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Growth and yield performance of *Aloe vera* grown in different soil types of Bangladesh

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Abstract

Plant requires suitable soil for higher yield, quality growth and desired crop productivity that differ with soil characteristics, availability of the nutrient elements and overall soil fertility. *Aloe vera*, a documented medicative plant, is used for numerous medical and cosmetic applications since very beginning of the civilization. An experiment was conducted in Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh to find out the most appropriate soil for *A. vera* cultivation. Seven types of soils *viz.*, acid, calcareous, non-calcareous, charland, saline, peat and acid sulphate were collected from different locations of Bangladesh. Eighteenth month old *Aloe vera* seedlings were collected from *Shomvogonj*, Mymensingh and planted during last week of May, 2017 following completely randomized design (CRD) with three replications. Most of the soils were light grey in colour, acidic to neutral in nature and clay to clay loam in texture except non-calcareous and charland soils. Bulk density, particle density and field capacity ranged from 1.23−1.45 g cm^{-3}, 2.20−2.58 g cm^{-3} and 27.07−30.20%, respectively. The ranges of pH, EC and organic matter contents were 3.8 to 7.8, 0.25 to 14.04 dS m^{-1} and 0.88 to 16.40%, respectively. The organic matter content was found as low to moderate except peat soil. Total N, exchangeable K, available P and S contents ranged from 0.05−0.95%, 0.17−0.73 cmol kg^{-1}, 3.09−12.10 and 11.06−735.12 µg g^{-1} soil, respectively. Growth and leaf biomass yield of *A. vera* was significantly influenced by different soil types. The highest plant height, leaf number, leaf area and leaf fresh weight were recorded from the plant grown in non-calcareous soil whereas maximum fresh gel weight, dry leaf weight and yield increase over acid sulphate soil were found from the plant grown in calcareous soil. The highest fresh leaf gel weight (907 g $plant^{-1}$) was obtained from the plant grown in calcareous soil which was identical with the gel weight (880 g $plant^{-1}$) of the plant grown in acid soil. The yield increase of acid, non-calcareous, charland, saline1 (6.32 dS m^{-1}) and saline2 (8.14 dS m^{-1}) soils over acid sulphate soil were 718, 712, 394, 144 and 86%, respectively. The overall performance of the soils in relation to leaf biomass yield was of the following order: calcareous ≥ acid ≥ non-calcareous > charland > saline1 (6.32 dS m^{-1}) > saline2 (8.14 dS m^{-1}) > peat > acid sulphate soil. The results suggest that farmers could be advised to grow *A. vera* either in calcareous or acid soils of Bangladesh. Since calcareous and non-calcareous soils are mostly used for growing cereals, pulses, cash crop like sugarcane, fruits etc., acid soil could be used for cultivating this important medicinal crop considering the socio-economic conditions of the country.

Introduction

Aloe vera, a multifunctional and miracle plant, used as medicinal and ornamental purposes, healthy food ingredient as well as the materials for cosmetic industries. It belongs to the family Alliaceae and genus *Aloe* containing about 420 species (Dange *et al*., 2000). This perennial succulent plant has the ability to develop water storage tissue in the leaves to survive in dry conditions with low or erratic rainfall (Kumar and Yadav, 2014). The leaves of this plant contain fat compounds, carbohydrates, proteins, lipids, and 18 essential amino acids, vitamins (e.g., A, C, E, vitamin B12, folic acid), minerals, glycoprotein, C-glucosylchromone, anthraquinones, emodin, salicylic acid and various kinds of enzymes (Hamman, 2008; Surjushe *et al.*, 2008). It also contains secondary metabolites like alkaloids, aloins, lectins, lignin, saponins, tannins, phenolic and glukomannan (Boudreau and Beland, 2006; Darini *et al.*, 2013). The cultivation of *A. vera* has gained commercial importance for medicinal products and cosmetics processing. Its cultivation is expanding rapidly as it provides quick and regular income to the farmers (Moorthy and Malliga, 2012). *Aloe* gel possesses important biological properties such as antimicrobial (Bashir *et al.*, 2011), anticancer (Naveena *et al.*, 2011), antioxidant (Miladi and Damak, 2008), antidiabetic (Jones, 2007), antiulcer (Borra *et al.*, 2011), hepatoprotective (Chandan *et al.*, 2007), immunomodulatory (Atul *et al.*, 2011) and many more medicinal activities. The gel of *Aloe* leaves is also associated with many health benefits as it contains polysaccharides (Josias, 2008). Yusuf *et al.* (2004) reported that the plant has the potential of secreting gastric acid on the gastric mucosal injury. Okonkwo *et*

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al. (2009) reported that the gel has also the potential of controlling body rashes, mouth odour, running nose, itching, soar throat and such veneral diseases as gonorrhoea, staphylococcus and vaginal discharge when combined with some African medicinal leaves.

Different biotic and abiotic factors may affect crop production (Orcutt and Nilsen, 2000). Soil provides most of our necessities through the plant and animal communities which develop on it (Garg and Kumar, 2012). Soil ensures physical support for plant growth and development by supplying necessary water and nutrient elements. Soil types, soil nutrient status, and fertilizer management usually influence the growth, yield and quality of a plant species, and their suitability is the prerequisite for higher yield and better quality crops (Hossain and Ishimine, 2005; Akamine *et al*., 2007; Chowdhury *et al*., 2008; Hossain *et al*., 2011; Islam *et al*., 2011). Soil type is an important abiotic factor that might affect plant growth through controlling the nutrient supply, altering the function of plant roots and soil-borne microbes like root endophytic fungi, mycorrhizal fungi and rhizobia (Chiarini *et al*., 1998; Egamberdiyeva, 2007; Latour, 1996; Pineda, 2010). Crop productivity varies with the contents and different combinations of nutrient elements, pH, EC and organic matter present in soil (Broadley *et al*., 2012; Hawkesford *et al*., 2012). Different soils might have various effects on the function of plant growth-promoting microorganisms (PGPMs), which could promote plant growth (Sripontan *et al*., 2014). For functioning through the soils, nutrients might be the most important factor to affect the growth of plants and their biochemical constituents (Altieri and Nicholls, 2003; Mevi-Schütz *et al*., 2003). The soil nutritional elements required for the growth are not only the important sources of materials for building up the structures of plant tissues, but also are actively involved in the metabolic activities within plants (Al-Humaid, 2005). Soil organic carbon is also a crucial parameter for soil fertility as it enhances soil physical, chemical and biological properties (Lützow *et al*., 2006; Birkhofer *et al*., 2008). To develop management practices for higher yield and good quality of plant product, investigation on different growth parameters of the plant is critical by using different types of local soils (Hossain and Ishimine, 2005). The quality of medicinal herb like *A. vera* is the comprehensive indicator reflecting certain cultivation technologies and ecological conditions in different Bangladeshi soils. It is a semi subtropical plant that can be grown easily like other vegetable crops (McKeown, 1987). *Aloe vera* grows well in all kinds of soils but well drained soil rich in organic matter is preferable (Kumar and Yadav, 2014) because of their their sensitivity to water stagnant conditions (Manvitha and Bidya, 2014). As an agro-based country, Bangladesh could easily introduce *A. vera* as a commercial crop like others and can be cultivated in its relatively high land and homestead area as it grows well in open space with proper drainage. Being a new crop, *A. vera* is needed to be domesticated in Bangladesh, a package regarding the soil and cultivation aspects, to standardize under different agro climatic conditions to boost up its cultivation. To the best of our knowledge, till now no detailed study has yet been conducted to evaluate the effects of different soil types on the growth and leaf yield of *A. vera* in Bangladesh. So, it is necessary to select better soil(s) for the cultivation of this valuable medicinal plant. In this study, based on the characteristics of the natural distribution pattern of soils, seven representative soil types of Bangladesh with different physiochemical properties were selected for conducting the controlled experiments on the cultivation of *A. vera*, aiming to study the correlations of the soil factors with its growth, and leaf biomass yield.

Materials and Methods

The experiment was conducted in the net house of Bangladesh Institute of Nuclear Agriculture, Mymensingh during May to August 2017. Seven types of soils namely acid, calcareous, non-calcareous, charland, saline, peat and acid sulphate soils were collected from different locations of six districts of Bangladesh *viz.*, *Fulbaria* (Mymensingh), *Sadar* (Natore), Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh, *Melandoh* (Jamalpur), *Botiaghata* (Khulna), *Kotalipara* (Gopalganj) and *Pekua* (Cox's Bazar), respectively during the month of February−April, 2017 for *A. vera* cultivation. Eighteen months old *A. vera* seedlings were collected from *Shomvogonj*, Mymensingh and used for the experiment following CRD with three replications. For the present investigations, approximately 40 kg soils from each location were collected from 0–15 cm depth of selected fallow land to screen out the best soil for *Aloe vera* cultivation. The soils were separately put in to plastic bags and carried to the laboratory with proper tagging. The collected soil samples were made free from plant residues and other extraneous materials; then air dried, ground and sieved through a 2 mm sieve. The whole process was done several times until adequate amount of soil was prepared for the experiment. Eight kg processed soil was taken in each earthen pot of 23 cm in height with 30 cm diameter at the top and 18 cm diameter at the bottom. Approximately 500 g sieved soil from each source was preserved in a polythene bag for physical and chemical analyses. The soil was mixed thoroughly with well decomposed dry cow dung (CD), urea, TSP, MoP and gypsum @500.0, 2.0, 0.9, 1.2 and 0.75 g pot^{-1}, respectively in each pot for normal growth and development of *A. vera* seedlings. The total nutrient concentrations of CD used in the experiments were OC, N, P, K, S, Ca and Mg as 24.03, 1.05, 0.35, 0.45, 0.24, 0.16 and 0.015% respectively. Distilled water was added in each pot, covered with polyethylene and kept for one week before transplanting. Intercultural operations like irrigation, soil loosening, weeding, insect pest control etc. were done as and when necessary. The crop was destructively harvested at 120 days after planting (DAP), cleaned, oven dried at 60°C for 72 hours. Plant height, branches plant^{-1}, leaves plant^{-1}, leaf area plant^{-1}, fresh and dry leaf weight of stevia were studied. Analysis of variance (ANOVA) was done following the principal of F-statistics and the mean values were separated by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Soils of different types affect crop production according to their capability as a nutrient supplier based on plant requirement. Incorporation of *A. vera* into agricultural production systems depends upon details information regarding the plant, suitability of soil, its agronomic potentiality and nutritional requirements. Seven different soils types were selected to find out the most suitable soil for *A. vera* cultivation in Bangladesh.

Physico-chemical properties of soils

The results of the physical and chemical properties of seven soils used in the study have been presented in Table 1. Colour, texture, pH and EC values, organic matter, total N, exchangeable K, available P and S concentrations in different soil types varied considerably. Majority of the soils were light grey in colour except acid and peat soils which were reddish and blackish, respectively. Most of the soils were clay to clay loam in texture except non-calcareous and charland soils which were sandy clay loam to loam. Bulk density, particle density and field capacity varied with respect to soils and ranged from 1.23−1.45 g cm^{-3}, 2.20−2.58 g cm^{-3} and 27.07−30.20%, respectively. Non-calcareous soil had the highest particle density and bulk density whereas the highest field capacity was found in saline2 soil.

The chemical properties of soils also varied across the soil types. The range of pH, EC and organic matter content was found as 3.80−7.80, 0.25−14.04 dS m^{-1} and 0.88−16.40%, respectively. The soils were acidic to slightly alkaline which should render them suitable for growing crops except acid sulphate soil (pH 3.8). The highest pH (7.8) and EC (14.04 dS m^{-1}) were recorded from saline2 and acid sulphate soils, respectively. Among the chemical parameters, the contents of total N, exchangeable K, and available P and S concentrations ranged from 0.05−0.95%, 0.17−0.73 cmol kg^{-1}, 3.09−12.10 and 11.06−735.12 μg g^{-1} soil, respectively. Peat soil had the highest organic matter (16.40%), N (0.95 %) and exchangeable K (0.73 cmol kg^{-1}) contents. Conversely, the charland soil exhibited the lowest organic matter (0.88%) and N (0.05%) contents. Available P content (12.1%) was highest in non-calcareous soil. Acid soil had generally intermediate values of the studied properties (Table 1).

Different types of soil have quite different physico-chemical properties, which have substantial effects on the growth, development and the active constituents of medicinal plants (Li and Xiao, 2012). Thus, various plants have different demands for appropriate type(s) of soil. For instance, Liu *et al*. (2007) reported that the types and texture of soil were closely related to the growth and development of medicinal plants and loam soil was relatively ideal type for the cultivation of root/stem-types of medicinal plants.

Table 1. Physico-chemical properties of different soil types used for *Aloe vera* cultivation

Parameters	Soil types							
	Acid	Calcareous	Non calcareous	Charland	Saline1	Saline2	Peat	Acid sulphate
Colour	Reddish	Light grey	Light grey	Light grey	Light grey	Light grey	Blackish	Light grey
Texture	Clay	Clay loam	Sandy clay loam	Loam	Clay	Cay	Clay loam	Clay
Bulk density (g cm^{-3})	1.23	1.42	1.45	1.44	1.25	1.24	1.41	1.28
Particle density (g cm^{-3})	2.25	2.51	2.58	2.54	2.23	2.20	2.52	2.24
Field capacity (%)	29.86	28.12	27.07	27.15	29.72	30.20	28.34	29.55
pH	5.2	7.5	6.7	7.0	7.5	7.8	5.7	3.8
EC (dS m^{-1})	0.25	1.26	0.68	0.61	4.41	6.10	4.09	14.04
OM (%)	1.58	1.40	1.83	0.88	1.97	2.51	16.40	2.45
Total N (%)	0.09	0.07	0.12	0.05	0.11	0.15	0.95	0.14
Avail. P (μg g^{-1})	3.09	4.86	12.1	6.91	5.89	6.90	3.12	4.72
Exch. K (cmol kg^{-1})	0.20	0.19	0.17	0.18	0.41	0.44	0.73	0.22
Avail. S (μg g^{-1})	11.80	15.78	11.06	19.50	35.20	43.47	641.40	735.12

Avail. = Available, Exch. = Exchangeable, Saline1 = 6.32 dS m^{-1} and Saline2 = 8.14 dS m^{-1}.

Effects of different soil types on the growth and leaf biomass yield of *A. vera*

Plant height

Data on the effects of different soil types on plant height of *A. vera* have been presented in Table 2. Soil types significantly influenced the height of *A. vera* plant at harvest. The highest plant height (44.03 cm) was recorded from the plant grown in non-calcareous soil which was statistically identical with those plants grown in acid soil (40.37cm), calcareous soil (41.73 cm) and charland soil (39.53 cm) but significantly different from the plants grown in saline, peat and acid sulphate soils. Saline and peat soils produced statistically similar heighted plants. The lowest plant height (23.17 cm) was recorded from the plant grown in acid sulphate soil. Similar findings were previously reported by Zaman *et al*. (2015) in case of stevia, who reported the tallest plant from non-calcareous soil and shortest plant from acid sulphate soil.

Leaf number

The number of leaves $plant^{-1}$ at harvest differed significantly due to the influence of different soil types of Bangladesh (Table 2). The highest number of leaves $plant^{-1}$

(12.67) was counted from the plant grown in non-calcareous soil which was identical with the number of leaves of the plant grown in acid (11.33) and calcareous (10.89) soils. The plants of calcareous (10.89) and charland (8.33) soils produced identical number of leaves. Saline soils of 6.32 and 8.14 dS m^{-1} also produced identical number of leaves $plant^{-1}$. The lowest number of leaves (4.00) was harvested from the plant grown in peat soil which was statistically identical with those plants grown in saline and acid sulphate soils (4.33). Better performance of non-calcareous and calcareous soils might be due to their moderate pH, less water holding capacity, good soil texture and higher nutrient contents compared to other soils. Similarly acid soil having pH less than 7, strongly acid in reaction with moderate status of organic matter, low moisture holding capacity (BARC, 2005) could the reasons for obtaining better yield. This finding was in line with Zaman *et al*. (2015) who observed the highest leaf number of stevia from non-calcareous soil and the lowest from acid sulphate soil.

Table 2. Growth and leaf biomass yield of *Aloe vera* grown in different soil types of Bangladesh

Soil types	Plant height (cm)	Leaves $plant^{-1}$ (no.)	Mean leaf area $plant^{-1}$ (cm^2)	Dry leaf weight (g $plant^{-1}$)
Acid soil	40.37±4.50a	11.33±0.58a	245.97±22.9a	133.4±5.4a
Calcareous soil	41.73±3.82a	10.89±1.15ab	255.57±3.3a	136.0±6.1a
Non-calcareous soil	44.03±4.58a	12.67±2.52a	262.70±18.3a	132.3±13.1a
Charland soil	39.53±3.55a	8.33±1.53b	200.67±16.4b	80.5±10.0b
Saline1 soil	30.73±3.69b	5.67±1.53c	181.89±12.3bc	39.7±2.0c
Saline2 soil	28.37±3.21bc	5.00±1.00c	170.21±15.6cd	30.3±0.9c
Peat soil	25.86±2.65bc	4.00±1.00c	166.54±14.5cd	18.3±3.0d
Acid Sulphate soil	23.17±2.42c	4.33±1.53c	144.38±8.3d	16.3±0.8d
CV%	10.60	19.01	7.40	9.06
$LSD_{0.05}$	6.28**	2.52**	26.06**	11.51**

Means within the same column followed by different letter(s) were significantly different according to DMRT (**P<0.01), Values are mean ± SD; Saline1 = 6.32 dS m^{-1}, Saline2 = 8.14 dS m^{-1}. LSD= Least significant difference and CV= Coefficient of variance

Leaf area

The data pertaining to leaf area $plant^{-1}$ at harvest as influenced by different soil types of Bangladesh have been presented in Table 2. Mean leaf area $plant^{-1}$ was significantly affected by different soil types. Maximum leaf area (262.70 cm^2) was measured from the plant grown in non-calcareous soil, which was identical with the leaf area of the plants grown in acid (245.97 cm^2) and calcareous (255.57 cm^2) soils. Charland (200.67cm^2) and saline1 (181.89 cm^2) soils produced identical leaf area $plant^{-1}$. Saline soil at all levels and peat soil also produced identical leaf areas $plant^{-1}$. The minimum leaf area (144.38 cm^2) was obtained from the plant grown in acid sulphate soil, which was identical with the plants grown in saline2 (170.21 cm^2) and peat soils (166.54 cm^2). These findings were in good agreement with the results reported by Khanom *et al*. (2008) and Zaman *et al*. (2015) for stevia.

Fresh leaf weight

Soil types had significant effects on leaf fresh weight of *A. vera* (Fig. 1). The highest leaf fresh weight was obtained from the plant grown in non-calcareous soil (1948 g $plant^{-1}$), which was statistically non-significant with the fresh weight of the plant grown in acid (1768 g $plant^{-1}$) and calcareous (1896 g $plant^{-1}$) soils.

The lowest fresh weight was obtained from the plant grown in acid sulphate soil (233 g $plant^{-1}$), which was identical with the fresh weight of the plant grown in peat soil (262 g $plant^{-1}$). Too low pH of acid sulphate soil which in turn reduces nutrient availability and very high organic matter content of peat soil causing nutrient toxicity could be the prime reason of getting lowest yield of *A. vera*. Soil provides physical support to plant as well as supplies necessary water and nutrient elements for plant growth and development. Plant growth basically depends on the physical, chemical and biological properties of soil. Khanom *et al.* (2008) cultivated stevia in four different soils of Bangladesh *viz.* calcareous, non-calcareous, acid and saline soils and reported that non-calcareous soil was the best performer followed by acid soil for the growth and leaf yield of stevia. The result coincided with the present study. Similar results were reported by Zaman *et al*. (2015) for the fresh weight of stevia leaf.

Fresh leaf gel weight

A statistically significant variation was noticed in terms of fresh leaf gel weight of *A. vera* due to differences in soil types (Fig. 2). The highest fresh leaf gel weight (907 g $plant^{-1}$) was obtained from the plant grown in calcareous soil, which was identical with the gel weight (880 g $plant^{-1}$) of the plant grown in acid soil. Better performance of acid soil might be due to having pH less than 7, strongly acid in reaction with moderate status of organic matter, low moisture holding capacity (BARC, 2005). The fresh gel weights of the plants grown in acid (880 g $plant^{-1}$) and non-calcareous (859 g $plant^{-1}$) soils were also identical. The lowest fresh gel weight was obtained from the plant grown in peat soil (192 g $plant^{-1}$), which was not supported by the result reported by Rahi *et al.* (2013) on *A. vera* grown in sodic soil. Very poor performance of peat soil might be due to its high organic matter content (>20%) and water saturated environment (Khan *et al.*, 2008). The poor performance of acid sulphate soil mainly could be due to its very low pH (3.9). The performance variation of different soils for fresh leaf weight might be due the physical and chemical properties of the soils under investigation.

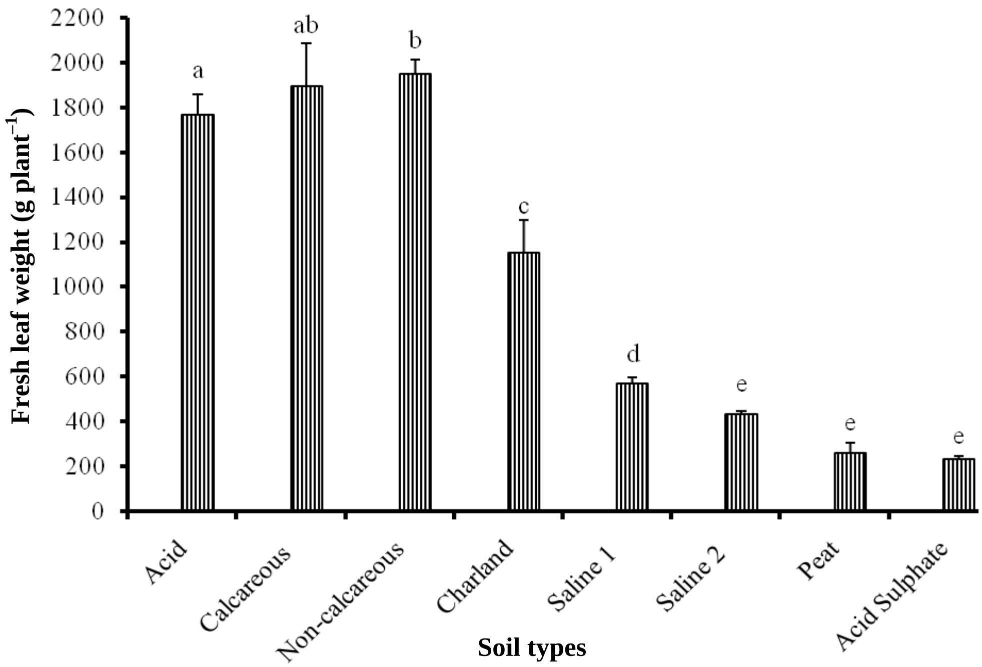

Fig. 1. Fresh leaf weight of *Aloe vera* grown in different soil types of Bangladesh (Saline1 = 6.32 dS m^{-1}, Saline2 = 8.14 dS m^{-1})

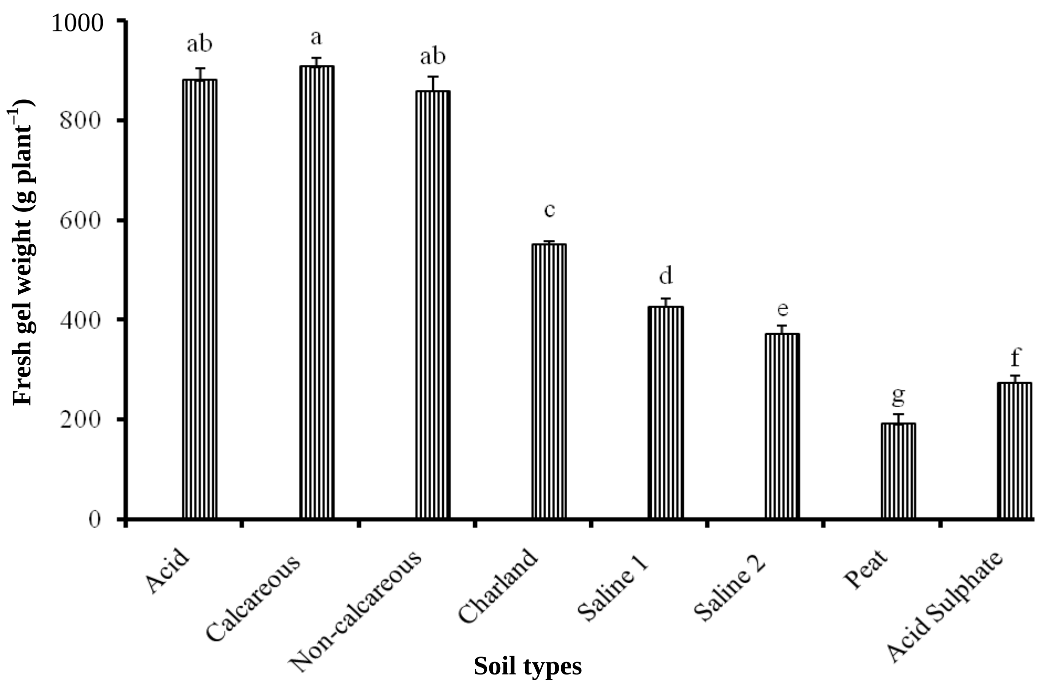

Fig. 2. Fresh gel weight of *Aloe vera* grown in different soil types of Bangladesh (Saline1 = 6.32 dS m^{-1} and Saline2 = 8.14 dS m^{-1})

In addition, balanced P, K, S, and pH and EC probably made better combination in calcareous soil for better gel yield of *Aloe vera*, as compared to the other soils (Table 1 and Fig. 2). Similar findings were also reported using balanced NPKS to obtain higher biomass production (Akamine *et al*., 2007; Hossain *et al*., 2012; Ohshiro *et al*., 2016)

Dry leaf weight

The dry weight of *A. vera* leaves varied significantly due to the differences in soil types (Table 2). The highest leaf dry weight (136.0 g plant^{-1}) was obtained from the plant grown in calcareous soil which was identical with the dry weights of the plants grown in acid (133.4 g plant^{-1}) and non-calcareous (132.3 g plant^{-1}) soils. The dry weight of the plant grown in charland soil was 80.5 g plant^{-1}. The lowest dry weight (16.3g plant^{-1}) was obtained from the plant grown in acid sulphate soil which was identical with the dry weight (18.3g plant^{-1}) of the plant grown in peat soil. The dry leaf yield of other soils increase over acid sulphate soil ranged between 12% for the plant of peat soil to 734% for the plant of calcareous soil.

The yield increase of the plants grown in acid, non-calcareous, charland, saline1 and saline2 soils were 718, 712, 394, 144 and 86%, respectively. Dry leaf yield of *A. vera* grown in different soils of Bangladesh was of the following order: calcareous ≥ acid ≥ non-calcareous > charland > saline1 (6.32 dSm^{-1}) > saline2 (8.14 dSm^{-1}) > peat >acid sulphate soils. The performance variation of different soils for *A. vera* cultivation might be due the physical and chemical properties of the soils under investigation. Among the properties, pH, organic matter content, salinity, nutrient contents and their availability could be the prime factors controlling the growth and yield of any crop. Very poor performance of peat soil might be due to its high organic matter content (>20%) and water saturated environment (Khan *et al.,* 2008) occupied up to 40cm depth having major constituent of dark brown muck. The poorest performance of acid sulphate soil mainly could be due to its very low pH (3.9).

Acid sulphate soil contains iron sulphides. When sea level rise inundates land, SO_4^{2-} in the sea water is mixed with land sediments containing oxides. The resulting chemical reaction produces sulphuric acid for which the name acid sulphate soils (Khan *et al*., 2008) stand. The potential of the acid sulphate soils for crop production is severely limited by some environmental factors like saline tidal flooding, tidal bores and probability of cyclone storms. Deficiency of P and toxicity of Fe and Al are the major constraints for crop cultivation in acid sulphate soil (Mukit, 2013). Similar findings were reported by Zaman *et al*. (2015), who found the tallest stevia plant from non-calcareous soil and the shortest from acid sulphate soil.

Correlation between different physical parameters of *A. vera*

Statistical relationships between growth, yield and yield attributes were studied. The correlation and regression lines of these parameters have been presented in Fig. 4.

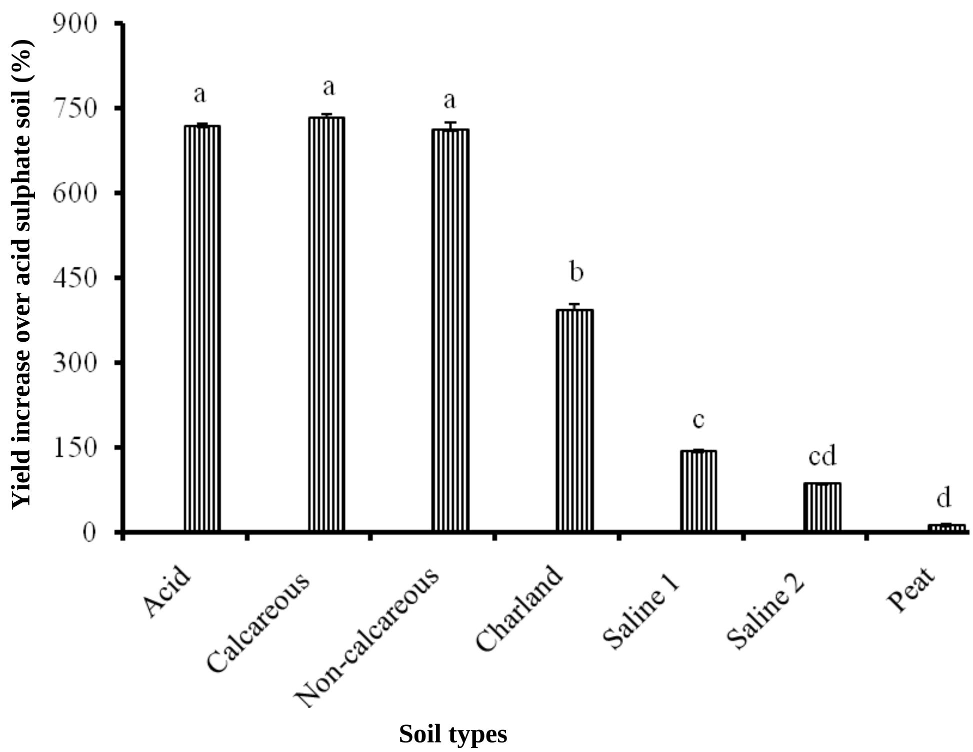

Fig. 3. Yield increase over acid sulphate soil of *Aloe vera* grown in different soil types of Bangladesh (Saline1 = 6.32 dS m^{-1} and Saline2 = 8.14 dS m^{-1})

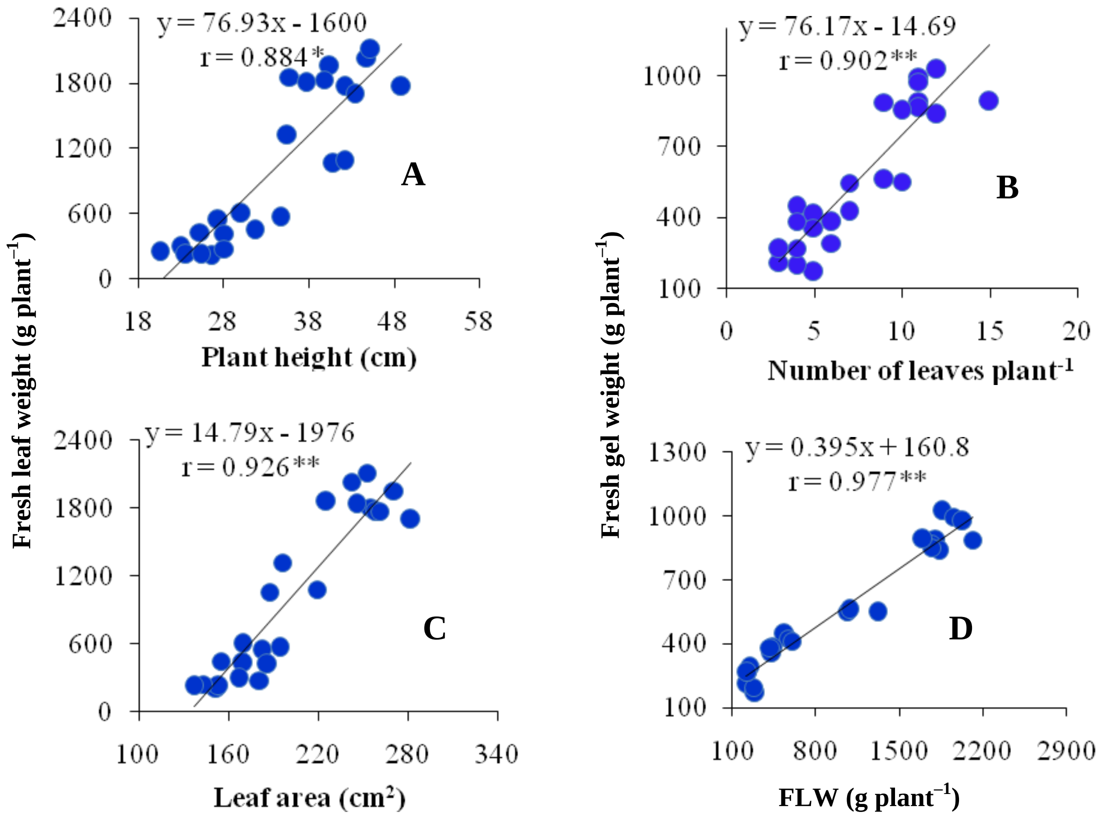

Fig. 4. Relationships between (A) plant height and FLW (B) number of leaves plant^{-1} and FGW (C) leaf area and FLW and (D) FLW and FGW of *Aloe vera* grown in different soil types of Bangladesh (FLW = Fresh leaf weight, FGW = Fresh gel weight)

The results revealed that the growth and yield parameters *viz.* plant height, number of leaves plant^{-1}, mean leaf area, fresh leaf weight and fresh gel weight (g plant^{-1}) were significantly and positively correlated where correlation coefficients (r) were 0.884*, 0.902**, 0.926**and 0.977**, respectively. The relationships were more evident from the regression equations (y = 76.93x − 1600, y = 76.17x − 14.69, y = 14.79x – 1976 and y = 0.395x + 160.8, respectively) showing gradual increase in fresh leaf and gel weight with increasing plant height, number of leaves plant^{-1}, leaf area and fresh leaf weight.

Conclusion

Aloe vera cultivation is expanding with the passage of time in different areas of the country as it provides quick and regular income to the farmers. The overall results of the study revealed that the growth and leaf gel yield of *A. vera* was significantly influenced by different soils types. In this study, among seven representative soil types, the calcareous soil displayed the best comprehensive performances in terms of the plant height, branch and leaf number, leaf area and fresh weight of leaves followed by those of non-calcareous and acid soils. The highest results of other growth parameters *i.e.*, dry weight, gel weight of leaf and yield increase over acid sulphate soil was found in calcareous soil. In contrast, the lowest values of all the parameters were found in the plant grown in acid sulphate soil, which was at par with the plant grown in peat soil. The increase of dry leaf yield ranged from 12% in peat soil to 734% in calcareous soil over acid sulphate soil. The overall results suggest that farmers could be advised to grow *A. vera* either in calcareous or acid soils of Bangladesh. Since calcareous and non-calcareous soils are mostly used for growing cereals, pulses, cash crop like sugarcane, fruits etc, acid soil could be a better option for cultivating this important medicinal crop considering the socio-economic conditions of the country.

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