through Whatman No.1 filter paper using Buchner funnel under suction pump. Final quantity of the filtrate was made to 100ml with 80% acetone. The filtrate was transferred into a conical flask wrapped with black paper to prevent photo-oxidation of the pigments. Absorbance was read at 663 nm for chlorophyll a and 645 nm for chlorophyll b, on a double beam spectrophotometer (Shimadzu) using 80% acetone as a blank.

Chlorophylls ($mg100^{-1}g$ fresh weight) were calculated using the following formulae:-

Chlorophyll a = (12.7 x A_{663}) – (2.69 x A_{645}) = ……….X

Chlorophyll b = (22.9 x A_{645}) – (4.68 x A_{663}) = ……….Y

Total chlorophylls = (8.02 x A_{663}) + (20.2 x A_{645}) =………..Z

$$\text{Chlorophyll a or Chlorophyll b or Total Chlorophylls } (mg100^{-1}g \text{ fresh tissue}) = \frac{X/Y/Z \times \text{volume of extract} \times 100}{1000 \times \text{weight of plant material in gram}}$$

Result and Discussion

Photosynthetic efficiency:

Figure 1 shows the allelopathic effect of *Acacia auriculiformis* on the chlorophyll contents of certain coastal species, including *Sonneratia alba*, *Acanthus ilicifolius*, *Derris trifoliate*, and *Crotalaria retusa*. The findings revealed that *Crotalaria retusa*, among the species under study, has the greatest concentrations of chlorophyll a and total chlorophyll (156.12 and 212.05 mg/100 g FW, respectively). While *Derris trifoliata* had the highest chlorophyll b content (73.19 mg/100g FW) under controlled conditions. Chlorophyll an increases of up to 21.15% were seen in *Acanthus ilicifolius* plants treated with leaf extracts.

Chlorophylls are one of several plant pigments that have a distinctive place in the existence of plant life; as a result, they are particularly concerned in the energy capturing and converting process. Because of this, its content is an excellent indicator for a general assessment of any crop's capacity for photosynthetic activity. Typically, chlorophyll is a green pigment that is a chemo protein that is present in almost all plants. According to McDonald (2003), all autotrophic eukaryotes have the four primary chlorophylls Chl-a, Chl-b, Chl-c, and Chl-d. Chl-a and Chl-b are the two main photosynthetic pigments in higher plants. Both are crucial to the process of capturing energy. Chlorophyll-a is recognized as a key component in the photosynthetic process, whereas Chlorophyll-b serves as an accessory.

The amount and circumstances under which chlorophyll variety is introduced determine a plant's general proficiency in photosynthetic processes. The rate of its amalgamation on the one hand, and the rate of its debasement on the other, determine the amount of chlorophyll in the leaf tissue. (Sestak and Catsky, 1962).

Sonneratia alba increased its levels of total chlorophyll by 11.86%, chlorophyll a by 12.48%, and chlorophyll b by 10.75% after being treated with leaf extract. *Acanthus ilicifolius* found to have 24.45%, 39.59%, and 28.12% elevation respectively; *Derris trifoliata* found to have 9.09%, 9.17%, and 9.12% enhancement for the same treatments; and *Crotalaria retusa* found to have 2.81%.

Crotalaria retusa's total chlorophyll content increased slightly as a result of the enhancement noticed during treatment. *Ipomoea pes-caprae* exhibits 10.99% improvement in chlorophyll a, 49.44% improvement in chlorophyll b, the highest amount among all examined species, and 22.44% improvement in total chlorophyll under the same treatment. The results of this treatment indicate that other plants' production increased as a result of the *Acacia auriculiformis* leaf extract treatment's increase in chlorophyll levels. Thus, treatment of *Acacia auriculiformis* leaves with leaf extract has been found to increase chlorophyll levels across all examined species, whereas treatment of the same plant with leaf leachate has been found to have adverse effects.

In the current investigation, leaf leachate treatment of the same *Acacia auriculiformis* plant produced outcomes that were completely contrary. (observed). This means that, compared to their control plant, all of the analyzed coastal plants have decreased levels of chlorophyll a, chlorophyll b, and total chlorophyll. The largest declines in chlorophyll a were seen in *Acanthus ilicifolus* (4.74% fall), *Derris trifoliata* (4.56% decline), and *Crotalaria retusa* (4.34% reduction). In the current study, *Crotalaria retusa* and *Acanthus ilicifolius* saw the largest losses of chlorophyll b (24.14% and 21.21%) under the same treatment of leaf leachate. *Derris trifoliata* showed the lowest decrease in chlorophyll b level, at 4.76%. The same kind of drop in total chlorophyll level during leaf leachate treatment is seen in all tested species. In comparison to the control, *Crotalaria retusa* saw the greatest loss of total chlorophyll (11.34% loss), whereas *Derris trifoliata* experienced the least (4.24% loss).

Other investigated coastal plants under leaf leachate treatment saw a fall in total chlorophyll levels of 8.18% in *Acanthus ilicifolius* and 6.36% in *Crotalaria retusa* compared to controls. This plant is toxic to other people when present in a living state or naturally, according to the overall observation of this therapy. *Acacia auriculiformis* becomes harmful to other plants when naturally occurring allelopathic activity of leaf leachate occurs, which reduces the total productivity of other plants. However, it is made clear by leaf extract treatment that artificial spraying of leaf aqua extract will increase the productivity of other plants.

It is also possible to draw the conclusion that the elevation of chorophyllase activity and Mg dechelatase activity, or the allelochemicals responsible for enhancing the activity of these enzymes, is what causes the loss of chlorophyll under leaf leachate treatment. Enzyme chorophyllase and Mg dechelatase, which typically take place during leaf senescence, are said to have a crucial role in the breakdown of chlorophylls, according to Dangl et al., (2000). Allelopathy, according to Rency et al. (2015), exhibits association between the plants in a positive or negative way, resulting in either an inhibitory or stimulatory potential on nearby plants.

Conclusion

It is evident from the current study that leaf extract of *Acacia auriculiformis* increases chlorophyll level among all tested species, however leaf leachate of the same plant species was found to have adverse effects. Thus, it may be deduced that *Acacia auriculiformis* is harmful to other plants when present in living or natural conditions because it reduces photosynthetic efficiency through chlorophyll loss, which may result in a decline in coastal species productivity.

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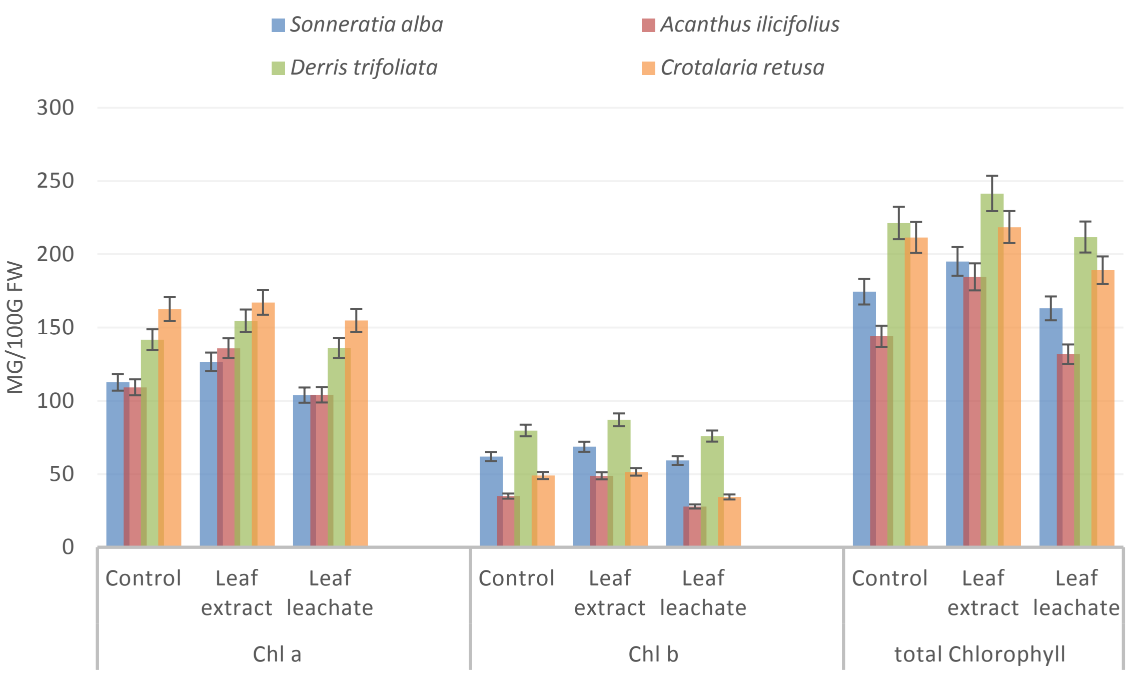

Fig. 1. Allelopathic effect of Acacia auriculiformis leaf extract and leachate on photosynthetic pigments of different costal plant species