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Effect of *Arbuscular mycorrhizae* on the growth of *Vigna radiata*

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Abstract
Mycorrhizal fungi form mutualistic relationships with the roots of some plants, allowing the plant access to nutrients and minerals while the fungi obtain food from the plant. Given that this relationship is beneficial to the plant, this paper investigates the nature of the impact of presence of mycorrhizal fungi on the growth of *Vigna radiata* (mung beans) in soil of differing chemical environments. Through comparing the stem lengths of plants seven days after germination, it is found that in soil with 0.0% fertilizer, the presence of locally collected, unclassified mycorrhizal fungi impact the growth of *Vigna radiata* negatively; in intermediate fertilizer concentrations there is no significant effect; at higher fertilizer concentrations, the mycorrhizal fungi aid in the plants' survival and growth. This paper I observed the plant spp. of Mung bean, planted them to 7 different types of soil samples, concludes that in nutrient-deficient environments, the mycorrhizal fungi compete for nutrients with the plant, yet benefits the plant by stabilizing its growth when nutrients are available. Like that I differ those plants by their growth and development. Due to the unclassified nature of the mycorrhizal fungi used in this experiment, this investigation is very preliminary and opens itself to many more topics of research in the future.

Keywords: *Vigna radiata* L., soil samples, germination mycorrhizal fungi, stem lengths, fertilizer etc

Introduction

We all know that Mycorrhizae are symbiotic relationships that form between fungi and plants, they form a network between them, and they transfer nutrition and chemical signals to each other. Mycorrhizae to be efficient at extracting nutrients from both mineral and organic sources, enabling plants to thrive in habitats that are considered poor in nutrients. The fungi colonize the root system of a host plant, providing increased water and nutrient absorption capabilities while the plant provides the fungus with carbohydrates formed from photosynthesis. Mycorrhizae also offer the host plant increased protection against certain pathogens. Approximately 90% of all vascular land plants live in some association with mycorrhizal fungi. Many beneficial soil microbes are sensitive to chemical and mechanical disturbances associated with conventional row crop agriculture, including *arbuscular mycorrhizal* (AM) fungi. AM fungi provide agricultural benefits through multiple mechanisms including increasing crop pathogen resistance, helping with crop nutrient acquisition, and increasing soil carbon storage. Conversion to less intensive row crop agricultural management systems such as biologically-based organic and no-till may reduce the negative effects of conventional management to AM fungi. AM fungus activity (via glomalin production), spore diversity, community structure, and community stability were surveyed over 20 years in no-till, biologically-based organic, and conventionally managed plots at the W.K. Kellogg Biological Station Long Term Ecological Research Site in Michigan, USA. A complementary greenhouse experiment tested for direct effects of AM fungal inoculate from these different agricultural management treatments on growth of corn and wheat plants. AM fungal inoculate from organically-managed treatments increased wheat, but not corn, growth. Overall, conversion from long-term conventional row crop agricultural management to no-till or biologically-based organic systems increased soil glomalin, but did not uniformly improve AM fungus diversity or crop plant benefits. In the future, novel agricultural systems combining organic management with conservation tillage may further improve AM fungal benefits to soils and crops. That's like *Vigna radiata* (Green gram) is an agricultural plant species from the general of *Vigna*, where more than 200 species reported from the family Fabaceae, which 7 are of tremendous agronomic importance. These are grown mainly in the warm temperate and tropical regions of the world. Valued for their grains with high and easily digestible proteins. The mung bean (*Vigna radiata* L.) is one of the most important edible legume crops, grown on more than 6 million ha worldwide (about 8.5% of the global pulse area) and consumed by most households in Asia. Due to its characteristics of relatively drought-tolerant, low-input crop, and short growth cycle (70 days or so), the mung bean is widely cultivated in many Asian countries (concentrated mainly in China, India, Bangladesh, Pakistan, and some Southeast Asian countries) as well as in dry regions of southern Europe and warmer parts of Canada and the United States. The mung bean contains balanced nutrients, including protein, dietary fiber, minerals, vitamins, and significant amounts of bioactive compounds. For those individuals who cannot afford animal proteins or those who are vegetarian, the mung bean is of a comparatively low-cost and has a good source of protein for them. In this paper I will investigate the impacts of mycorrhizal fungi on the growth of plants in soil has been eliminated of microbes, weeds, and parasites. Currently, some commercial farms remove weeds, parasites, and denitrifying bacteria from the soil, killing mycorrhizal fungi originally in the soil in the process of sterilization; this preliminary investigation explores the potential benefits of re-adding mycorrhizal fungi into the soil. *Vigna radiata* seeds were easy to cultivate and grow quickly, they were chosen for the experiment to investigate the interaction between plants and mycorrhiza.

Material and Method Material

1. Mung been seed
2. Pen and pencil
3. Tag
4. Graph paper
5. Formaldehyde
6. 7 types of Soil samples
7. Android phone Google map
8. Phone camera
9. Weight machine
10. Polythene bags
11. Spade

Different types of Soil samples

Sterilized soil sample

Rice field Soil

Edge of Field Soil

Soil under of Medicinal Plant

Road side soil

Barren land soil

Mixed soil

Sterilized soil sample

Method Step-1: Collect 5 types of different soil Samples of 7 kg each and pack in the separate polythene bags.

Step 2: Take 5 kg from each types of 7 kg soil and make 5 plots of 1 kg for each types of soil. So, total we have to prepare 5×5= 25 plots from 25 kg of soil.

10 kg mixed soil prepared

Step-3: A total 10 kg of mixed soil should be prepared with an additional 2 kg of soil from each sample.


Step-4: Pack 5 kg of 10 kg of mixed soil and treat the remaining 5 kg of mixed soil with Formaldehyde, and leave the treated soil for 72 hours to kill all the germs.


Step-5: The mixed of 5 kg of germ soil should be packed separately in 1 kg each and 5 kg of sterile soil (without germs) should be packed separately in 1 kg each.


Step-6: Now each type of soil should be stored for 200 grams for testing in the laboratory.

Step-7: Now from those seven types of soil sample we are taken 100 gram of soil from each types of soil sample and then each types of soil sample are examined in college laboratory for study of mycorrhiza spore number and then mean result mycorrhiza spore calculated from each type of soil sample.

Step-8: Then 5 to 6 germinated gram seeds should be planted in all the plotted packets.

Germinated mung seeds7

Step-9: After the seedlings, 2 or 3 relatively healthy trees should be left and the rest of the trees should be uprooted.

New plant grow up from germinating seeds

Step-10: After 15 days we have to determined the number of leaves, flowering, height of each plants, and prepared a data chart and result table from collected data. After every 15 days we have to noticed about the physical change of the plants and note down the changed data respectively.

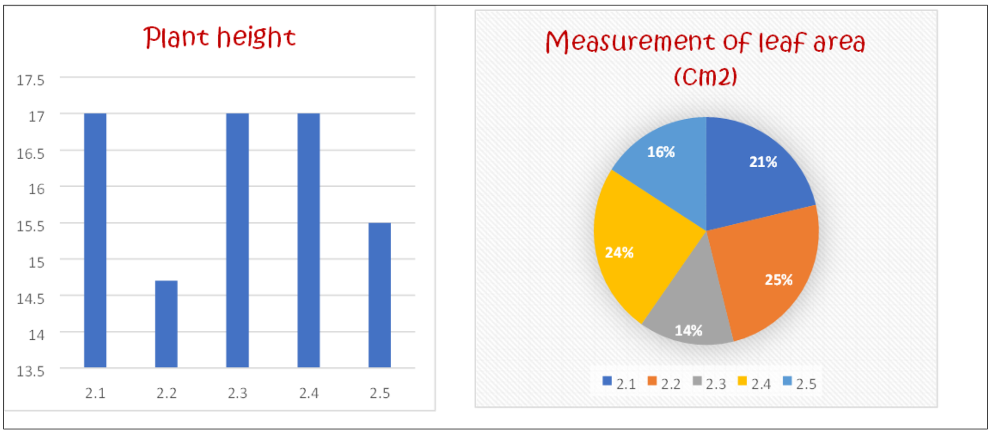
Step-11: Takes photographs of each steps and fix those photographs in appropriate place.

Observation and results

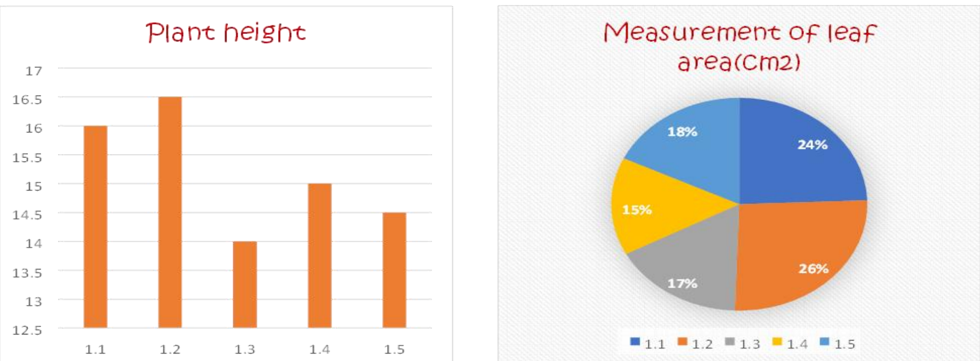
Data table 1: (15 days) Different soil use for observation of effect on plant growth parameters

Types of soil samples	Time (Days)	Tag no.	Plant height (cm)	Length of Leaf (cm)	Number of leaf	Measurement of Leaf area (cm^2)
1. Cultivation Field soil	0-15	1.1	16	8	4	12.6
		1.2	16.5	7.7	3	13.49
		1.3	14	7	4	8.62

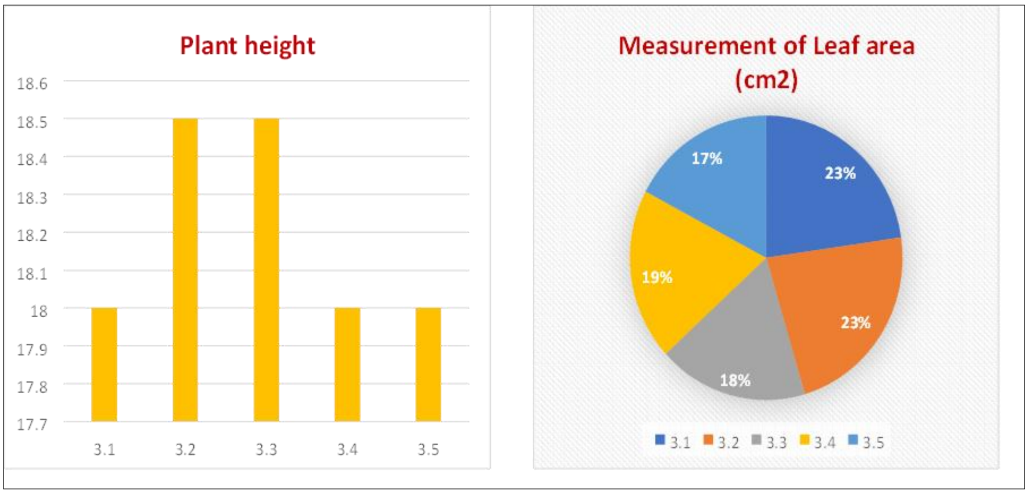
		1.4	15	7	3	7.66
		1.5	14.5	7	3	9. 24
2. Edge of Field soil	0-15	2.1	17	8.5	4	13.54
		2.2	14.7	8	4	15.76
		2.3	17	8	4	8.69
		2.4	17	8.3	4	15.45
		2.5	15.5	8.3	4	10.12
3. Under Medicinal Plant soil	0-15	3.1	18	10	4	19.81
		3.2	18.5	9.5	5	19.81
		3.3	18.5	9.3	4	15.50
		3.4	18	10	5	17.01
		3.5	18	10	4	15.08
4. Road side soil	0-15	4.1	18.5	10.5	4	17.28
		4.2	18	10	5	15.53
		4.3	17	10	5	15.82
		4.4	18.5	9.5	4	15.10
		4.5	16.5	9.5	4	16.2
5. Barren land soil	0-15	5.1	14	7	4	12
		5.2	15	7.5	4	10.6
		5.3	17.5	7.5	4	13.26
		5.4	16	7.2	4	11.12
		5.5	16.5	7.5	4	11.17
6. Mixed soil	0-15	6.1	17	9	5	13.15
		6.2	17.5	9	4	17.07
		6.3	18	10.5	4	10.42
		6.4	18.5	10	4	17.02
		6.5	18	7	4	9.2
7. Mixed sterilized soil	0-15	7.1	16.8	9	4	12.28
		7.2	16.5	8.5	4	10.82
		7.3	18	9.2	4	11.67
		7.4	15.5	8.5	4	12.07
		7.5	17	7.6	4	12.07

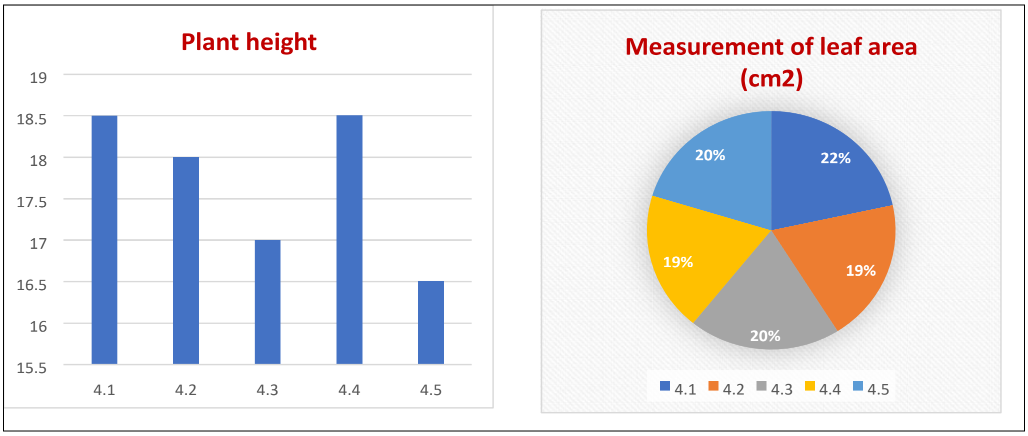


Cultivation field soil Bar &Pie diagram

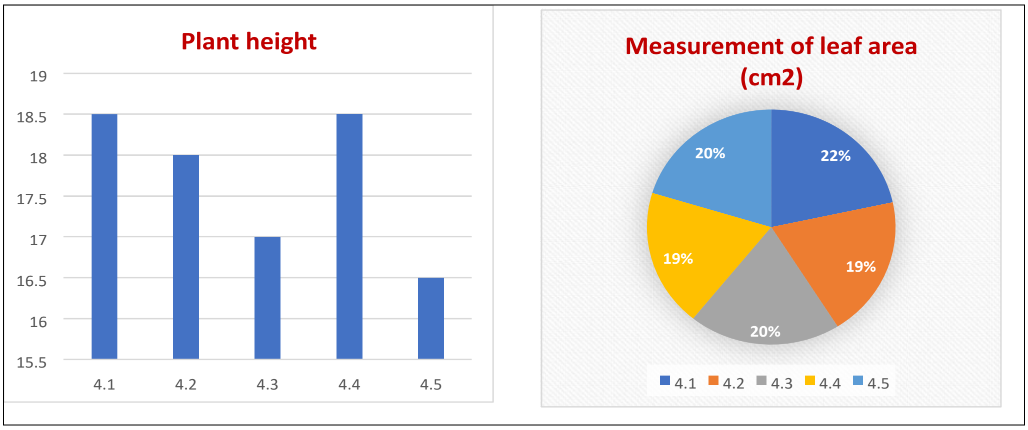


Edge of field soil Bar &Pie diagram

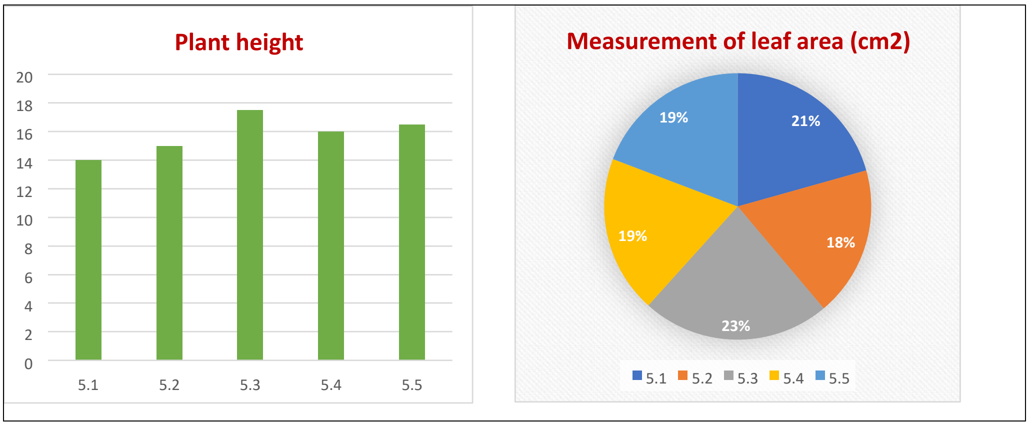




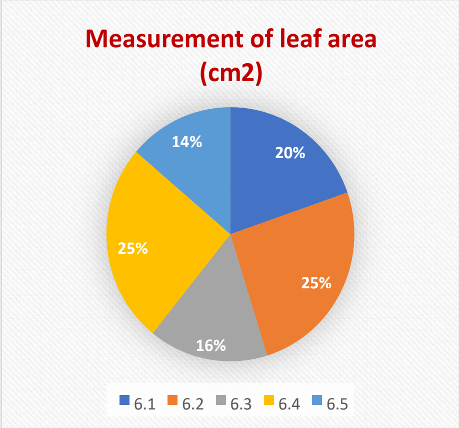
Under of medicinal plant soil Bar &Pie diagram



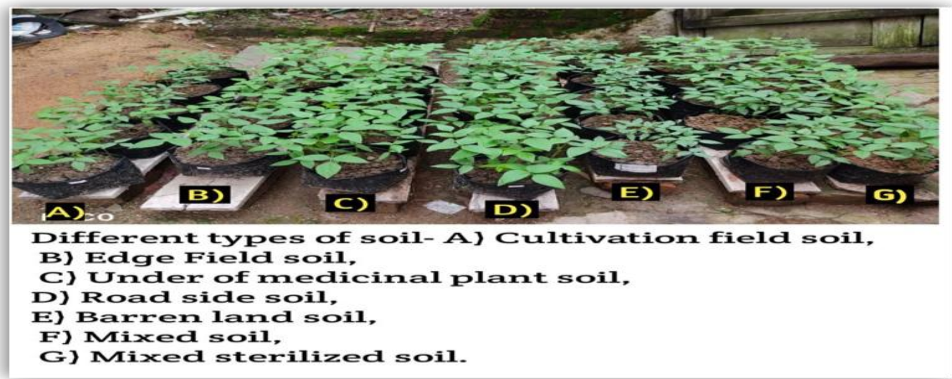
Road side soil pie and pedigree diagram

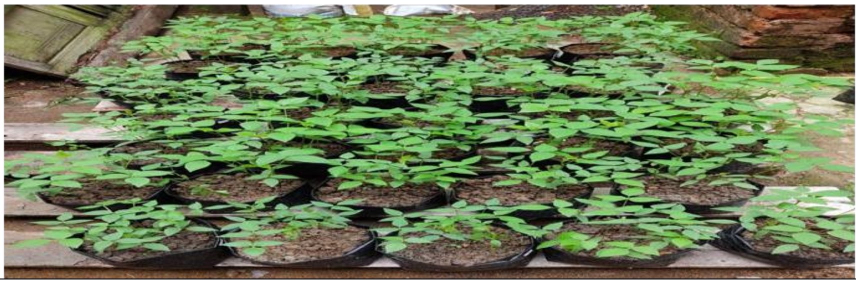


Discussion Obervation of barrel land soil.



Fixed soil observation plants





In Mixed sterilized soil observation of plants

Table 1: showing of VAM Spore counting per 100-gram soil samples:

Sl no.	Soil types	Plant present in the soil	VAM Spore number/100 gm	Mean
1.	Cultivating field soil	*Oryza sativa* *Cyanodon dactylon Glinus so.*	42	57.33
			58	
			72	
2.	Edge of field soil	*Evolvulus nummularius* *Digitaria ciliaris* *Melochia corchorifolia* *Alternanthera sessilis*	420	499.66
			512	
			567	
3.	Under of medicinal plant soil	*Terminalia arjuna*	162	177.33
			172	
			198	
4.	Road side soil	*Digitaria ciliaris* *Ziziphus mauritiana* *Evolvulus nummularius* *Alternanthera sessilis*	512	545
			548	
			575	
5.	Barren land soil	*Mikania micrantha Ficus sp.* *Hemidesmus indicus* *Digitaria ciliaris*	422	484
			473	
			557	
6.	Mixed soil	-	225	295.33
			310	
			351	
7.	Mixed sterilized soil	-	0	0
			0	
			0	

Table 2: Effect of VAM Spore on the growth of *Vigna radiata* plant

Soil types	Mean VAM Spore no	Mean of plant height	Mean of leaf no.	Mean of avg. leaf area
		15 Days	15 Days	15 Days
1.Cultivat ing Field soil	57.33	15.2	3.4	10.32
2. Edge of field soil	499.66	16.24	4	12.71
3. Under of medicinal Plant soil	177.33	18.2	4.4	17.44
4. Road side soil	545	17.7	4.4	15.99
5. Barren land Soil	484	15.8	4	11.63
6. Mixed soil	295.33	17.8	4.2	13.37
7. Mixed sterilized soil	0	16.76	4	11.78

Mycorrhizal fungi form mutualistic relationships with the roots of some plants, allowing the plant access to nutrients and minerals while the fungi obtain food from the plant. Given that this relationship is beneficial to the plant, this paper investigates the nature of the impact of presence of mycorrhizal fungi on the growth of *Vigna radiata* (mung beans) in soil of differing chemical environments. Here I used for this experiment, 7 types of soil samples and I differ them one of each soil sample in 5 different pots, the soil samples collected from different areas from our locality, like Cultivating field soil, Edge of field soil, Under of medicinal plant soil, road side soil, Barren land soil and then I mixed them and made two different pots. Then one of them I added 10% formaldehyde for sterilized, I planted germinated mung seeds to every soil samples of each pots.

Cultivating field soil- Where I collected this type of soil sample, there I find out that some plant spp. Like *Oryza sativa*, *Cyanodon dactylon*, *Glinus* sp. And which 100 gram of soil sample we collected for laboratory test, after this test we get 57.33 mean VAM Spore. Based on those number of Spores after 60 days I get the mean of plant height-15.2, mean of leaf number-3.4 and also I get the mean of average leaf area-10.32.

Edge of field soil- Where I collected this type of soil sample, there I find out that some plant spp. Like *Evolvulus nummularius*, *Digitaria ciliaris*, *Melochia corchorifolia*, *Alternanthera sessilis*. And which 100 gram of soil sample we collected for laboratory test, after this test we get 499.66 mean VAM Spore. Plant hight mean found 16.24, number of leaf 4 and mean average of leaf area 12.71 respectively.

Under of medicinal plant soil- Where I c llected this type of soil sample, there I find out that some plant spp. Like *Terminalia arjuna*. And which 100 gram of soil sample we collected for laboratory test, after this test we get 177.33 mean VAM Spore. Plant height mean found 18.02., number of leaf 4.4 and mean average of leaf area 17.44 respectively.

Road side soil- Where I collected this typ of soil sample, there I find out that some plant spp. Like *Digitaria ciliaris*, *Ziziphus mauritiana*, *Evolvulus nummuarius*, *Alternanthera sessilis*. And which 100 gram of soil sample we collected for laboratory test, after this test we get 545 mean VAM Spore. Plant height mean found 17.4., number of leaf 4.4 and mean average of leaf area 15.99 respectively.

Barren land soil- Where I collected this type of soil sample, there I find out that some plant spp. Like *Mikania micrantha, Ficus sp, Hemidesmus indicus, Digitaria ciliaris*. And which 100 gram of soil sample we collected for laboratory test, after this test we get 484 mean VAM Spore. Plant height mean found 15.8., number of leaf 4 and mean average of leaf area 11.63 respectively.

Mixed soil- Which 100 gram of soil sample we collected for laboratory test, after this test we get 295.33 mean VAM Spore. Based on those number of Spores. Plant height mean found 17.8., number of leaf 4.2and mean average of leaf area 13.37 respectively.

Mixed sterilized soil- Which 100 gram of soil sample we collected for laboratory test, after this test we get 0 mean VAM Spore. found 16.76., number of leaf 4 and mean average of leaf area 11.78 respectively.

Conclusion

Mung been is a highly yielding plant species. In this experiment we can find that the mung been plants are naturally grow in different types of soil samples without the applying of any types of chemical and bio fertilizer. So we can decide that mycorrhizae effect on those plants for their growth and development and it’s highly find in the plants of Road side soil samples. Vigna radiata can survive and grow in a range of environments that are not completely or almost completely nutrient deficient. One possible reason for the negative relationship between fertilizer concentration and stem length at an early stage of development could be an overabundance of nutrients in the soil, especially when the plants have just started growing and do not require as many nutrients. The fungi allowed the plants to be better suited for a wider range of fertilizer concentrations. Twice as many beans planted in soil without fungi were unable to grow at the highest fertilizer; furthermore, whereas the fungi-absent plants’ stem lengths decreased dramatically as fertilizer concentration increased, the plants grown in soil with fungi saw a more stable decrease in stem length. From the results of this experiment, it is suggested that, in nature, as nutrient availability changes due to season and weather, mycorrhizal fungi should help the bean plants survive and maintain stem length. The results also suggest that the fungi help the plants utilize the nutrients in the soil, helping them grow taller within the data collection period. significantly higher than those grown in soil without. However, at extremely low nutrient levels, the mycorrhizal fungi have a negative impact on plant growth. This result could arise from the fact that the fungi may compete for the nutrients in the soil, making less nutrients available to the plant itself, hindering its growth. Research suggests that mycorrhizal fungi are still able to delegate the nutrients in a way that is ultimately beneficial6 ; however, limited time frame of this experiment meant that such benefit is not witnessed here. The data collected from this experiment is not entirely conclusive, and thus more research must be conducted; nonetheless, the findings of this experiment have important implications because if mycorrhizal fungi are shown to be beneficial for the growth of mung beans in the long run, then the fungi may aid other plants as well.

References

1. Boureima S, Diouf M, Diop TA, Diatta M, Leye EM, Ndiaye F, Seck D. Effects of arbuscular mycorrhizal inocolation on the growth and the development of sesame (Sesamum indicum L.). Afr J Agri Res,2007:3(3):234-8.
2. Demir S. Influence of arbuscular mycorrhiza on some physiological, growth parameters of pepper. Turk J Bio,2004:28:85-90.
3. Deacon J. The Microbial World: Mycorrhizas. Mycorrhizas [Internet]. archive.bio.ed.ac.uk/jdeacon/microbes/mycorrh.htm. Accessed 2016 Sept 18.
4. Giovannetti M, Mosse B. An evaluation of techniques for measuring vesicular arbuscular mycorrhizal infection in roots. New Phytol,1980:84:489–500.
5. Graca MAS, Barlocher F, Gessner MO. Methods to study litter decomposition: A practical guide. Dordrecht, the Netherlands: Springer-Verlag, 2005, 329.
6. Goicoechea N, Szalai G, Antolon MC, Sonchez-Doaz M, Paldi E. Influence of arbuscular mycorrhizae and Rhizobium on free polyamines and proline levels in water stressed alfalfa. J Plant Physiol,1998:153:706–11.
7. Habibzadeh Y, Pirzad A, Zardashti MR, Jalilian J, Eini O. Effects of Arbuscular Mycorrhizal Fungi on Seed and Protein Yield under Water-Deficit Stress in MungBean. Agron J,2013:105:79–84.
8. Huang RS, Smith WK, Yost RS. Influence of vesiculararbuscular mycorrhiza on growth, water relations, and leaf orientation in Leucaena leucocephala Lam. De Wit. New Phytol,1985:99:229–43.
9. Kaya C, Higgs D, Kirnak H, Tas I. Mycorrhizal colonization improves fruit yield and water use efficiency in Watermelon (Citrullus lanatus Thunb.) grown under well-watered and water-stressed conditions. Plant Soil,2003:253(2):287-92.
10. Rajakaruna N, Bohm BA. Serpentine and its vegetation: a preliminary study from Sri Lanka. J Appl Bot,2002:76:20-8.
11. Rajakaruna N, Knudsen K, Fryday AM, O'dell RE, Pope N, Olday FC, Woolhouse S. Investigation of the importance of rock chemistry for saxicolous lichen communities of the New Idria serpentinite mass, San Benito County, California, USA. Lichenol,2012:44:695-714.
12. Rajapaksha AU, Vithanage M, Oze C, Bandara WMAT, Weerasooriya R. Nickel and manganese release in serpentine soil from the Ussangoda Ultramafic Complex, Sri Lanka. Geoderma,2012:189-90:1-9.
13. Rinklebe J, Shaheen SM. Assessing the mobilization of cadmium, lead, and nickel using a seven-step sequential extraction technique in contaminated floodplain soil profiles along the Central Elbe River, Germany. Water Air Soil Poll,2014:225:1-20.