



Studies on the screening of mycorrhization and different bio inoculant regimes on the growth and chlorophyll of aloe vera (*Aloe barbadensis*)

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Abstract

Arbuscular mycorrhizal fungi (AMF) represent an important group of root symbionts, given they serve a critical role in improving plant nutrition, growth, and product quality. Large and diverse beneficial bacterial communities, closely associated with spores, sporocarps, and extraradical mycelium, often facilitate AMF's services, which include N₂ fixation, nutrient mobilization, plant hormone, antibiotic, and siderophore production, as well as mycorrhizal establishment promotion, all of which contribute to improved host plant performance. The combined inoculation of arbuscular mycorrhizal fungi (*G. fasciculatum*) and phosphate solubilizing bacteria (*B. megaterium*) and *Azospirillum* had significantly increase the plant growth and yield of Aloe vera. To obtain the maximum benefit for plant growth, it is needed to select the right combination of arbuscular mycorrhizal fungi species and phosphorous-solubilizing nitrogen fixing microorganisms to be inoculated in filed condition. The future concerns about phosphorous depletion, cost of fertilizers, environment protection and thus sustainable agricultural practices will assure the development of eco-friendly technologies, including biotechnologies, which use diverse living organisms in humans benefit. While the arbuscular mycorrhizal fungi and phosphate solubilizing bacteria and *Azospirillum* have great potential to become one of the tools of organic agriculture.

Keywords: arbuscular mycorrhizal fungi, *B. Megaterium*, *azospirillum*, aloe vera

Introduction

Arbuscular mycorrhizas (AM) are the frequent mycorrhizal type. They are formed in an immensely wide variety of host plants by obligately symbiotic fungi which have been newly reclassified on the basis of DNA sequences into a separate fungal phylum, the *Glomeromycota* (Schüßler *et al.*, 2001). The plants comprise angiosperms, gymnosperm and the sporophytes of pteridophytes, all of which have roots as well as the gametophytes of some hepatics and pteridophytes. Native soil phosphorus is freely bound and available in the form of phytin, or its derivatives, has low solubility and mobility, and thus is not accessible to plants. For plants to use this organic Phosphorus, it must be hydrolyzed to inorganic Phosphate, which can be done by phosphatases produced by AM fungus or phosphate solubilizing bacteria (Gaur and Rana 1990) [7]. AM Fungi is particularly important for enhanced Phosphorus absorption at the root-soil interface, especially when Phosphorus levels are low. AMF colonization is a symbiotic relationship in which bidirectional nutrition transfer benefits both parties (plant and fungus). The AM Fungi helps for the heightened uptake of nutrients, especially Phosphorus; in return, AM Fungi obtains the photosynthetically fixed sugar from the plants. The AM fungi under the phylum *Glomeromycota* are a group of endophytes, and these can form symbiosis with the roots of 85% plant species. The AM Fungal colonization expressively improves the nutrient uptake especially Phosphorus uptake (Smith and Read, 2008; Smith *et al.*, 2011; Krishnamoorthy *et al.*, 2016; Kumar *et al.*, 2019; Agnolucci *et al.*, 2020) [28, 27, 16, 1].

The Aloe vera plant has been well-known and used for eras for its health, beauty, medicinal and skin care properties. The term Aloe vera derives from the Arabic word "Alloeh," which means "shining bitter material," and "vera," which means "truth" in Latin. Aloe vera was considered as a

universal remedy by Greek scientists 2000 years ago. Aloe was known as "the herb of immortality" by the Egyptians. The Aloe vera plant is now employed for a variety of medical applications. *Aloe barbadensis* miller is the scientific name for Aloe vera. It is a perennial, xerophytic, succulent, shrubby or arborescent, perennial, xerophytic, pea-green hue plant that belongs to the *Asphodelaceae* (Liliaceae) family. It is mostly found in arid areas of Africa, Asia, Europe, and North America. It may be found in Rajasthan, Andhra Pradesh, Gujarat, and Maharashtra in India. Aloe vera contains more than 200 different biologically active substances including: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids. It has been stated that growth and barbaloin yield is dependent on various factors i.e irradiation and soil nutrient (Paez *et al.*, 2000 Karray *et al* 2020; Emmett *et al.*, 2021) [23, 12, 6], leaf pruning (Gutterman and Chause-Volfson, 2000), leaf part, age, position and season (Beppu *et al.*, 2004; Chause-Volfson and Gutterman 2004) [4]. Saradhi *et al.* (2007) find that barbaloin content and the leaf dry mass is greatly correlated. Barbaloin has medicinal and cosmetic properties of protecting human skin against sun and fire burns as well as allergic reactions and recover the healing of skin wounds (Duke, 1989) [5]. Barbaloin also demonstrates anti-inflammatory, hepatoprotective activity (Nakagomi *et al.*, 1985) and cathartic effects (Ishii *et al.*, 1989) *in vivo*. Hence, the quantitative improvement of barbaloin in *Aloe vera* is of high marketable interest.

Several authors have discovered mycorrhizal symbiosis in Aloe vera (Gong *et al.*, 2002; Muthukumar *et al.* 2006; Kumar *et al.*, 2019; Agnolucci *et al.*, 2020) [21, 16, 1]. The demand for this therapeutic herb is rising all over the world. As a result, discovering companion microorganisms that may promote plant development while having no

detrimental impact on soil and environment is critical. In the current study, the beneficial effect of mycorrhizae and different bioinoculant regimes on the growth parameters and the aloin-content in *A. barbadensis*. PGPR promote plant growth directly by either facilitating resource acquisition (nitrogen, phosphorus and vital minerals) or modulating plant hormone levels, or indirectly by decreasing the inhibitory effects of numerous pathogens on plant growth and development in the forms of biocontrol agents (Glick, 2012 Karray *et al* 2020; Emmett *et al*, 2021) ^[10, 12, 6].

The objective of our research was investigating the beneficial interaction of AM fungi and different bioinoculant regimes on the growth enhancement and chlorophyll content of aloe vera were studied. However, parameters such as AM fungi and plant growth rhizobacteria have significant influence on the plant growth performance chlorophyll and yield.

Materials and Methods

Screening of am fungal isolates for colonization spore population and phosphatase activity in aloe vera

The percent root colonization of AM fungi in Aloe vera roots was determined by the method of Phillips and Hayman 1970.

AM fungal spore population was estimated by wet sieving and decanting method of Gerdemann and Nicolson 1963 ^[9].

One hundred grammes of rhizosphere soil samples were mixed vigorously in one litre of tap water for a few seconds to settle the larger particles. To remove big particles of organic matter, the suspension was decanted using a coarse dirt filter (500-800 µm sieve). The liquid that went through the sieve was separated and agitated to resuspend all of the particles. The suspension was decanted through a sieve (38 - 250 µm sieves) fine enough to contain the required spores. To guarantee that all colloidal items went through the sieve, the material remaining on the sieve was rinsed with a stream of water. The tiny quantity of debris that remained in the petridish was moved to a shallow layer of water and inspected with a stereo zoom microscope. The amount of spores in each soil sample was counted and reported as spores per 100 g of soil. Measuring phosphatase activity in roots was used by Morton's (1952) ^[20].

The rhizosphere soil sample were collected from fifteen different locations in semi-arid region of Tamilnadu. Four different AM fungal species *viz.*, *Glomus fasciculatum*, *Glomus mosseae*, *Gigaspora margarita* and *Acaulospora laevis* were isolated, characterized.

Isolated AM fungi are screened for the efficiency by root colonization percentage, AM fungal spore numbers, acid phosphatase and alkaline phosphatase activity in soil. All the four AM fungal species colonized the roots of Aloe vera. However, the degree of root infection and colonization varied considerably between them. The response of Aloe vera in terms of root colonization by AM fungi was the highest with *Glomus fasciculatum* followed by *Glomus mosseae*, *Gigaspora margarita* and *Acaulospora laevis* in soils. Acid phosphatase and alkaline phosphatase activities were also the highest in *Glomus fasciculatum*.

Characterization of phosphobacterial isolates obtained from rhizosphere soils of aloe vera

Isolation and characterization of phosphobacteria from rhizosphere soil of aloe vera. Serially dilute the soil sample from rhizosphere soil of aloe vera, 1 ml of aliquot from 10⁻⁵

and 10⁻⁶ was transferred into specific media of pikovskaya agar contains tri calcium phosphate. After incubation of 5 days to observe hallow zone around the colonies. There are 15 isolates were isolated morphological and biochemical characterized by size, shape, gram's reaction, catalase activity, H₂S production and methyl red. Based on the different biochemical characters to the genus level identify 2 genera like *Pseudomonas* sp. and *Bacillus* sp. The *in vitro* production of phytohormones such as indole acetic acid (IAA) and gibberellic acid (GA₃) by phosphobacteria isolates were estimated. The gibberellic acid production by phosphobacteria was determined by following the method of Borrow *et al.* (1955) ^[3]. Siderophore production by the phosphobacteria was estimated by the method described by Reeves *et al.* (1983). The organic acids produced by *Bacillus megaterium* was detected by paper chromatography. The standards of organic acids were prepared by dissolving the acids in deionized water in the concentrations of 20 mg ml⁻¹. The solvent systems, n-butanol: acetic acid water (12:3:5) as described by Bagyaraj and Manjunath, (1980) was used for the separation of organic acids. The proven *Azospirillum* strain was obtained from the Department of Microbiology, Faculty of Agriculture, Annamalai University was used in this stud.

Pot culture experiment

A pot culture experiment was conducted to evaluate the beneficial interaction of AM fungi and different bio inoculant regimes on the growth enhancement and Barboloin content of Aloe vera. Var Gurguva on (*Aloe barbadensis*) in the Department of Microbiology, Faculty of Agriculture, Annamalai university, Annamalai Nagar. The annual mean minimum and maximum temperature of experimental area is 25 °C and 39 °C respectively and the mean highest and lowest relative humidity was 96 78 percent respectively the mean annual rainfall of this area is 1500 mm. the cement pots of 1' X 2' X 2' were filled with well drained laterite or loamy soil @ 12 kg pot⁻¹ collected from semi-arid region of Tamil nadu, (soil pH 7.0 to 8.5, available N 210 kg ha⁻¹ and available phosphorus 16.71 kg ha⁻¹). The recommended dose of inorganic fertilizer 60:120:30 kg/ha respectively. AM fungal inoculum was achieved by 10g inoculum near the roots. Thirteen treatments were tried with inoculation of AM fungi and *Phosphobacteria* and *Azospirillum* three replications were maintained for each treatment and uninoculated control without inoculum was maintained under complete randomized block design. The treatments schedule was as follows.

Crop: Aloe vera

Varieties: Gurguva

Design: CRD

Replication: Three

Treatment details

T₁: Control

T₂: RDF

T₃: *G. fasciculatum*

T₄: *Bacillus Megaterium*

T₅: *Azospirillum*

T₆: 100% P + *G. fasciculatum* + *Bacillus megaterium*

T₇: 100% P + *G. fasciculatum* + *Azospirillum*

T₈: 100% P + *Bacillus Megaterium* + *Azospirillum*

T₉: 100% P+G. *Fasciculatum* +*Bacillus Megaterium* +*Azospirillum*

T₁₀: 50% P+G. *Fasciculatum* + *Bacillus Megaterium*

T₁₁: 50% P+G. *Fasciculatum*+ *Azospirillum*

T₁₂: 50% P+*Bacillus megaterium*+ *Azospirillum*

T₁₃: 50% P+G. *fasciculatum* + *Bacillus megaterium*+*Azospirillum*

Beneficial interaction of AM fungi and different bioinoculant regimes on the biometric observation of Aloe vera

Plant height

The plant height was recorded at 60, 90,120,150 and 180 DAP. The height was measured from the ground level to the tip of the growing point. The mean values were calculated and recorded in cm.

Dry biomass production

The plant samples were collected from each treatment and their dry weight was determined by drying the samples in hot air oven at 60°C till a constant weight was obtained.

Estimation of chlorophyll content

Chlorophyll content were extracted by grinding the leaf tissue with a mortar and pestle using ammoniacal acetone. The resulting extracts were centrifuged at 3000 3 g for 3 min. The total chlorophyll contents were determined by ultraviolet-Vis spectrophotometry (Beckman DU-50 spectrophotometer; Beckman Instruments, Inc., Fullerton, CA). The absorbance of the solution was measured at 470, 647, and 664 nm. Formulae and extinction coefficients used for the determination of leaf pigments (total chlorophyll) were described by Lichtenhaler and Wellburn (1983) [19]. The content of the total chlorophyll was expressed in microgram per gram of fresh weight.

Statistical analysis

The data recorded on various characters were statistically analysed as per the method by Gomez and Gomez (1984) [11].

Result and Discussion

Screening of am fungal isolates for colonization spore population and phosphatase activity in aloe vera

The isolated spores were characterized according to Gerdmen and Trappe (1974) [8] and the four AM fungal species viz., *Glomus fasciculatum*, *Glomus mossae*, *Gigaspora margarita* and *Acaulospora laevis* were found to be present in all the soil types.

Pot culture experiment was conducted in aloe vera to select the efficient AM fungal species for further inoculation

studies and the results are presented in (Table 1). The highest acid phosphatase activity of 28.03, 29.43 and 31.43 µg 24 h⁻¹ 10g of root and alkaline phosphatase activity of 32.45, 33.93 and 34.01µg 24 h⁻¹ 10g of root were recorded in 60,90 and 120 DAP respectively in *G. fasciculatum* inoculated Aloe vera plants. This treatment was followed by plants inoculated with *G. mossae*, *A. laevis*, *G. versiforme* and *Gi. Margarita*. The occurrence of *G. fasciculatum* in soils has been reported in various kinds of environments. Saline patches (Thapar and Uniyal, 1990), alfisol (Ravi *et al.*, 1995) dark brown chernozems (Talukdar and Germida, 1993) [29].

Characterization of phosphobacterial isolates

Isolation and characterization of different isolates from aloe vera rhizosphere soil. There are 15 different isolates were producing hallow zone around the colonies on pikovskaya agar. To purify the isolates, then morphological and biochemical characterization was done by standard procedures. Based on the biochemical characters the isolates were identified at genus level tabulate on Table 2.

The phosphobacterial isolates viz., PSB-1, PSB-3, PSB-5, PSB-6, PSB-9, PSB-10, PSB-12, and PSB-14 showed positive response for gram reaction, catalase test acid production, hydrolysis of starch, hydrolysis of gelatin and utilization of citrate and negative response for gas production from glucose broth and Voges-Proskauer test which helped to characterize these isolates as *Bacillus megaterium*

The isolates viz., PSB-2, PSB-4, PSB-7, PSB-8, PSB-11, PSB-13 and PSB-15 showed positive response for Gram reaction, acid production, gas formation from glucose broth, hydrolysis of starch, hydrolysis of gelatin, Voges-Proskauer test and negative for utilization of citrate which helped to characterize these isolates as *Bacillus polymyxa*

A collection of nine bacterial isolates known to be effective Plant Growth Promoting Rhizobacteria (PGPR) were screened for phosphate solubilization under *in vitro* condition. All the rhizobacteria were identified and the best phosphorus solubilizing PGPR strains were identified as *Bacillus brevis*, *B. megaterium* *B. polymyxa*, *B. sphaericus* and *B. thuringiensis* (Freitas *et al.*, 1997)

Previous information has exposed the effect of arbuscular Mycorrhizal fungi and *Azospirillum* on the growth and barbaloin content of the plant (Tawaraya *et al.*, 2007; Pandey and Banik, 2009) [30,1]. The use of beneficial soil plant growth promoting rhizobacteria (PGPR) for enlightening crop production requires the selection of rhizosphere-competent bacterial strains with multiple plant growth promoting traits (Nautiyal *et al.*, 2008; Hynes *et al.*, 2008; Mitter *et al.*, 2017)

Table 1: Screening of AM fungal isolates for colonization spore population and phosphatase activity in aloe vera

S. no.	AM fungal isolate	Root colonization (%)			AM fungal spore number (100 g ⁻¹ of rhizosphere soil)			Acid phosphatase activity (µg/ 24 hrs ⁻¹ 10g ⁻¹ of root)			Alkaline phosphatase activity (µg/ 24 hrs ⁻¹ 10g ⁻¹ of root)		
		60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
1.	<i>Glomus mossae</i>	19.43	17.13	20.45	22.45	25.05	25.23	27.45	28.19	30.15	31.23	31.43	33.43
2.	<i>Glomus fasciculatum</i>	20.25	21.45	23.13	25.31	26.91	27.95	28.03	29.43	31.43	32.45	33.93	34.01
3.	<i>Glomus versiforme</i>	16.13	15.55	18.33	20.21	24.95	23.95	25.23	26.45	28.23	29.33	29.45	31.09
4.	<i>Acaulospora laevis</i>	18.23	16.63	19.93	21.33	24.33	24.13	26.13	27.23	29.45	30.41	30.39	32.23
5.	<i>Gigaspora margarita</i>	15.11	15.36	17.95	19.59	23.23	22.45	24.57	25.43	27.43	28.95	28.33	30.45
	SE	1.25	1.76	1.38	1.47	0.63	1.17	0.85	0.86	0.92	0.90	1.29	0.89
	CD (p = 0.05)	2.53	2.09	2.03	2.25	1.21	2.23	1.53	1.42	1.84	1.76	2.47	1.73

Table 2: Characterization of Phosphobacterial isolates obtained from rhizosphere soils of Aloe vera

Isolates	Shape	Grams	Catalase	Citrate	Indole	VP	Methyl red	Spore	Genus level identification
PSB 1	Rod	+	+	+	+	-	+	+	<i>Bacillus</i> sp.
PSB 2	Rod	-	+	+	-	-	-	-	<i>Pseudomonas</i> sp.
PSB 3	Rod	+	+	+	+	-	+	+	<i>Bacillus</i> sp.
PSB 4	Rod	-	+	+	-	-	-	-	<i>Pseudomonas</i> sp.
PSB 5	Rod	+	+	+	+	-	+	+	<i>Bacillus</i> sp.
PSB 6	Rod	+	+	+	+	-	+	+	<i>Bacillus</i> sp.
PSB 7	Rod	-	+	+	-	-	-	-	<i>Pseudomonas</i> sp.
PSB 8	Rod	-	+	+	-	-	-	-	<i>Pseudomonas</i> sp.
PSB 9	Rod	+	+	+	+	-	+	+	<i>Bacillus</i> sp.
PSB 10	Rod	+	+	+	+	-	+	+	<i>Bacillus</i> sp.
PSB 11	Rod	-	+	+	-	-	-	-	<i>Pseudomonas</i> sp.
PSB 12	Rod	+	+	+	+	-	+	+	<i>Bacillus</i> sp.
PSB 13	Rod	-	+	+	-	-	-	-	<i>Pseudomonas</i> sp.
PSB 14	Rod	+	+	+	+	-	+	+	<i>Bacillus</i> sp.
PSB 15	Rod	-	+	+	-	-	-	-	<i>Pseudomonas</i> sp.

Fifteen phosphobacterial isolates screened for Phosphate solubilizing efficiency, producing potential of Indole acetic acid (IAA) and Gibberellic acid (GA₃) and Siderophore. Among the fifteen isolates, Among the all isolates PSB 12 was perform best in IAA 69.39, GA₃ 8.1, siderophore production 9.14 and phosphate solubilization efficiency 3.11mm. (Table 3). Parande *et al.* (1991) studied the phosphorous solubilizing capacity of *Bacillus megaterium*, *Pseudomonas aeruginosa*, *Aspergillus sp.*, *Mucor sp.* and *Rhizopus sp.* and the value ranged from 8.0 µg P ml⁻¹ to 12.0 µg P ml⁻¹. *B. megaterium* showed the highest activity of 12.0 µg P ml⁻¹. John *et al.* (1999) tested 18 phosphate solubilizing bacterial strains for their ability to solubilize tricalcium phosphate in NBRIP broth (National Botanical Research Institute's Phosphate growth medium). Among the various strains tested, NBRI3 recorded the highest P solubilization (510 µg ml⁻¹) on the fifth day of incubation. Based on the above screening tests, the isolates *Glomus fasciculatum* and *Bacillus* (PSB 12) were found to be most efficient strains and selected for further studies.

The effect of application of *G. fasciculatum* and different bio inoculant regimes with graded levels of phosphorus on the plant height was studied and the results are presented in Table. 4 Application of individual and combination of *G. fasciculatum*, phosphobacteria and *Azospirillum* along with graded levels P significantly increased the plant height of Aloe vera than control treatment.

The Plant height was Measured at 60, 90, 120, 150 and 180 DAP. The max plant height was recorded (35.45, 37.33, 43.09, 47.45 and 51.83cm) in T₁₃ Followed by (34.09, 35.49, 41.45, 45.03, and 48.49cm) T₉ The least plant height was recorded in the control T₁ was (23.47, 25.03, 29.45, 32.09 and 36.93cm). Interestingly the similar findings were observed in dual inoculation of AM fungi *G.mosseae* and nitrogen fixing bacteria *Azotobacter chroococcum* and *A. brasilense* improve the plant growth and nutrient status of neem seedling than the single inoculation and uninoculated control (Sumana and Bagyaraj, 2002; Pecundo *et al* 2021).The beneficial effects of dual inoculation have been stated by numerous workers (Sreeramula *et al.*, 2000, Vassilev *et al*, 2001 Smith *et al.*, 2011: Karray *et al* 2020: Emmett *et al*, 2021)^[27, 12, 6] for certain plant species

A Pot culture Experiment conducted to study effect of AM Fungi and different bio inoculant regimes on the dry

biomass Production of Aloe vera in gram per plant the Maximum dry biomass was recorded in the T₁₃ (50% P + *G. fasciculatum* + *Bacillus megaterium* + *Azospirillum*) 35.45, 37.33, 43.09, 47.45 and 51.83 g plant⁻¹ at 60, 90, 120, 150 and 180 DAP followed by T₉ and T₁₀, the minimum biomass production was recorded in the control plant (T₁).Fig -1.The chlorophyll content was maximum in Chlorophyll(a) was 0.195 mg g⁻¹) and Chlorophyll(b) was 0.915 mg g⁻¹) the Total chlorophyll 1.11 mg g⁻¹). In the present study, dry mass production and chlorophyll content were significantly higher in co-inoculated aloe vera plants compared to single inoculation. Similar findings were reported by Begum and Priya (2004; Kumar *et al.*, 2019; Agnolucci *et al.*,2020; Karray *et al* 2020: Emmett *et al*, 2021)^[16, 1, 12, 6].

Conclusion

The present study determines the efficiency of microbial inoculation and optimization of growth limitations of the plant and the concentration of chlorophyll content in *Aloe vera*. *Glomus fasciculatum* was found to be the best microorganism among the four species of AM fungi studied which showed maximum growth and chlorophyll content in *Aloe vera*. Along with AM fungi, *Azospirillum* and *Phosphobacteria* inoculation also showed enhanced growth and yield in *Aloe vera*. Dual Inoculation of AM fungal species with different bioinoculant regimes significantly increased leaf growth, resulting in significant increase in chlorophyll content of individual plant. Based on the different treatments T₁₃ (50% P + *G. fasciculatum* + *Bacillus megaterium*+ *Azospirillum*) perform best compare with other treatments. Followed by T₉ (100% P+*G. fasciculatum* +*Bacillus megaterium* + *Azospirillum*) and T₁₀ (50% P + *G. fasciculatum* + *Bacillus megaterium*) The combined application of *G. fasciculatum* + *Bacillus megaterium*+ *Azospirillum* perform best compare with other treatments. It promotes the growth and development of the aloe vera on both qualitative and quantitative manner.

Thus, inoculation of *Aloe vera* with AM fungi in conjugation with different bio inoculant regimes like *Phosphobacteria* and *Azospirillum* leads to higher uptake of phosphorus and thereby enhances the plant growth as well as the yield of *Aloe vera* plant.

Table 3: Screening of phosphobacterial isolates for indole acetic acid (IAA) gibberellic acid siderophore and phosphate solubilizing potential by isolates obtained from the rhizosphere soils of aloe vera

Isolates	IAA	GA 3	Siderophore	Phosphate Solubilizing (mm)
PSB 1	51.09	4.1	6.19	1.43
PSB 2	57.53	5.9	5.83	1.71
PSB 3	54.91	4.7	6.21	1.39
PSB 4	53.01	4.3	4.31	1.84
PSB 5	52.45	4.5	6.45	1.56
PSB 6	62.13	6.0	5.29	1.34
PSB 7	58.91	5.3	7.24	1.52
PSB 8	60.03	5.1	8.32	1.20
PSB 9	65.81	6.3	6.19	1.79
PSB 10	59.97	6.1	5.80	1.21
PSB 11	60.03	7.2	6.03	2.13
PSB 12	69.39	8.1	9.14	3.11
PSB 13	67.89	8.2	7.31	2.81
PSB 14	70.12	4.7	8.16	2.72
PSB 15	63.11	7.9	7.4	2.41

Table 4: Effect of AM Fungi and different bio inoculant regimes on the plant height of Aloe vera

Treatment details	Plant height				
	60 Dap	90 Dap	120 Dap	150 Dap	180 Dap
T ₁ : Control	23.47	25.03	29.45	32.09	36.93
T ₂ : RDF	27.03	29.03	34.41	37.05	41.03
T ₃ : <i>G. fasciculatum</i>	26.93	28.45	33.95	36.16	39.93
T ₄ : <i>Bacillus Megaterium</i>	25.45	27.43	32.01	35.83	38.41
T ₅ : <i>Azospirillum</i>	24.09	26.93	31.43	34.13	37.01
T ₆ : 100% P + <i>G. fasciculatum</i> + <i>Bacillus megaterium</i>	32.23	33.45	39.45	42.93	46.93
T ₇ : 100% P + <i>G. fasciculatum</i> + <i>Azospirillum</i>	28.93	30.93	35.93	38.13	42.51
T ₈ : 100% P + <i>Bacillus megaterium</i> + <i>Azospirillum</i>	30.93	32.03	37.01	40.33	44.63
T ₉ : 100% P + <i>G. fasciculatum</i> + <i>Bacillus megaterium</i> + <i>Azospirillum</i>	34.09	35.49	41.45	45.03	48.49
T ₁₀ : 50% P + <i>G. fasciculatum</i> + <i>Bacillus megaterium</i>	33.39	34.03	40.03	43.45	47.03
T ₁₁ : 50% P + <i>G. fasciculatum</i> + <i>Azospirillum</i>	29.05	31.03	36.43	39.83	43.53
T ₁₂ : 50% P + <i>Bacillus megaterium</i> + <i>Azospirillum</i>	31.45	32.93	38.93	41.23	45.31
T ₁₃ : 50% P + <i>G. fasciculatum</i> + <i>Bacillus megaterium</i> + <i>Azospirillum</i>	35.45	37.33	43.09	47.45	51.83
SED	1.17	1.24	1.58	1.52	1.22
CD (0.05)	0.04	0.07	0.06	0.09	0.12

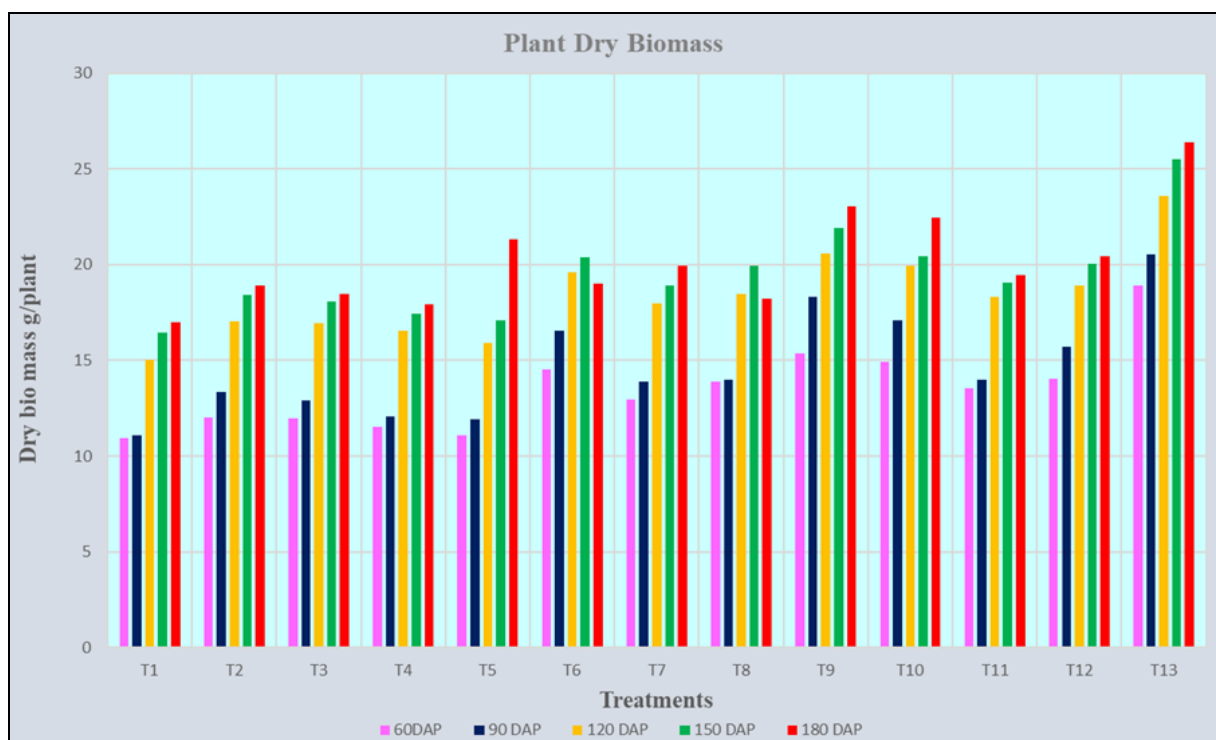


Fig 1: Effect of AM Fungi and different bio inoculant regimes on the Dry matter production of Aloe vera

Table 5: Effect of AM fungi and different bio inoculant regimes on the chlorophyll content of aloe vera

Treatments	Chlorophyll (a)	Chlorophyll (b)	Total chlorophyll (mg g ⁻¹)
T ₁ : Control	0.139	0.590	0.729
T ₂ : RDF	0.153	0.710	0.863
T ₃ : <i>G. fasciculatum</i>	0.151	0.690	0.841
T ₄ : <i>Bacillus Megaterium</i>	0.149	0.630	0.779
T ₅ : <i>Azospirillum</i>	0.143	0.610	0.753
T ₆ : 100% P + <i>G. fasciculatum</i> + <i>Bacillus megaterium</i>	0.171	0.521	0.692
T ₇ : 100% P + <i>G. fasciculatum</i> + <i>Azospirillum</i>	0.159	0.750	0.909
T ₈ : 100% P + <i>Bacillus megaterium</i> + <i>Azospirillum</i>	0.132	0.521	0.653
T ₉ : 100% P + <i>G. fasciculatum</i> + <i>Bacillus megaterium</i> + <i>Azospirillum</i>	0.163	0.833	0.996
T ₁₀ : 50% P + <i>G. fasciculatum</i> + <i>Bacillus megaterium</i>	0.173	0.690	0.863
T ₁₁ : 50% P + <i>G. fasciculatum</i> + <i>Azospirillum</i>	0.161	0.591	0.752
T ₁₂ : 50% P + <i>Bacillus megaterium</i> + <i>Azospirillum</i>	0.193	0.789	0.982
T ₁₃ : 50% P + <i>G. fasciculatum</i> + <i>Bacillus megaterium</i> + <i>Azospirillum</i>	0.195	0.915	1.11
SED	0.193	0.137	0.141
CD (0.05)	0.436	0.241	0.210

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