Research Article

Mineral and Water Content in *Aloe ferox* Leaf Gel Grown on Different Fertilizer Treated Soils

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ABSTRACT

The 27 polythene bags each containing 12 kg of sand- silt (1:2) soil, were used for the cultivation of *Aloe ferox*. Out of these, 3 were control and 24 were treated with organic, inorganic and bio-fertilizers. The pH, EC and mineral content of soil before and after adding basal dose of fertilizers were determined. The pH, EC, water and mineral content of the leaf gel. The water and mineral content were higher in the gel extracted from organic and bio-fertilizer treated plants. The mean mineral content in the dry gel of 8 different treatment in decreasing order includes P (313.730 mg/g) > N (14.555 mg/g) > Mg (0.399 mg/g) > K (0.366 mg/g) > Na (0.354 mg/g) > Ca (0.335 mg/g) > Zn (0.334 mg/g) > Cu and Fe (0.313 mg/g).

Keywords: *Aloe ferox*, leaf gel, mineral content, fertilizer, treated soil.

1. INTRODUCTION

Aloe ferox Mill. is (*Aloe candelabrum* A. Berger) also called as Cape *Aloe*, which belongs to the Asphodelaceae *sensu lato* family. It's leaves are thick, fleshy, spear shaped, stainless and thorny[1]. It is an always green perennial plant. It grows easily in different climates and different ecological zones. The flowers are red, orange, yellow and white spread over curved leaves with clustered thorns[2]. It's bitter taste is characteristic. The industrial development of *Aloe ferox* gel took place in the 1990s, when an *Aloe* factory was established in Albertinia[3]. The gel is used as a food supplement. It contains polysaccharides and various phenolic phytochemicals such as alkaloids and phenolic phytochemicals.

Aloe has been used as a traditional medicine since ancient times[4].The roots and leaves of *Aloe ferox* are applied topically[5]. *Aloe ferox* as a wild species native to South Africa which is commercially profitable[6]. It is described as anti-inflammatory, antifungal, anti-cancer, antibacterial, anti-malarial and antioxidant[7,8].

2. MATERIALS AND METHODS

2.1 Soil analysis

The physico-chemical characteristics of the pot soil (control and after adding the basal dose of fertilizer) were determined by the standard methods at the Department of Soil Science and Agriculture Chemistry, J. N. Agriculture University, Jabalpur. The pH was determined by pH meter (SKY Technology, India), electrical conductivity by electrical conductivity meter (ConCal+, Analab Scientific Instruments Private Limited, India); Ca, Fe, Mg, Na and Zn content by atomic absorption spectrophotometer A A 300 SHIMADZU, USA[9] ; K content by digital flame photometer 381, Environmental and Scientific Instrument Company, India[10] ; N[11] and P by using uv–visible spectrophotometer, 1800, Electronics[12].

2.2 Cultivation of plants

The *Aloe ferox* plantlets were collected from Jawaharlal Nehru Agriculture University, Jabalpur, India. The cultivation of *Aloe ferox* was done in home garden at Jabalpur. *Aloe ferox* was grown in polythene bag containing 12 kg sandy soil (sand: silt soil in the ratio of 1: 2) supplemented with different fertilizer, *i.e.*, (i) organic - farm yard manure, vermi-compost, granular urea (NH_2 CO NH_2 – 46 % N), Indian Potash Limited, India. (ii) inorganic – muriate of potash (KCl – 60 % K_2O), IPL, India, single super phosphate $CaH_4(PO_4)_2$ -16% P_2O_5, IPL, India and (iii) bio-fertilizers- phosphate solubilizing bacteria (1× 10^9 colony forming unit - cfu/mL), Indian Farmer Fertilizer Corporative Ltd; Azolin- P (*Azospirillum lipoferum*) 1×10^8 cells/mL, Agriya Agro Tech, Madurai, India and *Azotobacter* spp. (1×10^8 cfu / mL), IFFCO, India as per quantity given in Table 1. Three plantlets were cultivated for each treatment. Three plantlets for control were cultivated without any fertilizer treatment. Fertilizers were applied thrice to the plants, *i.e.*, the first at the time of planting, the second at 90 days after planting and the third at180 days after planting. The plants were irrigated at an interval of 7days except during the rainy period.

2.3 Extraction and drying of gel

The one year old mature leaves of *Aloe ferox* grown in the soil supplemented with different fertilizers were harvested. These were washed with sterilized water and were subjected to surface sterilization with 70% ethyl alcohol. *Aloe* gel fillets were removed from the harvested leaves and homogenized in an electrical mixer. The homogenized gel was vacuum filtered through Whatman filter paper no.4 (pore size 20-25 µm) to remove large fibers and cell wall. The 200 g of filtered *Aloe* gel of each sample (F_{28} to F_{54}) kept in porcelain dish was dried in a hot air oven at 105° ± 1°C for 5 hours and then cooled the dish in the desiccators. Weighting was done before and after drying. Drying was repeated till the constant weight was

obtained. Finally, each gel of the sample $F_{28}$to F_{54} was powdered using mortar and pestle.

2.4 Physico-chemical analysis of gel

The pH and electrical conductivity of the fresh mucilaginous gel[13].

2.4.1 Potential of hydrogen (pH)

The pH was measured by using the pH meter, SKY Technology, STI – 431, India. The electrode was warmed up for 20 minutes in distilled water. The buffer solution of pH 4.0, 7.0 and 9.2 were used to calibrate the instrument. The electrode was rinsed with distilled water before taking observation. The 20mL *Aloe* gel was taken into a beaker. Then, electrode was dipped into the gel and pH values were recorded.

2.4.2 Electrical conductivity

The electrical conductivity in fresh *Aloe* gel was determined with the help of electrical conductivity meter (ConCal$^+$, Analab Scientific Instruments Private Limited, Vadodara, India). First of all, turn on the instrument and leave it for 15 minutes and let the electrode dip in the distilled water. The instrument was calibrated by using 0.01 M KCl solution. The 0.01M KCl solution was prepared by dissolving 0.7456 g of KCl in 1L distilled water. After calibration the electrode was rinsed with distilled water before taking observation. The 20mL *Aloe* gel was taken into a beaker. Then, electrode was dipped into the gel and EC values were recorded.

2.4.3 Water content

The 200 g of fresh gel sample (F_{28} to F_{54}) was weighed in a clean crucible of known weight. The sample was then dried in oven at 105°C for 5 h. The crucible was cooled and weighed to determine water loss in the gel sample. Water content was calculated by the following formula –

$$\text{Water content (\%)} = \frac{\text{Initial Weight (g)} - \text{Final Weight (g)}}{\text{Initial Weight (g)}} \times 100$$

Initial weight = Crucible weight + Sample weight

Final weight = Crucible weight + Sample Weight after drying

The dried gel was powdered using the pestle and mortar.

Table 1: Schedule of fertilizer treatment during the cultivation of *Aloe ferox.*

S..no.	Type of fertilizer	Basal dose on planting time	2nd dose on 90 DAP	3rd dose on 180 DAP	Total quantity
(A)	Organic fertilizer				
1	Farm yard manure	360.00g	180.00 g	180.00 g	720.00 g
2	Vermi-compost	180.00 g	90.00 g	90.00 g	360.00 g
3	Urea	17.50 g	8.75 g	8.75 g	35.00 g
(B)	Inorganic fertilizer				
4	Single super phosphate	25.00 g	12.50 g	12.50 g	50.00 g
5	Muriate of potash	3.33 g	1.66 g	1.66 g	6.66 g
(C)	Bio – fertilizer				
6	Phosphate solubilizing bacteria	10.00 mL	10.00 mL	10.00 mL	30.00 mL
7	Aolin-P (*Azospirillum lipoferum*)	10.00 mL	10.00 mL	10.00 mL	30.00 mL
8	Azotobacter Spp.	10.00 mL	10.00 mL	10.00 mL	30.00 mL

Note - DAP = Day after planting, g = gram, mL = milliliter

Table 2: Numbering of fertilizer treated *Aloe ferox* replicates along with control.

Replication – I	Replication – II	Replication - III
F_{28} = FYM	F_{37} = FYM	F_{46} = FYM
F_{29} = VC	F_{38} = VC	F_{47}= VC
F_{30} = U	F_{39} = U	F_{48}= U
F_{31} = SSP	F_{40}= SSP	F_{49} = SSP
F_{32} = MP	F_{41}= MP	F_{50} = MP
F_{33} = PSB	F_{42} = PSB	F_{51}= PSB
F_{34} = Azos	F_{43}= Azos	F_{52} = Azos
F_{35} = Azot	F_{44}= Azot	F_{53}= Azot
F_{36} = Control	F_{45} = Control	F_{54} = Control

Note - FYM = farm yard manure, VC = vermi-compost, U = urea, MP = muriate of potash, SSP = single super phosphate, PSB = phosphate solubilizing bacteria, Azos = *Azospirillum lipoferum*, Azot = *Azotobacter* spp., control= without adding fertilizer.

2.5 Mineral analysis of gel

The mineral analysis of the dry gel powder of F_{28} to F_{54} samples was carried out by the standard methods. The results are presented as mean and standard deviation in terms of mg/L and mg/g dry gel.

2.5.1 Estimation of N

Nitrogen was determined by micro Kjeldahl method[14]. The 0.1g gel powder was used in Kjedahl digestion tube. The digested plant material was poured into the distillation tube followed by addition of 10 mL of 40% NaOH. The ammonia trapped in boric acid was titrated with 0.1 N HCl. Nitrogen contents in the dry gel sample was calculated using the following formula –

$$\text{N (\%)} = \frac{\text{Sample titration (mL)} - \text{Blank titration (mL)} \times \text{Normality of HCl} \times 1.4007}{\text{Weight of sample}}$$

2.5.2. Estimation of P

Acid digestion method was used to digest the dried gel powder of each sample for mineral analysis. The 0.5 g of dried *Aloe* gel powder was put into 150 mL beaker. Add 1.5 mL 60 % $HClO_4$ and 5 mL concentrate HNO_3. Heat on hot plate, slowly at first until frothing ceases. Heat until HNO_3 is almost evaporated. If charring occurs, cool, add 5 mL HNO_3 and continue heating. Heat to white fumes of $HClO_4$. Cool, add 5 mL HCl and transfer to 50 mL volumetric flask. After complete digestion, the 5 mL each of 0, 0.5, 1.0, 1.5, 2.0 and 2.5 mg/L standard solutions and 5 mL digested gel sample were individually transferred into 50 mL volumetric flask and 10 mL of vanadomolybdate reagent was added in each flask. Phosphorus content in the dried *Aloe* gel was determined by adopting vanadomolybedophosphoric acid yellow color method[15]. Absorbance was recorded at 420nm using UV-Visible Spectrophotometer-1800 (Electronics, India).

Phosphorus content in the dry *Aloe* gel was calculated by following formula -

$$P\ (\%) = \frac{C}{\text{Weight of Sample}} \times \frac{100}{\text{Digest taken (mL)}} \times \frac{\text{Volume of digest (mL)}}{1000}$$

Weight of plant sample = 0.5g

Aliquot (digest) taken = 5mL

Volume of digest = 50mL

C = Concentration of P in aliquot obtained from standard curve (mg/mL)

2.5.3 Estimation of Ca, K and Na

The concentrate of total Ca, K and Na in the *Aloe ferox* leaf gel was determined with the help of a Digital Flame Photometer 381, Environmental and Scientific Instruments Company, India, by using the method[15]. The 1.0 g dry gel powder of sample F_{28} to F_{54} was digested as described in case of P. The digested sample was diluted 5 times and 2 mL diluted sample per probe was put into the flame photometer. The stock solution of KCl (dissolve 1.907 g KCl in distilled water and dilute to 1L), NaCl (dissolve 2.542 g NaCl in distilled water and dilute to 1L) and $CaCO_3$ (dissolve 1.249 g $CaCO_3$ in distilled water and dilute to 1L) were used for preparing a series of dilution, *viz* ., 0, 20, 40, 60, 80 and 100 mg/L. Potassium was detected at 766 nm (violet color), Na at 589 nm (yellow color) and Ca at 622 nm (orange color) in flame photometer. The Ca, K and Na concentration in each sample were determined after plotting the standard curve. The final concentration was calculated after multiplying with the dilution factor (5) and expressed in terms of mg/L.

2.5.4 Estimation of Cu, Fe, Mg and Zn

Content of Cu, Fe, Mg and Zn in the gel extracts F_{28} to F_{54} were determined individually with the help of Atomic Absorption Spectrophotometer A 6300 SHIMADZU, USA[15]. Standard solution of $CuCl_2$, $FeCl_3$, $MgCl_2$, pure Zn and various titrates were obtained from Titrisol of Merck, India. The standards were individually dissolved in deionized water to prepare the stock solution of 1000 mg/L. The different concentrate, *viz.,*0, 0.5, 1.0, 1.5, 2.0 mg/L were prepared to calibrate the instrument for the particular element. The 1.0 g of *Aloe* gel powder was mixed with AR Grade 10 mL concentrate nitric acid (HNO_3) and 3 mL 60% perchloric acid ($HClO_4$) and heated on hot plate until HNO_3 is almost evaporated. Charring occurs then it was cooled. The 10 mL concentrate HNO_3 was added and heating was continued. Heat to white fumes of $HClO_4$ and then cool. The 10 mL HCl was added and make up to 50 mL (0.05L) volume in the flask. Digested material was filtered through Whatmen filter paper No. 40 in 50 mL volumetric flask. The 40 µL filtrate was diluted 5 times by adding 160 µL 10% HCl. The 20 µL of each diluted sample was directly run through atomic absorption spectrophotometer. The readings of absorbance were noted and mineral content was determined through the standard curve.

2.5.5 Calculation

The concentration of each mineral obtained after experimental analysis was finally converted into mg/g dry gel by using the following formula–

$$\text{Mineral (mg/g dry gel)} = \frac{X\ \text{mg/L} \times \text{Volume of sample (L)} \times \text{Dilution factor (if any)}}{\text{Weight of sample (g)}}$$

X = Concentration obtained from standard curve.

Volume of sample = 0.05 L

Dilution factor = 5

Weight of sample = 1.0 g

2.6 Statistical analysis

The mean and standard deviation of the triplicate treatment were calculated by using the Microsoft Excel (version7).

3. RESULTS AND DISCUSSION

3.1 Physico-chemical parameters of soil

The mean value of the physico-chemical properties of the pot soil replicates supplemented with different fertilizers as well as of the control is presented in Table 3. These data indicate that control value of each parameter is lower than that of fertilizer treated soil.

The electrical conductivity of the fertilizer treated soil ranged from 0.12-0.31 dS/m. Similar range of electrical conductivity, *i.e*., 0.12 - 0.33 dS/m in the soil of Jabalpur region[16].

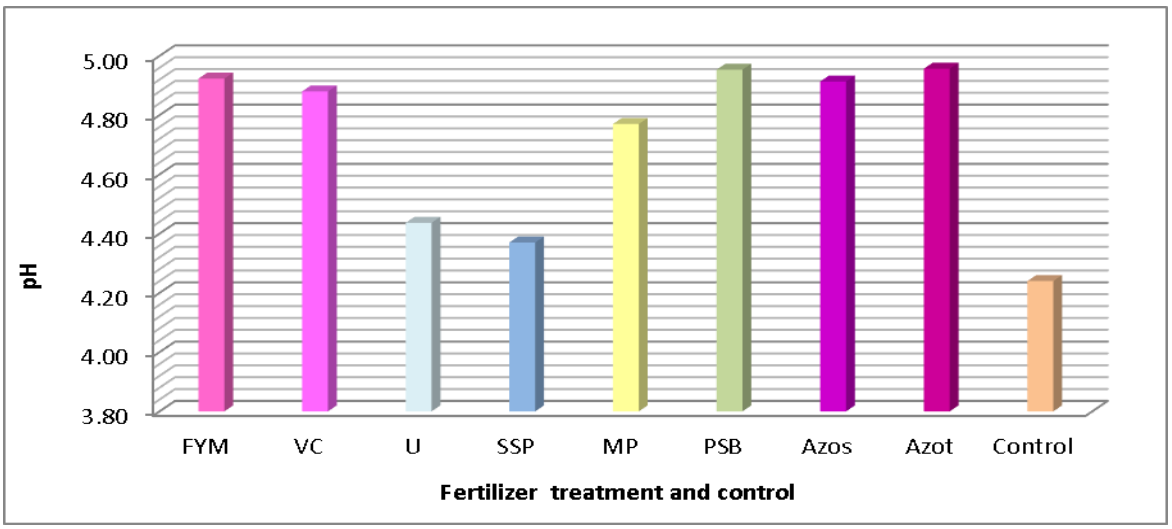
The minerals content of Ca, Cu, Fe, Mg, Mn, Na and Zn in the present investigation fell under the normal range as reported by the other scientists[16,17,18]. The average nutrient content of treated soils in decreasing order was - available K (315.44 kg/ha) > available N (157.55 kg/ha) > available P (35.50 kg/ha) > Fe (17.66 ppm) > Zn (17.46 ppm) > Mg (13.84 ppm) > Ca (11.24 ppm) > Cu (6.96 ppm) > Na (6.77 ppm) > Mn (6.40 ppm).

Table 3: Mean value (n = 3) of physico – chemical characteristics of pot soil before and after adding basal dose of fertilizer.

Pot type	Fertilizer added	pH	EC (dS/m)	Av.N (kg/ha)	Av.P (kg/ha)	Av.K (kg/ha)	Ca (ppm)	Cu (ppm)	Fe (ppm)	Mg (ppm)	Mn (ppm)	Na (ppm)	Zn (ppm)
F28,F37,F46	FYM - 360g	6.8	0.12	151.23	35.94	312.15	10.5	7.09	18.27	12.54	5.22	6.96	16.98
F29,F38,F47	VC - 180g	6.7	0.15	164.24	36.32	389.12	10.3	6.41	17.91	11.52	4.19	7.36	18.02
F30,F39,F48	U - 17.50g	6.8	0.24	152.96	37.25	304.67	11.5	6.15	19.74	14.72	6.21	5.54	17.34
F31,F40,F49	SSP- 25g	6.7	0.31	162.34	33.25	296.25	10.7	6.61	15.91	15.11	8.12	8.03	16.07
F32,F41,F50	MP- 3.33g	6.7	0.19	150.52	34.98	310.28	10.6	6.72	13.81	12.31	5.32	6.71	17.65
F33,F42,F51	PSB -10mL	6.7	0.22	163.07	37.63	290.98	14.6	9.76	19.87	14.53	8.05	7.10	18.20
F34,F43,F52	Azos-10mL	6.8	0.17	154.72	32.35	313.19	10.9	6.37	17.89	16.41	7.86	5.94	17.09
F35,F44,F53	Azot-10mL	6.7	0.19	161.34	36.29	306.85	10.8	6.53	17.85	13.54	6.23	6.48	18.36
Mean		**6.74**	**0.20**	**157.55**	**35.50**	**315.44**	**11.24**	**6.96**	**17.66**	**13.84**	**6.4**	**6.77**	**17.46**
Standard deviation		**0.05**	**0.05**	**5.37**	**1.74**	**28.78**	**1.31**	**1.09**	**1.86**	**1.54**	**1.31**	**0.74**	**0.71**
F36,F45,F54	Control	6.5	0.11	150.51	31.54	250.10	10.2	6.30	15.80	10.51	4.51	5.21	16.64

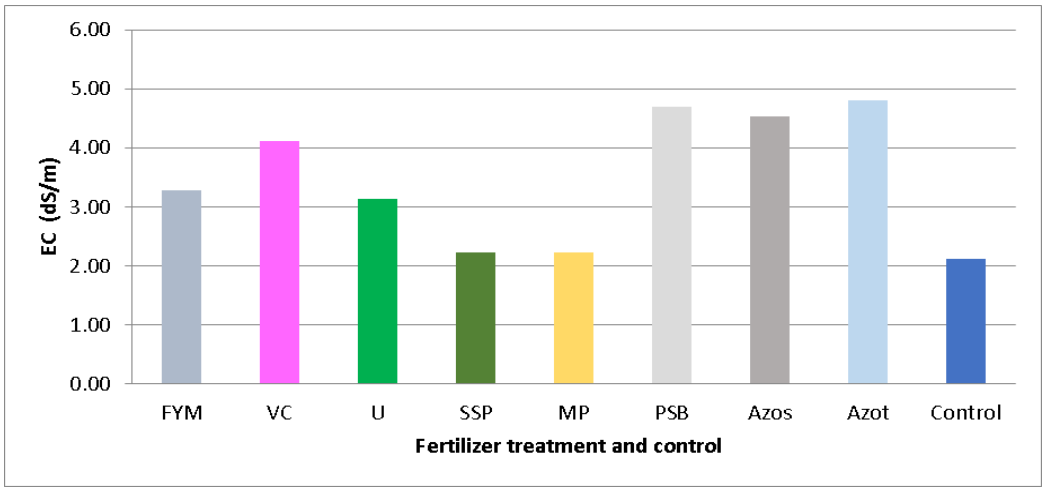
Note - FYM = farm yard manure, VC = vermi-compost, U = urea, MP = muriate of potash, SSP = single super phosphate, PSB = phosphate solubilizing bacteria, Azos = *Azospirillum lipoferum*, Azot = *Azotobacter* spp., control = without adding fertilizer, pH = potential of hydrogen, EC = electrical conductivity, (dS/m) = deciSimen per meter, Av = Available, kg/ha = kilogram / hectare, ppm = parts per million.

Figure 1: The mean pH of fresh gel of *Aloe ferox* extracted from plants grown in different fertilizer treatment.



Note: - FYM = farm yard manure, VC = vermi-compost, SSP = single super phosphate, MP = muriate of potash, PSB = phosphate solubilizing bacteria, Azos = *Azospirillum lipoferum*, Azot = *Azotobacter* spp., control = without adding fertilizer.

Figure 2: The mean electrical conductivity fresh gel of *Aloe ferox* extracted from plants grown in different fertilizer treatment.



Note: - FYM = farm yard manure, VC = vermi-compost, SSP = single super phosphate, MP = muriate of potash, PSB = phosphate solubilizing bacteria, Azos = *Azospirillum lipoferum*, Azot = *Azotobacter* spp., control = without adding fertilizer, EC = electrical conductivity.

Table 4: Mean mineral content (n = 3) in *Aloe ferox* gel extracted from plants grown under different fertilizer treatment

Mean mineral concentration(mg/L)									
Mineral	**FYM**	**VC**	**Urea**	**SSP**	**MP**	**PSB**	***Azos***	***Azot***	**Control**
Ca	1.210	1.129	1.191	1.851	1.230	1.861	1.122	1.112	1.100
Cu	1.197	1.117	1.127	1.180	1.940	1.165	1.158	1.135	0.030
Fe	1.532	1.459	1.062	1.156	1.192	1.321	1.129	1.184	0.072
K	1.698	1.520	1.710	1.134	1.197	1.382	1.123	1.964	0.190
Mg	1.780	1.481	1.101	1.237	1.161	1.642	1.134	1.314	0.172
Na	1.325	1.986	1.419	1.108	1.654	1.342	1.164	1.324	0.035
Zn	1.930	1.129	1.127	1.110	1.284	1.310	1.164	1.645	1.421
Mean mineral content (%) in fertilizer treatment									
N	1.110	1.898	1.320	1.174	1.241	1.513	1.173	2.215	1.900
P	39.840	31.121	30.834	29.612	27.638	30.652	31.165	30.118	20.12

Note: - FYM = farm yard manure, VC = vermi-compost, SSP = single super phosphate, MP = Muriate of potash, PSB = phosphate solubilizing bacteria, Azos = *Azospirillum lipoferum*, Azot = *Azotobacter* spp., control = without adding fertilizer.

Table 5: Mean mineral content (n= 3) in *Aloe ferox* dry gel (mg/g) obtained from plants grown under different fertilizers treatment.

Mean mineral content (mg/g) in fertilizer treatment											
Mineral	**FYM**	**VC**	**Urea**	**SSP**	**MP**	**PSB**	***Azos***	***Azot***	**Mean n = 24**	**Standard Deviation**	**Control mg/g**
Ca	0.303	0.282	0.298	0.463	0.307	0.465	0.280	0.278	0.335	0.075	0.275
Cu	0.299	0.279	0.282	0.295	0.485	0.291	0.289	0.283	0.313	0.065	0.007
Fe	0.383	0.364	0.265	0.289	0.298	0.33	0.282	0.296	0.313	0.039	0.018
K	0.425	0.380	0.427	0.283	0.299	0.345	0.280	0.491	0.366	0.073	0.047
Mg	0.445	0.370	0.275	0.309	0.290	0.410	0.283	0.328	0.339	0.059	0.043
N	11.100	18.980	13.200	11.740	12.410	15.130	11.730	22.150	14.555	0.374	19.000
Na	0.331	0.497	0.354	0.277	0.413	0.335	0.291	0.331	0.354	0.066	0.009
P	398.40	311.210	308.340	296.120	276.380	306.520	311.650	301.180	313.730	33.770	201.200
Zn	0.482	0.282	0.281	0.277	0.321	0.327	0.291	0.411	0.334	0.070	0.355

Note - FYM = farm yard manure, VC = vermi-compost, SSP = single super phosphate, MP = Muriate of potash, PSB = phosphate solubilizing bacteria, Azos = *Azospirillum lipoferum*, Azot =*Azotobacter* spp., control = without adding fertilizer, n = number of sample, mg/g = miligram/gram.

3.2 The pH and EC of fresh gel

The pH in the fresh gel of the fertilizer treated *Aloe ferox* ranged from4.77 - 4.96 and electrical conductivity from 2.23 - 4.80 dS/m. The pH 4.24 and EC 2.12dS/m of the control plant was lower than that of 8 different fertilizer treatments. The 3000 µS/cm electrical conductivity in the fresh gel of *Aloe vera*[19].

3.3 Water content of fresh gel

Extraction of the mucilaginous gel from pulp gave 69 % yield from the harvested leaves. The mean water content in fresh gel in the control along with different treatment in ascending order 94.4 % (control) < 94.8 % (urea) < 95.0 % (single super phosphate) < 95.7 % (*Azospirillum*) < 96.6 % (*Azotobacter*) < 97.3 % (muriate of potash) < 97.5 % (vermi compost) < 97.8 % (phosphate solubilizing bacteria) < 98 % (farm yard manure).

3.4 Mineral content in the dry gel

The mean mineral content in dry gel experimental solution in term of mg/L and percentage in dry weight is presented in Table 3 which is finally converted to mg/g dry gel (Table 4).

The mean Ca content of the dry gel of *Aloe ferox* in eight different treatments ranged from 0.278 mg/g (*Azotobacter* spp.) to 0.465 mg/g (phosphate solubilizing bacteria). The least value was of Cu content 0.279 mg/g in vermi-compost and highest value 0.485 mg/g in muriate of potash treatment. The amount of Fe ranges from (0.265 mg/g) in urea to (0.383 mg/g) in farm yard manure treated soil. The Mg content ranged from 0.275 mg/g in (urea)to 0.445 mg/g in (farm yard manure).The content of other mineral *viz.*–N ranged from11.100 mg/g (farm yard manure) to 22.150 mg/g (*Azotobacter* spp.) P from 276.380 mg/g (muriate of potash) to 398.400 mg/g (farm yard manure.), K from 0.28 mg/g (*Azospirillum lipoferum*) to 0.491 mg/g (*Azotobacter* spp.) Na from 0.277 mg/g in single super phosphateto 0.497 mg/g in vermi-compost, Zn from 0.277 mg/g in single super phosphate to 0.482 mg/g in farm yard manure.

The mean mineral content in the dry gel of 8 different treatment in decreasing order is as follows – P (313.730 mg/g) > N (14.555 mg/g) > Mg (0.399 mg/g) > K (0.366 mg/g) > Na (0.354 mg/g) > Ca (0.335 mg/g) > Zn (0.334 mg/g) > Cu and Fe (0.313 mg/g).

The highest quantity of Ca, Mg and K and the lowest for Zn in the *Aloe vera* gel[20].But this study revealed highest quantity of N, P, Na & K and lowest quantity of Cu and Fe in the *Aloe ferox* gel sample.

4. CONCLUSIONS

The pH (4.24 to 4.96), electrical conductivity (2.12 to 4.80 dS/m) and mineral content of the experimental pot soil (the control and treated) were in the optimum range suitable for *Aloe ferox* cultivation. The water content of the fresh *Aloe* gel was least (94.4 %) in the control and highest (98.0%) in case of FYM treated plants. The *Azotobacter* treatment was most effective for elevating the content of Ca, Fe, Mg and P in the gel. The muriate of potash treatment gave the suppressive result for Ca, N, P and Zn content as compared to other treatment. The farm yard manure, vermi-compost and all the bio- fertilizers treatment supported high mineral content in the gel. Study revealed Ca, Fe, Mg, P and Na as micro nutrient (greater than 0.01mg/g) and Cu, Fe and Zn as micro nutrients (between 0.0001 - 0.01 mg/g) of the dry gel. Phosphorus content was highest (254.075 mg/g) and Zn the lowest (0.006 mg/g).

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