



EFFECTS OF HERBAL PLANT EXTRACTS ON GERMINATION AND SEEDLING GROWTH OF SOME VEGETABLES

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ABSTRACT

A pot experiment was conducted to study the effects of aqueous extracts of some herbal plant leaves viz. bael (*Aegle marmelos*), amla (*Phyllanthus emblica*), beleric myrobalan (*Terminalia belerica*), arjuna (*Terminalia arjuna*), neem (*Azadiracta indica*), horitoki (*Terminalia chebula*) and water (as control) with three replications on germination and seedling growth of three vegetables namely turnip (*Brassica rapa*), spinach (*Beta vulgaris*) and ladies finger (*Hibiscus esculentus*). Aqueous extract of *Terminalia arjuna* significantly increased germination and growth of turnip and ladies finger while germination and growth in spinach were found to be increased with the treatment of aqueous extract of *Terminalia belerica* in comparison with control. Aqueous extract of *Azadiracta indica* inhibited the germination percentage as well as growth of turnip and ladies finger. Inhibitory effect of *Terminalia chebula* was also observed on the growth of ladies finger.

KEY WORDS: Germination, Seedling growth, Aqueous extract, Herbal Plants, Vegetables.

INTRODUCTION

Plants are reservoir of different types of natural occurring bio-organic compounds having a wide range of biological activities. Different parts of plants and their extracts have been used for various purposes since long time ago due to their chemical properties, availability, and simple use without side effects. Certain plant extracts found to have cytotoxic effects^[1], some showed antioxidant properties^[2,3] while a group of plant species effectively showed antimicrobial activities^[4-6] and reduced plant diseases like damping-off and wilt^[7]. Some investigations have also reported Bio-insecticidal effects of plant extracts from certain species^[8]. Besides protecting plants from different pest and diseases, several investigators reported the effect of plant extracts on germination and growth of different crops. Germination and growth of lettuce significantly inhibited by *Hypericum myrianthum* and *Hypericum polyanthemum* plant extracts^[9]. Aqueous extracts of Mikania found to decrease germination percentage, fresh weight and radical length of Chinese and tomato without affecting corn and long bean seedlings^[10]. Besides the inhibitory effects, there are a lot of reports indicating positive effects of plant extracts on germination and growth. Plant extracts of *Eugenia jambolana*, *Nerium oleander* and *Citrullus colocynthis* found to improve the growth and yield of lupine plants^[7]. Soaking of Bean seeds in leaf extracts of *Moringa oleifera* resulted in

increased growth and yield in bean plants^[11]. Rapid and uniform germination with emergence are desirable for well establishment in vegetables. Various chemicals are employed to increase germination as well as growth of vegetables but high rates of fertilizer application particularly nitrogen (N) fertilizers can delay and reduce seedling emergence of many vegetable crops^[12]. Due to being expensive along with hazardous toxic effects of chemical compounds, use of natural and biodegradable substances like fresh plant extracts has drawn significant importance during the last few decades^[13-15]. Present study was undertaken to observe the effects of aqueous extracts of some herbal plants viz. bael (*Aegle marmelos*), amla (*Phyllanthus emblica*), beleric myrobalan (*Terminalia belerica*), arjuna (*Terminalia arjuna*), neem (*Azadiracta indica*) and horitoki (*Terminalia chebula*) on the germination and growth of three vegetables namely turnip (*Brassica rapa*), spinach (*Beta vulgaris*) and ladies finger (*Hibiscus esculentus*).

MATERIALS AND METHODS

Plant materials

To conduct this experiment, fresh leaves of the herbal plants presented in Table-1 were collected from the campus of Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh.

TABLE 1: Different herbal plant leaves collected for the experiment

English name	Scientific name	Family
Arjuna	<i>Terminalia arjuna</i>	Combretaceae
Beleric myrobalan	<i>Terminalia belerica</i>	Combretaceae
Horitoki	<i>Terminalia chebula</i>	Combretaceae
Anola/amla	<i>Phyllanthus emblica</i>	Euphorbiaceae
Neem	<i>Azadiracta indica</i>	Azadiractaceae
Bael	<i>Aegle marmelos</i>	Rutaceae

Selection of Vegetables

Based on the growing pattern and availability in sub-tropical countries, three vegetables namely Turnip (*Brassica rapa*), Spinach (*Beta vulgaris*), and Ladies finger (*Hibiscus esculentus*) were selected to conduct this study.

Preparation of Aqueous Extracts

Two hundred (200) grams of fresh and clean leaves of each selected plants were cut into smaller pieces and taken into 1L reagent bottle separately after blending with the help of a mechanical blender. 800 ml of water was added to each reagent bottle and were kept for 72 hours at room temperature of $29 \pm 2^\circ\text{C}$ having relative humidity of $85 \pm 5\%$ with proper stirring at a regular interval. After 72 hours the aqueous slurry were filtered separately through Whatman No.1 filter paper. These aqueous extracts were used as treatments in our experiment along with water as control treatment.

Set up for the Investigation of Vegetable Crop Seeds

For each treatment, 20 seeds of each selected vegetables were placed separately in different pots (25cm x 30cm) containing equal amount of dried, well mixed sandy loam soil (pH 6.10). Then 200 ml of each aqueous extracts were applied in each pot respectively while only distilled water was used as control treatment. All the treatments were replicated for three times. 20 ml of distilled water was applied in each pot per day as irrigation and after ten days another 200 ml of aqueous extracts (treatments) were applied in each respective pot and only water in the control.

Germination Test

Number of germinated seeds was noted daily by visual counting. Germination percentage was computed by the following formula^[16].

$$G = \frac{n}{N} \times 100$$

Where, n is the sum of number of seeds germinated and N is the total number of seeds placed for germination.

Technique for Shoot and Root Growth Measurement

5 seedlings selected randomly from each pot were uprooted very carefully ensuring no shoot and root damage at certain period of seedling growth and the shoot length and root length of the seedlings were noted.

Determination of chlorophyll contents

The chlorophyll contents of vegetable seedlings were determined according to the method of Arnon^[17]. Total chlorophyll was determined using the formula given by Porra^[18]. Fresh leaves (0.1g) were taken in each test tubes containing 10mL of 80% acetone and were shaken overnight using an electric horizontal shaker. Absorbance

of the supernatant was measured at 663 nm, 645 nm and 470 nm wavelength using a spectrophotometer. Chlorophyll-a (Chl-a), chlorophyll-b (Chl-b), total

chlorophyll and total carotenoid contents were measured using following formulae:

$$\text{Chl-a (mg g}^{-1} \text{ f. wt)} = 12.21 A_{663} - 2.81 A_{646}$$

$$\text{Chl-b (mg g}^{-1} \text{ f. wt)} = 20.13 A_{646} - 5.03 A_{663}$$

$$\text{Total chlorophyll (mg g}^{-1} \text{ f. wt)} = 17.76 (A_{646}) + 7.34 (A_{663})$$

$$\text{Total carotenoid (mg g}^{-1} \text{ f. wt)} =$$

$$\frac{(1000A_{470} - 2.05 \text{ Chl-a} - 114.8 \text{ Chl-b})}{245}$$

A= Absorbance

f. wt = Fresh weight

Data analysis

The collected data were analyzed statistically using the analysis of variance (ANOVA) technique with the help of computer by MSTAT-C program. The treatment means were compared by Dunckun's Multiple Range (DMRT) Test^[19] at 5% level of significance.

RESULTS & DISCUSSION

Effects of aqueous extracts on germination

The effects of aqueous extracts of different herbal plant leaves on the germination of selected vegetables are shown in Table 2. A significant effect of aqueous extracts was found on the germination of vegetables throughout the growing period (P = 5). Germination percentage of Turnip and Ladies' finger found to be maximum with the treatment of aqueous leaf extract of arjuna (*Terminalia arjuna*) while in case of Spinach, aqueous extract of beleric myrobalan (*Terminalia belerica*) significantly increased the germination percentage with compared to control. Similar results were observed by Roy *et al.*^[20] who reported that aqueous extract of *Terminalia belerica* leaves significantly increased germination of swamp cabbage (*Ipomoea aquatica*) and okra (*Hibiscus esculentus*). In contrast, the aqueous extract of Neem (*Azadirachta indica*) significantly decreased germination percentage of turnip and ladies finger indicating an inhibitory effect of *Azadirachta indica* on seed germination. Xuan *et al.*^[21] had been showed that the germination of several crops : alfalfa (*Medicago sativa*), bean (*Vigna angularis*), carrot (*Daucus carota*), radish (*Raphanus sativus*), rice (*Oryza sativa*), and sesame (*Sesamum indicum*) was strongly inhibited by neem extract. The reduction in germination percentage of vegetables might have been due to the presence of different allelochemicals in the aqueous extracts.

TABLE 2: Effects of Aqueous Extracts of herbal Plants on Germination of different vegetables

Treatments	Turnip			Spinach			Ladies finger	
	15 DAS	30 DAS	45 DAS	10 DAS	20 DAS	30 DAS	7 DAS	14 DAS
Bael	80 ab	83 b	96 ab	81 ab	91 a	96 a	68 ab	73 b
Amla	81ab	86 ab	93 b	80 b	90 a	95 a	66 ab	75b
Beleric myrobalan	82 a	92 a	93 b	83 a	91 a	97 a	79 ab	80 ab
Arjuna	84 a	94 a	98 a	79 c	89 ab	94 a	81 a	83 a
Neem	66 c	74 c	89 c	81 ab	84 b	93 a	62 b	65 c
Horitoki	77 b	87 ab	95 ab	80 b	80 c	95 a	76 ab	78 ab
Water (Control)	76 b	91 a	96 ab	81 ab	81 c	96 a	77 ab	77 ab
CV %	2.79	2.98	3.2	3.37	3.66	4.56	3.83	3.49
LSD	3.80	4.21	4.07	0.99	1.07	1.07	2.94	4.40

In a column, figures having the similar letter (s) did not differ significantly by DMRT at P 5% level
DAS = Days after sowing

Effects of aqueous extracts on growth (shoot length and root length)

Shoot length and root length of the considered three vegetables found to be influenced significantly (Table-3, 4) by the aqueous extracts of different herbal plant leaves (P = 5). Shoot length of turnip and ladies finger found to be maximum with the treatment of aqueous extract of arjuna (*Terminalia arjuna*) while in case of spinach, the treatment of aqueous extract of beleric myrobalan (*Terminalia belerica*) resulted in maximum shoot length (Table-3). The other treatments showed moderate performance except the aqueous extract of neem (*Azadirachta indica*), which found to decrease the shoot length of turnip and ladies finger while aqueous extract of horitoki (*Terminalia chebula*) decreased shoot length of ladies finger in comparison with control. Table-4 shows

the effects of aqueous extracts on the root length of turnip, spinach, and ladies finger. Aqueous extract of arjuna (*Terminalia arjuna*) found to increase the root length of turnip and ladies finger while the maximum root length in spinach was found with the treatment of aqueous extract of beleric myrobalan (*Terminalia belerica*). Aqueous extract of neem (*Azadirachta indica*) was found to significantly decrease the root length of turnip and ladies finger while aqueous extract of horitoki (*Terminalia chebula*) also decreased the root length of ladies finger with compared to control. Results in Table-3 and Table-4 clearly indicated the growth promontory effects of beleric myrobalan (*Terminalia belerica*) and arjuna (*Terminalia arjuna*) extracts confirming the results of Roy, Sarker [20]. The increased growth may be obtained due to the presence of some growth regulatory substances.

TABLE 3: Effects of Aqueous Extracts of herbal plants on Shoot length of Vegetables

Treatments	Turnip			Spinach			Ladies finger	
	15 DAS	30 DAS	45 DAS	10 DAS	20 DAS	30 DAS	7 DAS	14 DAS
Bael	4.08 ab	6.80 ab	7.38 a	4.00 c	5.50 ab	6.78 b	4.56 c	11.18 ab
Amla	4.30 ab	7.40 a	8.54 a	4.36 b	6.00 a	7.38 a	6.57 ab	10.61 ab
Beleric myrobalan	4.50 ab	6.70 ab	7.50 a	5.06 a	6.10 a	7.56 a	6.41abc	12.41 a
Arjuna	4.97 a	7.50 a	8.64 a	4.86 a	5.53 ab	6.58 b	7.12abc	12.17 a
Neem	3.92 b	5.00 b	5.32 b	4.56 ab	5.18 b	6.82 b	4.94 bc	9.818 b
Horitoki	3.90 b	6.20 ab	6.96 ab	4.60 ab	5.70 ab	7.00 ab	5.61abc	9.97 b
Water (Control)	4.70 ab	7.00 ab	7.46 a	4.20 b	5.30 b	6.44 c	6.38 abc	11.84 a
CV %	1.87	2.09	2.24	2.18	2.49	2.71	3.45	4.3
LSD	2.66	2.99	3.43	3.21	5.04	4.38	3.87	4.20

In a column, figures having the similar letter (s) did not differ significantly by DMRT at P 5% level.
DAS = Days after sowing

Results also demonstrated the inhibitory effect of aqueous extract of neem (*Azadirachta indica*) on the growth (shoot length and root length) of turnip and ladies finger. A similar effect of aqueous extract of horitoki (*Terminalia chebula*) was observed on the growth of ladies finger. Tripathi and Singh [22] were found similar results in a study where aqueous extract of *Terminalia chebula* showed strong inhibitory effects on wheat seed germination as well as radical and plumule growth. Xuan, Tsuzuki^[21] concluded that, aqueous extracts of neem (*Azadirachta*

indica) strongly inhibited the growth of several crops while working with aqueous extracts of horitoki (*Terminalia chebula*), Roy, Sarker^[20] had been reported significant inhibition on both shoot length and root length of swamp cabbage. The results of this study indicating the inhibitory effect of neem (*Azadirachta indica*) is consistent with the findings of previous studies^[23, 24]. As there was a direct contact between aqueous extracts and roots, the reduction in plant growth might have been due to the direct or indirect effect of different allelochemicals.

TABLE 4: Effects of Aqueous Extracts of herbal plants on Root length of Vegetables

Treatments	Turnip			Spinach			Ladies finger	
	15 DAS	30 DAS	45 DAS	10 DAS	20 DAS	30 DAS	7 DAS	14 DAS
Bael	3.60 ab	4.10 a	4.74 ab	1.80 c	3.90 b	4.56 a	6.41 b	7.54 ab
Amla	3.10 b	4.40 a	5.74 ab	2.30 ab	4.20 ab	4.90 a	6.79 ab	7.11 ab
Beleric myrobalan	3.10 b	4.30 a	5.64 ab	2.50 ab	5.00 a	5.70 a	7.65 a	8.41 a
Arjuna	3.94 a	5.00 a	6.04 a	2.48 ab	4.50 ab	5.16 a	7.79 a	8.63 a
Neem	3.16 b	3.80 a	4.18 b	2.68 a	4.14 ab	4.80 a	6.05 bc	6.77 b
Horitoki	2.94 b	4.40 a	5.50 ab	2.30 ab	4.90 ab	5.36 a	5.58 c	6.49 b
Water (Control)	3.02 b	4.80 a	5.38 ab	1.90 bc	4.40 ab	5.26 a	6.08 bc	7.17 ab
CV %	1.78	1.95	2.13	1.99	2.7	3.19	3.9	3.15
LSD	1.67	2.23	3.14	3.20	4.73	5.62	.07	1.35

In a column, figures having the similar letter (s) did not differ significantly by DMRT at P 5% level.

DAS = Days after sowing

Effects of aqueous extracts on chlorophyll and carotenoid contents

Table-5 shows the effect of leaf extract of herbal plants on the Chlorophyll contents of turnip and spinach. Aqueous extract of bael (*Aegle marmelos*) found to increase the Chlorophyll-b, Total Chlorophyll and carotenoid contents of turnip while maximum Chlorophyll-a content was recorded with the aqueous extract of Amla (*Phyllanthus emblica*). Aqueous extracts of Bael (*Aegle marmelos*) also found to increase the chlorophyll-b and carotenoid

contents of spinach while the Chlorophyll-b along with total chlorophyll contents of spinach found to be higher with the treatment of aqueous extracts of Neem (*Azadirachta indica*). Variations in the chlorophyll contents of vegetables might have been due to the interaction of different allelochemicals present in different plant extracts. Higher carotenoid contents in turnip and spinach were found with the aqueous extracts of Bael (*Aegle marmelos*) while the lowest were found with Arjuna (*Terminalia arjuna*) plant extracts.

TABLE 5: Effect of Aqueous Extracts of herbal Plants on Chlorophyll and Carotenoid contents

Treatments	Chlorophyll Contents (mg/g Fw)						Total Carotenoid	
	Turnip			Spinach			Turnip	Spinach
	Chl. a	Chl. b	Total chl.	Chl. a	Chl. b	Total chl.		
Bael	0.87 b	0.75 a	1.63 a	0.51 ab	0.17 a	0.68 a	4.86 a	2.58 a
Amla	1.15 a	0.14 b	1.27 ab	0.51 ab	0.15 c	0.66 a	3.06 b	2.34 ab
Beleric myrobalan	0.60 b	0.29 b	0.89 bc	0.44 c	0.15 c	0.60 a	2.84 bc	2.06 bc
Arjuna	0.65 b	0.22 b	0.87 bc	0.48 ab	0.14 bc	0.63 a	2.84 bc	2.09 bc
Neem	0.76 b	0.28 b	1.05 b	0.59 a	0.12 c	0.70 a	3.15 b	2.20 abc
Horitoki	0.75 b	0.29 b	1.04 b	0.46 c	0.16 ab	0.62 a	3.06 b	1.87 c
Water (Control)	0.72 b	0.28 b	1.00 b	0.48 ab	0.12 c	0.61 a	3.15 b	2.18 abc
CV %	1.75	1.87	2.13	1.79	1.91	1.99	2.99	2.34
LSD	0.26	0.36	0.43	0.17	0.07	0.19	0.85	0.38

In a column, figures having the similar letter (s) did not differ significantly by DMRT at P 5% level.

DAS = Days after Sowing; Fw = Fresh weight, Chl. =Chlorophyll

CONCLUSION

Experimental investigations were conducted to determine the effects of aqueous extracts of different herbal plants on germination and growth of three vegetables. Aqueous extract of Arjuna (*Terminalia arjuna*) increased the germination and growth of ladies' finger and turnip, aqueous extract of Beleric myrobalan (*Terminalia belerica*) increased germination and growth of spinach while aqueous extract of neem (*Azadirachta indica*) decreased germination and growth of turnip, ladies finger, and spinach. Growth of ladies finger was also found to be decreased with the aqueous extract of horitoki (*Terminalia chebula*). Further studies should identify, isolate, and test the allelochemical (s) from these plants which will explore their potential as plant growth regulators or as natural herbicides.

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