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Effect of NPK, FYM, Microbial Consortium and Gibberellic Acid Application on Growth and Yield of Aloe Vera

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A B S T R A C T

In order to increase the biomass yield of aloe vera five treatments namely T1- control, T2-NPK, T3 -NPK + FYM, T4-NPK+FYM +Microbial consortium (MC) and T5 - NPK+FYM + microbial consortium + gibberellic acid (GA)where imposed in pot experiment. The result of the study revealed that application of NPK either alone or in combination with organic manure, microbial consortium and gibberellic acid @ 05 ppm significantly increased the leaf length, leaf breadth, leaf thickness, leaf area index, gel content and biomass yield of aloe vera. Foliar application of gibberellic acid @0.5ppm in combination with NPK and FYM showed a significant increase in the biomass yield of aloe vera as compared to treatments.

***Key words*:** Aloe vera, NPK, FYM, Gibberellic Acid, Growth, Yield

Aloe vera is a shrubby or arborescent, perennial, xerophytic, succulent, pea- green color plant and has been used in dermatology [1]. Plant is indigenous to eastern and southern Africa, also cultivated in Europe. In India it is cultivated in the northwest Himalayan region [2]. In Pakistan, these plants are planted in gardens in Sindh and Punjab, region. It is also found in Goi in Poonch [3]. World trade worth of about 80 million US$ dollars exists now and this is likely to increase by 35-40 (%) within 5 years. USA dominates the market (65%) while India and China have a share of 10 (%) each which could be enhanced by its commercial cultivation [4]. The cultivation of Aloe vera has gained great commercial importance for medicinal products and cosmetics processing. Its cultivation is expanding as it provides quick and regular income to the farmers [5]. The Aloe pulp had proteins, lipids, amino acids, enzymes, inorganic compounds, and carbohydrates [6]. It also contained vitamins A, C, E, vitamin B_{12}, folic acid, a glycoprotein, C glucosyl chromone, anthraquinones, aloin, emodin, fatty acids and salicylic acid [7]. Aloe gel could improve wound healing [8]. Plant reduces severe joint and muscle pain associated with arthritis, as well as pain related to tendinitis and injuries [9]. The anthraquinones extracted from aloe vera act as a laxative. It increases intestinal water content, stimulates mucus secretion and increases intestinal peristalsis. The two fractions from Aloe that are claimed to have anticancer effects include glycoproteins (lectins) and polysaccharides [10].

Today, the Aloe industry in the USA and Mexico has established high ethical standards for businesses of Aloe products [11]. The leaves of Aloe vera are eaten as vegetables. Leaves are helpful for relieving indigestion and constipation. Cosmetic companies add sap or other derivatives from Aloe vera to products such as makeup items, moisturizers, soaps, sunscreens, shaving cream, and shampoos [12]. It is available in a variety of products such as medicated cream, hand and body lotion, heat rub, pure Aloe vera juice, mini lift mask, medicated jelly, and moisturizer etc. Commercially Aloe can be found in pills, sprays, ointments, lotions, liquids, drinks, jellies and creams to name a few of the thousands of products available [13]. In India Aloe vera is cultivated by small and marginal farmers with very low yield. Previous studies had showed that the yield of Aloe Vera can the increased by application of NPK or FYM [14]. Therefore, it is an imperative need to study the effect of organic manure and fertilizers application and growth regulation spray on the growth and yield of aloe vera were studied.

MATERIALS AND METHODS

The experimental soil used for the pot experiment was collected at Meethikudi village located near Chidambaram town of Tamil Nadu. The soil analyzed sandy loam in texture neutral in reaction pH (7.1), non-saline (EC =0.22), low in available N (96kg ha1) medium in P (14 kg) and available K (128 kg ha^{-1}). The experimental soil was processed and filled in 10 kg pots. The recommended dose g NPK (25:25:25) was

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applied to the pots as per the treatments. FYM was obtained from Annamalai university experimental farm and applied to the pots @ 150 g pot. Similarly microbial consortium is applied @ 250 ml per pot before planting. Aloe vera suckers collected at Annamalai University orchard was planted @ one sucker per pot. The plant was uprooted in 90 days and the biomass yield was recorded. Leaf gel is also separated and weighted to record the gel content of leaves. The biometric observation such as number of leaves, leaf length, leaf breadth, leaf girt was measured at 90 days of the planting. The leaf samples were air dried, powdered and analyzed for total NPK, Ca, Mg, S, Zn, Fe, Mn, Cu, using standard methods. The plants are allowed to grow up to 90 days. The gibberellic acid was sprayed to crops @ o.5 ppm as per treatments on 30 and 50 days after planting.

RESULTS AND DISCUSSION

Effect of treatments on number of leaves

Application of NPK to aloe vera either NPK alone in combination with organic manure (FYM) significantly increased the number of leaves. Similarly, the application of NPK along with FYM, microbial consortium and gibberellic acid favorably increased the number of leaves. The highest number of leaves (8) was noted with T_5 which was significantly higher than NPK alone (6) and control (5). The response in terms of numbers of leaves for the NPK + FYM + microbial consortium and gibberellic acid might be due to the increased nutrients uptake and better physiological activity [15-16].

Effect of treatments on leaf length

Fertilization of aloe vera with either NPK alone in combination with organic manure significantly increased the leaf length. Similarly, application of NPK along with FYM, microbial consortium and gibberellic acid also favorably increased the leaf length of aloe vera. The treatment T_5 recorded the higher leaf length of (32.8 cm) which was significantly higher than NPK alone (20.9cm) and control (13.5cm). The higher response in terms of leaf length for NPK, FYM, microbial consortium and gibberellic acid might be due to increased and sustained release of essential plant nutrients from soil as well as the growth-promoting effect of microbial consortium and gibberellic acid. Similar observations Aloe vera was noticed by Barandozi *et al*. [17].

Effect of treatments on leaf breadth

Application of NPK to aloe vera either alone in combination with organic manure (FYM) significantly increased leaf breadth. Similarly, the application of NPK along with FYM, microbial consortium and gibberellic acid positively increased the leaf breadth. The higher leaf breadth of 4.1cm was noted with T_5 which was significantly higher than NPK alone (2.9cm) and control (2.5cm). The higher response in terms of leaf breadth for the NPK, FYM, microbial consortium and gibberellic acid applied treatment in (T5) might be due to better availability and sustained release of essential plant nutrients in soil as well as growth promoting effect of microbial consortium and gibberellic acid. Similar observation in aloe vera was noticed by Barandozi *et al*. [17].

Effect on treatments on leaf girth

The soil application of NPK either in the presence or absence of organic manure (FYM) significantly increased leaf girth. Similarly, application of NPK along with FYM, microbial consortium and gibberellic acid also favorably increased the leaf girth. The higher leaf girth of 8.1 cm was noted with T5 which to significantly higher than NPK alone (5.9cm) and control (5.0cm). The higher response in terms of leaf girth for NPK, FYM, microbial consortium and gibberellic acid might be due to increased and better release of essential plant nutrients from soil as well as growth promoting effect of microbial consortium and gibberellic acid. Similar observation in aloe vera was noted by Baranodozi *et al*. [17].

Effect of treatments on leaf fresh weight

The application of NPK to aloe vera either NPK either alone or in combination with organic manure (FYM) significantly increased leaf fresh weight. Similarly, the application of NPK, FYM, microbial consortium and gibberellic acid favorably increased leaf fresh weight. The higher leaf fresh weight of 85.5gm was noted with T_5. which was significantly higher than NPK alone (59-9g) and control (50.5g). The response in terms of leaf fresh weight for NPK, FYM, microbial consortium and gibberellic acid might be due to better and sustained release of essential plant nutrients from FYM and soil as well as growth promoting effect of microbial consortium and gibberellic acid. Hasanuzzaman *et al*. [18] showed that organic fertilization increased leaf fresh weight of aloe vera. Goussous and Mohammad [19] reported an increase of leaves fresh weight of allium cepa due to N and P fertilizers.

Effect of treatments on leaf dry weight

Fertilization of aloe vera with NPK either alone or combination with organic manure significantly increased the leaf dry weight. Similarly, application of NPK along with FYM, microbial consortium and gibberellic acid also favourably increased the leaf dry weight. The higher leaf dry weight of (1.1g) was noticed with T_5 which is significantly higher than T_4 (0.97g), T_3 (0.95g), T_2, (0.93g), T_1 (0.91g) NPK alone (0.93g) and control (0.91g). The higher response in terms of leaf dry weight NPK, FYM, microbial consortium and gibberellic acid application might be due to increased and sustained release of essential plant nutrients from soil as well as the growth-promoting effect of microbial consortium and gibberellic acid [20].

Effect of treatments on moisture content

The soil application of NPK Aloe Vera either in the presence or absence of organic manure (FYM) significantly increased leaf moisture content similarly application of NPK along with FYM, microbial consortium and gibberellic acid also favorably increased the leaf moisture content. The higher leaf moisture content of (98.29%) was noted with T_5 which is significantly heifer than NPK alone (97.8%) and control (97.6%). The higher response in terms of leaf moisture content for NPK, FYM, microbial consortium and gibberellic acid might be due to increased and availability both macro and micronutrients from NPK and FYM. The growth promoting effect of microbial consortium and gibberellic acid also contributed increased. Moisture content is an important quality feature that directly influences storability of aloe vera [21].

Effect on leaf biomass

The application of NPK to aloe vera either alone or in combination with organic manure (FYM) significantly increased leaf biomass. Similarly, the application of NPK, FYM, microbial consortium and gibberellic acid positively increased biomass of aloe vera. The higher biomass of 452.8g was noted with T_5. which was significantly higher than NPK alone (256.6g) and control (202.5g). The response of Aloe vera in terms of leaf biomass for NPK, FYM, microbial consortium and gibberellic acid might be due to higher availability of plant nutrients from soil as well as growth promoting effect of

microbial consortium and gibberellic acid. A significant increase in plant leaves height of *Allium cepa* by P fertilizers which is in agreement with present results [22].

Effect of treatments on leaf area

The soil application of NPK either in the presence or absence of organic manure (FYM) significantly increased leaf area of aloe vera. In the same way application of NPK along with FYM, microbial consortium and gibberellic acid also favorably increased the leaf area. The higher leaf area of (17.5 cm) was noted with T_5 which was significantly higher than NPK alone (13.1 cm) and control (11 cm). The higher response in terms of leaf area for NPK, FYM, microbial consortium and gibberellic acid might be due to better availability of essential plant nutrients from soil as well as growth promoting effect of microbial consortium and gibberellic acid [23-25].

Table 1 Effect of various treatments on various growth characters of Aloe vera

Treatments	No. of leaves	Leaf length cm	Leaf breath cm	Leaf girth cm	Leaf fresh weight gm	Leaf dry weight gm	Leaf moisture contents %	Leaf biomass gm	Leaf area cm^2	Leaf gel contents %
T_1: Control	5	13.5	2.5	5.0	40.5	0.91	97.6	202.5	11.0	85.8
T_2: NPK	6	20.9	2.9	5.9	42.6	0.93	97.8	256.6	13.1	87.9
T_3: NPK and FYM	7	24.8	3.2	6.6	46.3	0.95	97.9	324.1	14.0	92.1
T_4: NPK, FYM and microbial consortium	8	27.5	3.6	7.8	50.4	0.97	98.05	403.2	15.1	93.9
T_5: NPK, FYM microbial consortium and gibberellic acid	8	3.2.8	4.1	8.1	56.6	1.1	98.29	452.8	17.5	96.7
SED	0.4	0.1	0.15	0.03	3.2	0.06	0.90	0.18	0.07	4.4
CD = (00)	0.8	0.2	0.20	0.06	6.4	0.12	0.18	0.36	0.14	8.8

Table 2 Effect of fertilizers combinations on Aloe vera

Treatments	N mg	P mg	K mol kg	Ca mol kg	Mg mg	S mg	Zn mg	Fe mg	Mn mg	Cu mg	Co mg	B mg
T_1: Control	500±11	400±02	190+10	200 ± 90	100±11	100±80	200±20	100±50	100±11	100±15	100±80	100±08
T_2: NPK	700±10	600±05	2.05±05	250±08	150±03	130±18	2200±20	180±15	130±15	160±80	110±75	190±04
T_3: NPK and FYM	900±09	700±10	280±08	300±12	180±08	160±30	270±50	200±01	180±18	190±70	160±80	240±05
T_4: NPK, FYM and microbial consortium	1000±11	500±11	300±05	400±18	220±22	180±40	290±05	280±18	220±20	250±90	190±70	290±80
T_5: NPK, FYM microbial consortium and gibberellic acid	1500±11	1400±10	300±11	450±03	290±81	250±50	320±09	350±50	290±30	300±15	290±90	390±07

Effect on leaf gel content

Fertilization of aloe vera with NPK alone or combination with organic manure significantly increased the leaf gel content. Similarly, application of NPK along with farmyard manure (FYM), microbial consortium and gibberellic acid also favourably increased the leaf gel content. The higher leaf gel content of (96.7%) was noticed with T_5 which was significantly higher than T_4 (93.9%), T_3 (92.1%), T_2 (87.9%) T_1 (85.8%). The higher response in terms of leaf gel content for NPK, FYM, microbial consortium and gibberellic acid applied treatment might be due to increased and sustained release of essential plant nutrients from organic manure and fertilizers as well as the growth-promoting effect of microbial consortium and gibberellic acid. The results of our study agree with the findings of [26] who reported that growth and regulated S application significantly influenced the leaf gel yield of aloe vera.

Application of NPK to Aloe vera either alone or in combination with organic manure, microbial consortium and gibberellic acid. significantly increased the micro and micro elements content of aloe vera. Among the treatments T_5 recorded the higher N, P, K, Ca, Mg, S, Zn, Fe, Mn, Cu, Co, B, content of 1500µgm, 1400µgm. 300molkg. 450 mol kg, 290µgm, 250µgm, 320µgm, 350µgm, 290µgm, 300µgm, 290µgm, 390µgm respectively. This was followed by T_4 which recorded the N, P, K, Ca, Mg, S, Zn, Fe, Mn, Cu, Co, B, content of 1000µgm, 500µgm, 300 mol kg. 220 mol kg,180µgm, 290µgm, 280µgm, 220µgm, 250µgm,190µgm, 290µgm. However, these treatments recorded significantly higher N, P, K, Ca, Mg, S, Zn, Fe, Mn, Cu, Co, B content in aloe vera as compared to NPK alone (T_2). The control registered the lower N, P, K, Ca, Mg, S, Zn, Fe, Mn, Cu, Co, B content of 500µgm, 400µgm, 190 mol kg, 200 mol kg, 100µgm, 100µgm, 200µgm, 100µgm, 100µgm,100µgm, 100 µgm100 µgm.

CONCLUSION

The result of the study revealed that application of NPK improved the growth and biomass yield of aloe vera. However combined application of NPK, along with FYM, microbial consortium and gibberellic acid was identified as the last treatment which could increase the biomass yield and gel content of aloe vera by 123.6 g and 12,70 percent respectively.

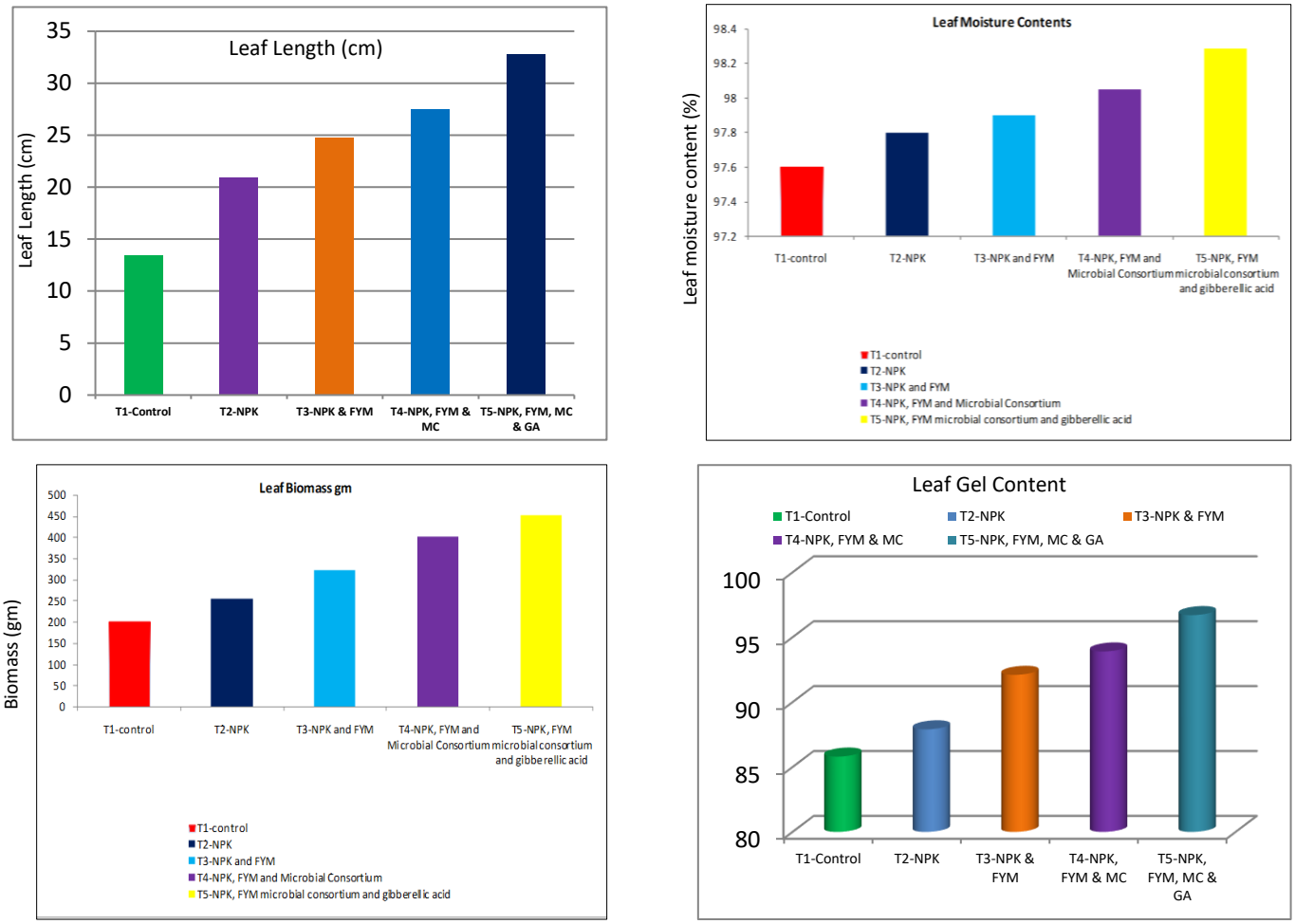

Fig 1 Effect of various treatments on growth and yield of Aloe vera

LITERATURE CITED

1. Balasubramanian J, Narayanan N. 2013. Aloe vera: Nature gift. *Species* 2(6): 11-13.
2. Mukesh SS, Paul MB, Shalim S, Vishnu B. 2010. *Aloe vera:* Plant of immortality. *Int. Jr. Phar. Sci. Research* 1(1): 7-10.
3. Stewart RR. 1972 An annotated catalogue of the vascular plant of West Pakistan and Kashmir. Fakhri Printing Press Karachi. pp 766.
4. Biswas BC. 2010. Cultivation of medicinal plant. *Ferti. Marketing News* 41(3): 1 -4.
5. Moorthy SK, Malliga P. 2012. Plant characteristics, growth and leaf gel yield of *Aloe barbadensis* Miller as affected by cyanopith biofertilizer in pot culture. *Int. Jr. Civil and Structural Engineering* 2(3): 884.
6. Hamman JH. 2008. Composition and applications of Aloe vera leaf gel. *Mole.* 13: 1599-1616.
7. Surjushe A, Vasani R, Saple DG. 2008. Aloe vera: A short review. *Ind. Jr. Derm.* 53(4): 163-166.
8. Sharrif MM, Verma SK. 2011. Aloe vera their chemicals composition and applications: A review. *International Journal of Biological and Medical Research* 2(1): 466-471.
9. Kumar KP, Bhowmik SD, Chiranjib, Biswajit. 2010. Aloe vera a potential herb and its medicinal importance. *Jr. Chem. Pharm Research* 2(1): 21-29.
10. Haque MZ, Rouf MA, Jalil MA, Islam MB, Islam MM, Ahsan MA. 2012. Studies on the production of musabbar from Aloe vera. *Jr. Adv. Sci. Research* 3(1): 51-54.
11. Saeed MA, Ahmad I, Yaqub U, Akbar S, Waheed A, Saleem M, Din N. 2003. *Aloe vera:* a plant of vital significance. *Quar. Sci. Visi.* 9(1/2): 1-13.
12. Nandal U, Bhardwaj RL. 2012. *Aloe vera:* a valuable wonder plant for food, medicine and cosmetic use - a review. *Int. Jr. Pharm. Sci. Rev. Research* 13(1): 65.
13. Brown JS, Marcy SA. 1991. The use of botanicals for health purposes by members of a prepaid health plan. *Res. Nurs. Health* 14: 339-350.
14. Abbass PDJA. 2009 The effect of nitrogenous and phosphate fertilizers of the properties on the vegetative growth and aromatical oil yield of local mint (*Mentha spicata* L). *American-Eurasian Jr. Sust. Agriculture* 3(2): 262-265.
15. Abdissa YT, Align A, Pant LM. 2011 Growth, bulb yield and quality of onion (*Allium cepa* L.) as influenced by nitrogen and phosphorus fertilization on vertosol growth attributes, biomass production and bulb yield African *Jr. Agric. Research* 6(14): 3252-3258.
16. Yoldas F, Ceylan S, Mordogan N, Esetlili BC. 2011 Effect of organic and inorganic fertilizers on yield and mineral content of onion *(Allium cepa). Afr. Jr. Biolec.* 10(55): 11488-11492.
17. Barandozi FN, Fnferadi ST, Xaghavi MR. 2011. Effect of 'eels of fertilizer on morphological traits in Aloe vera. *Jr. Med. Plants Research* 5: 4537-4541.

18. Hasanuzzaman M, Ahamed KU, Khalequzzaman KM, Shamsuzzaman AMM, Nahar K. 2008. Plant characteristics, growth and leaf yield of (*Aloe vera* L.) as affected by organic manure in pot culture. *Australia Jr. Crop Science* 2(3): 158-163.
19. Goussous SJ, Mohammad MI. 2009. Comparative effect of two arbuscular mycorrhizae and N and P fertilizers on growth and nutrient uptake of onions. *Int. Jr. Agr. Biology* 114: 161-167.
20. Hosain KI, Wadud MA, Kashem E, Santosa F, Ahmad MS. 2007. Effect of different nitrogen and potassium 'rates on agronomic characters of *Aloe indica. Bui. Agronomy* 55(1): 58-62.
21. Ali AH, Abbas ZB, Hassan JB, Jusoh AB, Zahari M. 2011 Microwave antenna sensing technique for determination of moisture content in Hevea Latex from Hevea Brasiliensis tree. *Aust. Jr. Crop Sciences* 5(11): 1326-1333.
22. Vetayasupom S. 2006 Effects of biological and chemical fertilizers on growth and yield of shallot (*Allmmcepa var ascolonicum)* production. *Jr. Bio. Sciences* 6(1): 82-86.
23. Abdulsalam MA, Hamil AF. 2004. Effect of planting dates and compound fertilizers on growth yield and quality of hacksaws onion under Al-Hassa Oasis conditions Ser. *Jr. King Faisal University* (*Basic Applied Sciences*) 51: 65-79.
24. Alsafar MS, Al-Hassan YM. 2009. Effect of nitrogen and phosphorus fertilizers on growth and oil yield of indigenous Mint (*Mentha longifolia* L.). *Biotec*. 8(3): 380-348.
25. Hosenpor GA, Hassani AP, Azimi J. 2013 Effect of chemical and biological nitrogen on some morphological characters of *Calendula officinalis* L. *Inter. Jr. Agr. Pl. Production* 4(2): 165-170.
26. Ramachandra CT, Srinivasa RP. 2008. Processing of Aloe vera leaf get: A review. *American Journal Agric. Biological Sciences* 3(2): 502-510.