J. Sher-e-Bangla Agric. Univ., 11(1 & 2) : 47-51, January & July 2020 ISSN 1997-6038

EFFICACY OF SOME COMMON MEDICINAL PLANTS FOR ITS POSSIBLE INHIBITORY ACTIVITY

M. T. I. Chowdhury[1], M. S. I. Khan[1], M. A. Islam[1], S. S. B. Mustafiz[2], Y. Kawanami[3]

ABSTRACT

A study was conducted at the functional molecular chemistry laboratory of Kagawa University to find out the effect of some plant extracts as a growth inhibitor during March 2017 to August 2017. Four common plant leaves (Eucalyptus, Jamun, Mahogany and Cannon ball tree), which were collected from Bangladesh, were extracted and their efficacy was tested using four different plant species. Among the test species, cress was the most sensitive, whereas lettuce, Italian ryegrass and rice seedlings showed almost similar inhibitory activity on shoot and root growth. Among the four different plant leaf extracts, Cannon ball tree (*Couroupita guianensis)* showed strong inhibition on plant growth. On the other hand, Mahogany (*Swietenia macrophylla*) leaf extracts exhibited relatively weaker inhibitory activity than the other leaf extracts against the four plant species.

Keywords: growth inhibitor, leaf extracts, pesticides, synthetic chemicals, test species

INTRODUCTION

Plants have been used as a source of medicine in the world-wide (Hayta *et al.,* 2014; Van Wyk *et al.,* 2018). Until the middle of nineteenth century, plants were the main therapeutic agents used by humans and even today their role in medicine is present. It has been estimated by the WHO that around 80% of the world population relied on medicinal plants as their primary healthcare source (Farnsworth *et al.,* 1985) and their demand is increasing day by day in the developing countries. The plant chemicals are mainly the secondary metabolites derived biosynthetically from plant primary metabolites (e.g., carbohydrates, amino acids, and lipids) which are not directly involved in the growth, development, or reproduction of plants. Secondary metabolites can be classified into several groups according to their chemical classes, such as alkaloids, terpenoids, tannins, phenolics, and others (Harborne, 1984). Most of these secondary metabolites are used for plants defense against predators or for other purposes.

Agricultural intensification through the excessive and inappropriate use of chemical fertilizers, pesticides, plant growth regulators and others has polluted water bodies and degraded soils and thus led to biodiversity loss by killing beneficial plants, insects and other wildlife (Pell *et al.,* 1998, Aktar *et al.,* 2009). In addition, killing non-target plants, pesticide exposure can cause sub-lethal effects on plants (Dreistadt *et al.,*1994; Chowdhury *et al.,* 2018). Uses of synthetic chemicals including growth retardants are superficially increased in the crop field for more production (Rademacher, 2000). Untill today, there is no sustainable alternative way to avoid the chemicals. To avoid the detrimental effects of synthetic chemicals, research on novel natural products have moved from the fringe to the mainstream for the development of ecologically acceptable, environment friendly and relatively safe natural plant growth retardants. In this regards, research on natural products might be important as a plant growth regulator or weed control. In view of these facts, the aim of the present study was to evaluate the growth inhibitory activities of four medicinal plant leaves against four test species, including one weed, in the laboratory condition.

MATERIALS AND METHODS

Common leaves of four medicinal plants were collected from different areas of Bangladesh during March 2017**.** Those were: a) Eucalyptus (*Eucalyptus obliqua*), b) Jamun (*Syzygium cumini*), c) Mahogany (*Swietenia macrophylla)*, and d) Cannon ball tree (*Couroupita guianensis*). Collected leaves

[1] Professor, Dept. of Agricultural Chemistry, Sher-e-Bangla Agricutural University, Dhaka, Bangladesh, [2]Manager, Bangladesh Sugar and Food Industries Corporation, Dhaka, [3]Professor, Kagawa University, Japan

were first dried in the sun where 80% moisture was removed and then leaves were kept in an oven for one week.

Dried leaves (50 g) of the test species were ground into powder by a grinding machine and extracted with 250 mL of 70% (v/v) aqueous methanol for 48 h. The extract was then filtered through one layer of filter paper (No. 2; Advantec), using a vacuum pump. The residue was re-extracted with equal amount of methanol for 24 h and filtered. The two filtrates were then combined and evaporated to dryness using a rotary evaporator at 40°C. Activities of the leaf extracts were tested using four different plant species: lettuce (*Lectuca sativa*), cress (*Lepidium sativum*), Italian ryegrass (*Lolium multiflorum*), and rice seedlings (*Oryza sativa* L. cv. Nihonbare). Experiments were carried out following the protocol of Chowdhury *et al*., 2015 and 2016.

RESULTS AND DISCUSSION

The shoot and root growth of lettuce, cress, Italian rye grass and rice were significantly inhibited by the leaf extracts obtained from four different medicinal plant extracts (Fig. 1, 2, 3 and 4). Moreover, the effectiveness of different plant extracts were different among test species, and the inhibition rate was proportional to the corresponding extract concentration which implies that those medicinal plants have growth inhibitory substances or allelochemicals. The concentration-dependent inhibitory effects of medicinal plant extracts were found by Khan and Kato-Noguchi (2016) and Khan *et al.* (2021). In addition, Khan *et al.* (2013) observed that aqueous methanol extracts obtained from mango leaf inhibited shoot and root length at higher concentration whereas, stimulated at lower concentration. Our results showed that the growth of lettuce, cress, Italian ryegrass and rice seedlings were completely inhibited at concentration greater than 0.030 mM obtained from mahogany, jamun, cannon ball and eucalyptus leaf extracts. Similar trend of findings were observed by Islam *et al.* (2013) and Suzuki *et al.* (2016) who found that the highest concentrations of leaf extracts inhibited shoot and root length completely. Moreover, the results were correlated with the findings described by Khan *et al.* (2013); Khan and Kato-Noguchi (2016) and Khan *et al.* (2021). We found that leaf extracts obtained from four medicinal plants showed inhibitory effects at 0.003 mM concentration which implies that those medicinal plants might contain allellochemicals. Our results imitated the previous findings described by Suwitchayanon *et al*., 2015 and Khan and Kato-Noguchi, 2016 where in the growth of shoot and root was inhibited by extracts obtained from *Hibiscus sabdariffa* and *Couripita guianensis* at 0.003 g DW that was equivalent to the extract concentration we found. The variation of inhibitions of shoot and root growth were found in all test species and greater inhibitions were found in dicotyledonous test species. Similar results were found by Piyatida and Kato-Noguchi, 2010 and Islam *et al*., 2013.

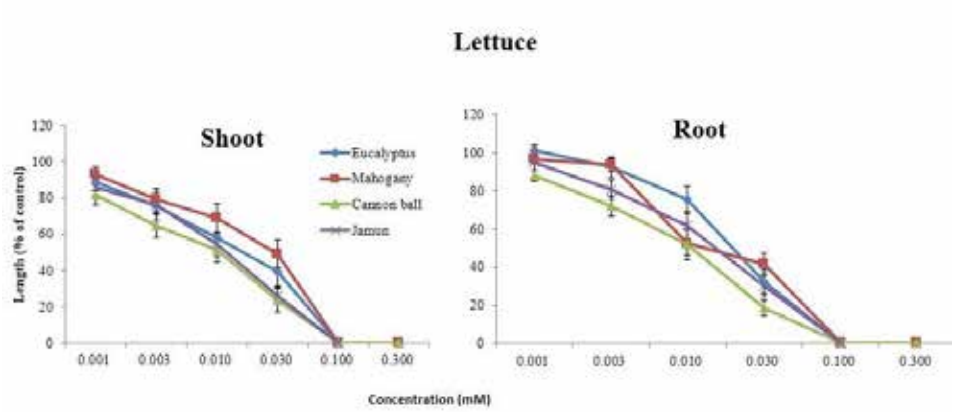

Fig. 1. Effect of aqueous methanol extracts of Eucalyptus, Mahogony, Cannon ball and Jamun leaves on the shoot and root growth of lettuce. Means ± SE from 3 independent experiments were tested.

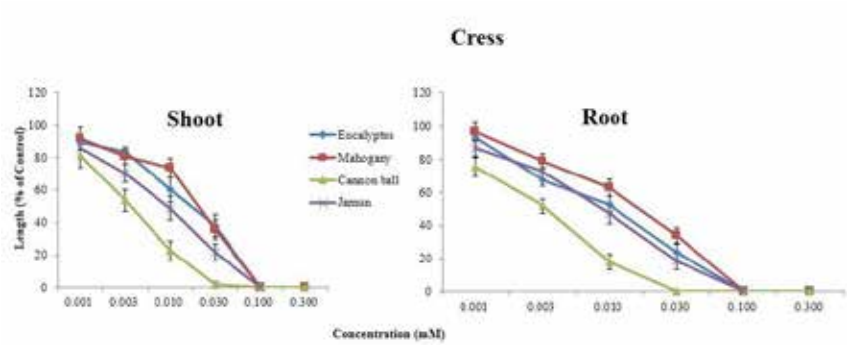

Fig. 2. Effect of aqueous methanol extracts of eucalyptus, mahogony, cannon ball and jamun leaves on the shoot and root growth of cress. Means ± SE from 3 independent experiments are tested.

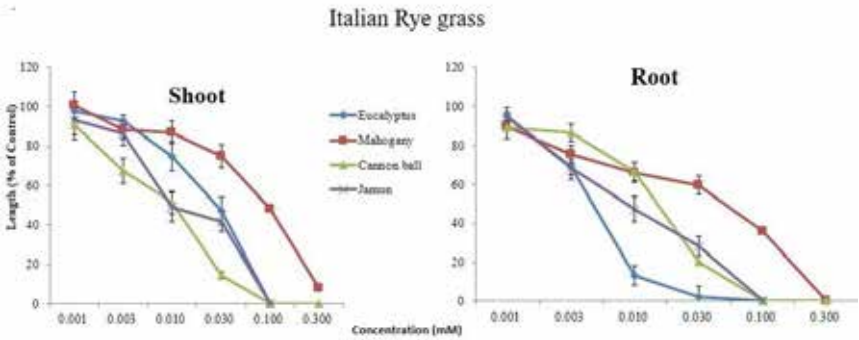

Fig. 3. Effect of aqueous methanol extracts of eucalyptus, mahogany, cannon ball and jamun leaves on the shoot and root growth of Italian Rye grass. Means ± SE from 3 independent experiments were tested.

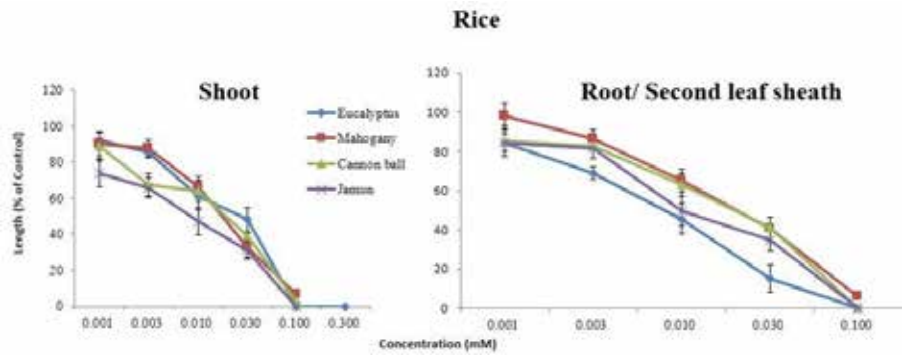

Fig. 4. Effect of aqueous methanol extracts of eucalyptus, mahogany, cannon ball and jamun leaves on the shoot and root growth of rice. Means ± SE from 3 independent experiments were tested.

Based on the concentrations required for 50% inhibition (IC_{50}) values of all the test plants, we found more effective inhibition of shoot and root growth of the dicotyledonous test plants than that of monocotyledonous (Fig. 5). The leaf extracts of four medicinal plants showed different inhibitory activities on different test plants, which indicates that the variation in selectivity of inhibitory substances was specific against the target plants. The possibility of such unequal susceptibility to extracts may be due to the involvement of bio-chemicals with their different inherent responses (Khan and Kato-Noguchi, 2016). The IC_{50} values of lettuce, cress, Italian ryegrass, and rice seedling hypocotyls are shown in Fig. 5. Among the test species, cress was most sensitive whereas lettuce,

Italian ryegrass and rice seedlings showed almost similar inhibitory activity on shoot and root growth. Among the four different plant leaf extracts, cannon ball tree (*Couroupita guianensis)* showed strong inhibition on plant growth. A similar pattern of growth inhibitory activity was reported by Khan and Kato-Noguchi (2016). On the other hand, Mahogany (*Swietenia macrophylla*) leaf extracts exhibited relatively weaker inhibitory activity than the other leaf extracts of Bangladeshi plant against the four plant species.

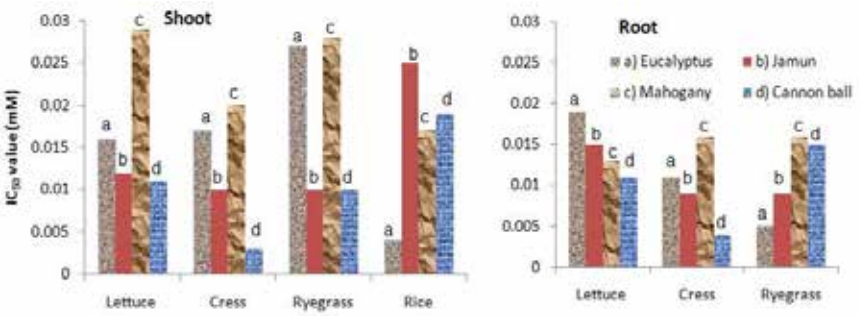

Fig. 5. IC_{50} values (g DW equivalent extract mL^{-1}) of shoot and root growth of four test plants by treated with aqueous methanol extracts of four different plant leaves extracts.

CONCLUSION

The aqueous methanol extracts of four different medicinal plants were tested on seedling growth of some plants. The observed inhibitory activities of test plants were significantly high, which proposes that these four species have growth inhibitory potential and may possess allelopathic substances. Therefore, these four species could be the candidates for isolation and identification of those active substances. These results might be helpful to carry out next experiment to establish the natural growth retardants which would be biodegradable and safe for the environments.

Acknowledgements

We are very much grateful to The United Graduate School of Agricultural Sciences, Ehime University for their financial support to complete the research work. I am also grateful to my PhD supervisor Prof. Yasuhiro Kawanami for his lab facility and guidance. My sincere thanks and gratitude also for my two co-workers; Miyu Fukai and Koshu Koyama.

REFERENCES

Aktar, M.W., Sengupta, D. and Chowdhury, A. 2009. Impact of pesticides use in agriculture: their benefits and hazards. *Interdiscip. Toxicol.,* 2(1): 1–12.

Chowdhury, M.T.I., Ando, H., Yanagita, R.C. and Kawanami, Y. 2018. Synthesis and inhibitory activity of deoxy-D-allose amide derivative against plant growth. *Biosci. Biotechnol. Biochem.,* 82(5): 775-779.

Chowdhury, M.T.I., Ando, H., Yanagita, R.C and Kawanami, Y. 2016. Syntheses and biological activities of deoxy-D-allose fatty acid ester analogs. *Biosci. Biotechnol. Biochem.,* 80(4): 676-681.

Chowdhury, M.T.I., Naido, M., Yanagita, R.C., Kawanami, Y. 2015. Synthesis of 6-*O*-decanoyl-D-altrose and 6-*O*-decanoyl-D-gulose and evaluation of their biological activity on plant growth. *Plant Growth Regul.,* 75(3): 707-713.

Dreistadt, S.H., Clark, J.K. and Flint, M.L. 1994. Pests of Landscape Trees and Shrubs: An Integrated Pest Management Guide (3rd Edn.). UC ANR Publication 3359.

Farnsworth, N.R., Akerele, O., Bingel, A.S., Soejarto, D.D. and Guo, Z. 1985. Medicinal plants in therapy. Bull. *World Health Organ.,* 63(6): 965.

Harborne, J. 1984. Methods of Plant Analysis. Phytochemical Methods. Dordrecht, Springer, 1-36pp.

Hayta, S., Tasar, N., Cakilcioglu, U. and Gedik, O. 2014. Morphological, karyological features and pollen morphology of endemic Ebenus haussknechtii Bornm. Ex hub.-Mor. From Turkey: A traditional medicinal herb. *J. Herb. Med.,* 4(3): 141-146.

Islam, A.K.M.M., Khan, M.S.I. and Kato-Noguchi, H. 2013. Allelopathic activity of *Litchi chinensis* Sonn. *Acta Agric. Scand. - B Soil Plant Sci.,* 63(8): 669-675.

Khan, M.S.I., Kaium, M.A., Sarkar, B.K., Begum, R., Begum, N., Islam, M.A., Chowdhury, M.T.I., Habib, M. and Hakim, M.A. 2021. Potencies of *Justicia Adhatoda* L. For Its Possible Phytotoxic Activity. *Plant Sci. Today.,* 8: 289-292.

Khan, M.S.I. and Kato-Noguchi, H. 2016. Assessment of allelopathic potential of *Couroupita guianensis* Aubl. *POJ.,* 9(2): 115-120.

Khan, M.S.I., Islam, A.K.M.M. and Kato-Noguchi, H. 2013. Evaluation of Allelopathic Activity of Three Mango (*Mangifera indica*) Cultivars. *Asian J. Plant Sci.,* 12: 252-261.

Pell, M., Stenberg, B. and Torstensson, L. 1998. Potential denitrification and nitrification tests for evaluation of pesticide effects in soil. *Ambio.*, 27: 24-28.

Piyatida, P. and Kato-Noguchi, H. 2010. Screening of allelopathic activity of eleven Thai medicinal plants on seedling growth of five test plant species. *Asian J. Plant Sci*., 9(8): 486-491.

Rademacher, W. 2000. Growth retardants: effects on gibberellin biosynthesis and other metabolic pathways. *Annu. Rev. Plant Physiol. Plant Mol. Biol.,* 51: 501-531.

Suzuki, M., Khan, M.S.I., Iwasaki, A., Suenaga, K. and Kato-Noguchi, H. 2016. Allelopathic potential and an allelopathic substancein mango leaves. *Acta Agric. Scand. B Soil Plant Sci.,* 67: 37-42.

Suwitchayanon, P., Pukclai, P., Ohno, O., Suenaga, K. and Kato-Noguchi, H. 2015. Isolation and Identification of an Allelopathic Substance from *Hibiscus sabdariffa*. *Natur. Pro. Commu*., 10: 765-766.

Van Wyk, A. and Prinsloo, G. 2018. Medicinal plant harvesting, sustainability and cultivation in South Africa. *Biol. Conserv.,* 227: 335-342.