

EFFECT OF MYCORRHIZAE ON AGRICULTURAL CROP CHICK PEA (*CICER ARIETINUM*)

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ABSTRACT- Mycorrhizae establish symbiotic relationships with plants and play an essential role in plant growth, disease protection, and overall soil quality. Mycorrhizae have been shown to increase growth and yield of plants. They have been identified with both nutrient mobilization and nutrient cycling. Present investigation was carried out with chick pea plant where effect of mycorrhizae was studied on gram plant. This investigation indicated beneficial effect of application of mycorrhizae on root length and root branches. It also shows positive effect on shoot length and shoot branches.

Keywords: Mycorrhizae, Chick pea, arbuscular, ectomycorrhizae. Agriculture.

1. INTRODUCTION

Mycorrhizae establish symbiotic relationships with plants and play an essential role in plant growth, disease protection, and overall soil quality. Of the seven types of mycorrhizae described in current scientific literature (arbuscular, ecto, ectendo, arbutoid, monotropoid, ericoid and orchidaceous mycorrhizae), the arbuscular and ectomycorrhizae are the most abundant and widespread [1]. Mycorrhizae have been shown to increase growth and yield of plants. They have been identified with both nutrient mobilization and nutrient cycling. Arbuscular endo mycorrhizae play a significant role in agriculture and most natural ecosystems, whereas ectomycorrhizae have a great potential in forestry and wasteland regeneration. The use of mycorrhizal fungi would reduce dependence on chemical fertilizers besides minimizing environmental pollution. The present review addresses the progress that there has been in the area of the ecto and endo mycorrhizae. It also examines the potential of field applications of mycorrhizal biotechnology in agriculture and forestry [2].

Chickpea (*Cicer arietinum* L.), commonly known as gram or Bengal gram, is one of the most important pulse crops of India and has a major role in the country's pulse economy. It is cultivated primarily as a rabi-season crop and is consumed in several forms, including whole grain, split pulse (chana dal), flour (besan), and green seeds and leaves as vegetables. Chickpea straw is also utilized as livestock fodder. India is the leading producer of chickpea globally, and the crop contributes a substantial proportion of the country's total pulse production. Recent estimates indicate that chickpea occupied approximately **10.09 million ha and produced about 11.75 million tonnes in India**, with an average productivity of approximately **1.164 t ha⁻¹**. During 2021–22, the crop reached a peak area of about **10.7 million ha**, production of approximately **13.5 million tonnes**, and productivity of **1.261 t ha⁻¹**. Chickpea production is geographically concentrated, with **Madhya Pradesh, Maharashtra and Rajasthan** being among the principal producing states. During 2018–19 to 2022–23, Madhya Pradesh produced approximately **3.19 million tonnes**, Maharashtra **2.46 million tonnes**, and Rajasthan **2.25 million tonnes** of chickpea. Maharashtra accounted for approximately **23.09% of the national chickpea area**, while Madhya Pradesh and Rajasthan accounted for approximately **22.30% and 20.61%**, respectively. These figures demonstrate the major contribution of chickpea to India's food-legume production and highlight the importance of the crop in the agricultural economies of central and western India [3]. The impacts of climatic changes in agriculture is increased intensity and frequency of storms, drought and flooding, altered hydrological cycles and precipitation variance have implications for future food security of India with serious changes of species habitats in some areas, leading to species range shifts, changes in plant diversity [4]. In developing countries, 11 percent of arable land could be affected by climate change, including a reduction of cereal production in up to 65 countries, about 16 percent of agricultural GDP [5]. Considering all the above aspects present study was carried out with following aims and objectives. To study effect of different concentration of mycorrhizae on growth of Chick pea. To study effect on morphology root and shoot development.

2. MATERIALS AND METHODS

Chick Pea (*Cicer arietinum*)

Morphology – *Cicer arietinum* is a short annual herb, attaining a height of less than a metre. Depending on the angle of the branches and the soil surface, the plant assumes erect, semi-erect, spreading, Semi-spreading and prostrate' growth habit. Branching

starts from the base at ground level, giving plant a bushy appearance. The plant surface including roots, stem, leaves and pods are pubescent, covered with glandular and non-glandular hairs. The glandular hairs secrete a mixture of acids containing malic, Oxalic and citric acids. This acid mixture acts as defence mechanism against sucking pests. The exudation from the roots helps in solubilizing the soil nutrients [6].

METHODS –

- Collection of seed – The seeds were collected from local rural farmers. About 4 local varieties of chick pea seeds were selected for germination.
- Selection of seed – Healthy seeds were selected for checking seed viability.
- Seed viability- Selected seeds were proceeded for seed viability test by using cocopeat and germination percentage were calculated using following formula.

$$\text{Germination Percentage (\%)} = \frac{\text{Total no. of seeds germinated}}{\text{Total no. of seeds sown}} \times 100$$

Soil preparation-

1. Pot mixture - 50% black soil
30% vermicompost
10% sand
10% cocopeat
2. Take 10 pot for to check the effect of mycorrhizae & also controlled one.
3. Add 0.1 gm of mycorrhizae in first pot mixture then the concentration of mycorrhizae going to increase by 0.1 gm in each pot ie, 0.2 in second pot mixture respectively etc.
4. Sowing of seed – sow 10 seeds on each pot at particular distance considering control one.
5. After the germination of seed wait for further observation.
6. Observed the growth of plant after every 7 days.

3. OBSERVATION AND RESULT

3.1 Germination percentage-

Investigation of germination percentage was an essential aspect to ensure seed viability.

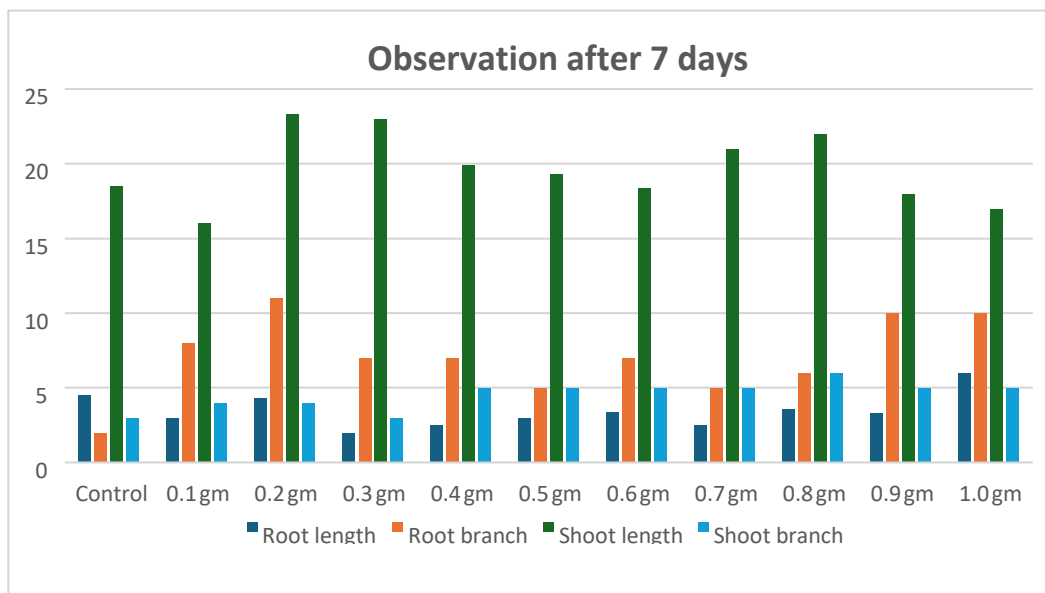
For this total 100 healthy seeds were selected and proceeded for germination in cocopeat. Among the 100 seeds sown, total seeds 96 were germinated. Hence the total germination percentage was **96%**. Further such seeds were selected for further studies.

3.2 Observations

The selected seeds were sown in prepared soil mix pots and allowed to germinate. After interval of every 7 days the results were observed. The different aspects of growth pattern like root length, root branch, shoot length and shoot branch were noted every week. The observed results were noted in observation table.

Table 1 – Observation after 7 days

Sr. No	Concentration	Root length	Root branch	Shoot length	Shoot branch
	Control	4.5 cm	2	18.5 cm	3
1.	0.1 gm	3 cm	8	16 cm	4
2.	0.2 gm	4.3 cm	11	23.3 cm	4
3.	0.3 gm	2 cm	7	23 cm	3
4.	0.4 gm	2.5 cm	7	19.9 cm	5
5.	0.5 gm	3 cm	5	19.3 cm	5
6.	0.6 gm	3.4 cm	7	18.4 cm	5
7.	0.7 gm	2.5 cm	5	21 cm	5
8.	0.8 gm	3.6 cm	6	22 cm	6
9.	0.9 gm	3.3 cm	10	18 cm	5
10.	1.0 gm	6 cm	10	17 cm	5



Form the above table we can observed that the root length is highest in 1.0 gm concentration compare to control. Root branch are more in number in all concentration exceptional control one. Shoot length is longest in 0.2 gm, 0.3 gm, 0.7 gm, 0.8 gm, 0.4 & 0.5 also while control have only 18.5 cm of length. Shoot branches are more in all types of concentration as compare to control.

Table 2 - Observation after 14 days

Sr. No	Concentration	Root length	Root branch	Shoot length	Shoot branch
-	Control	9 cm	6	44 cm	6
1.	0.1 gm	4.5 cm	10	38.5 cm	6
2.	0.2 gm	5.2 cm	13	45 cm	9
3.	0.3 gm	4 cm	9	41 cm	9
4.	0.4 gm	4.5 cm	7	35 cm	7
5.	0.5 gm	3.5 cm	3	38 cm	7
6.	0.6 gm	5 cm	10	31 cm	7
7.	0.7 gm	3 cm	3	37.5 cm	9
8.	0.8 gm	4.5 cm	8	49.5 cm	8
9.	0.9 gm	3.3 cm	9	44 cm	9
10.	1.0 gm	3.5 cm	9	32.2 cm	8

In table 2, root length is longest only in control one other have short root length. Root branches are typically more in 0.2 gm, 0.6 gm, 0.1 gm, 0.9 gm, 0.1 gm, 0.3 gm 0.8 gm & 0.3 as control one. Shoot length is highest in 0.8 gm concentration followed by 0.2 gm, 0.9 gm while in control it is 44 cm. Shoot branches are only common in 0.1 concentration & control, in other concentration it is increased.

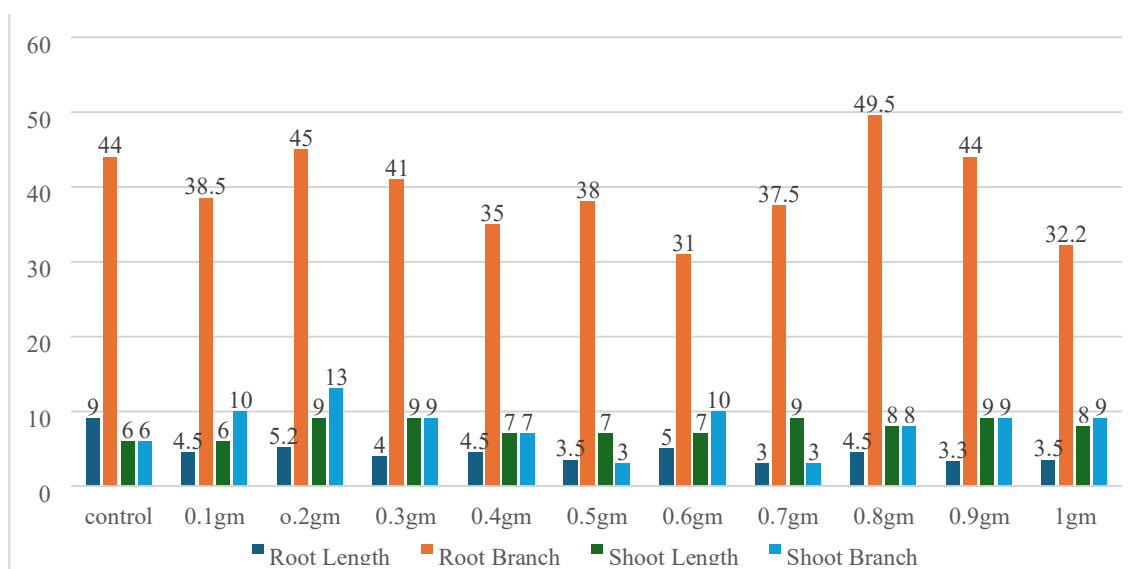
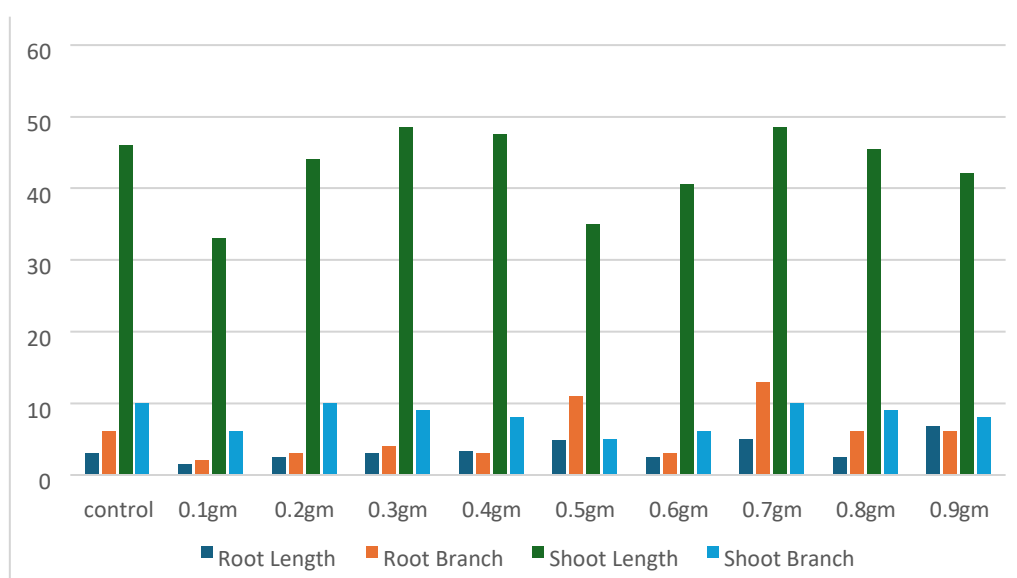


Table 3 – Observation after 21 days

Sr. No	Concentration	Root length	Root branch	Shoot length	Shoot branch
-	Control	9cm	12	48 cm	11
1.	0.1 gm	3 cm	6	46 cm	10
2.	0.2 gm	1.5 cm	2	33 cm	6
3.	0.3 gm	2.5 cm	3	44 cm	10
4.	0.4 gm	3 cm	4	48.5 cm	9
5.	0.5 gm	3.2 cm	3	47.5 cm	8
6	0.6 gm	4.8 cm	11	35 cm	5
7	0.7 gm	2.5 cm	3	40.5 cm	6
8.	0.8 gm	5 cm	13	48.5 cm	10
9.	0.9 gm	2.5 cm	6	45.5 cm	9
10.	10 gm	6.8 cm	6	42 cm	8

From the above table root length in control is highest than other concentration. Root branches are only increased in 0.8 concentration. Shoot length is highest in 0.8, 0.4 concentration compare to control. Shoot branches are more in control than other concentration.



3.3 DISCUSSION

This study concluded that the treatment 75% NPK + arbuscular mycorrhiza fungi (AMFs) (T2) gave the highest values for grain yield and forage yield of maize and cowpea that are growing under intercropping system 2:2 ridges cowpea/maize. Moreover, no significant differences were found between fertilizer treatments T1 (100% NPK mineral) and T2 (75% NPK + arbuscular mycorrhiza fungi (AMF)) combination on yield and the studied characters of maize and cowpea. This means that we can reduce the use of mineral fertilizers by 25% under this study and, thus, reduce the cost of production. The intercropping system 2:2 ridges cowpea/maize produced 70% more than of its monoculture crop of yield and forage yield/ha for maize and cowpea in both seasons, and resulted in improvement quality, increased land equivalent ratio (LER), gross return and net return.

Soybean is one of the major commodities in Indonesia. Due to its high demand, it requires an effort to increase the production. Soybeans are generally cultivated in dry land, for that it needs a special management to increase the yield. The association between Mycorrhiza and roots help the plant to get water and nutrients. In this regard Mycorrhiza expected to increase soybean yield and efficiency. This research aim is to study the dose of Mycorrhiza on the growth and yield of soybean efficiently. The experiment was conducted in Selogiri District, Wonogiri, while the analysis of Mycorrhiza and soil was in Faculty of Agriculture, Universitas Sebelas Maret Surakarta from February to April 2016. Randomized Complete Block Design (RCBD) with two factors was employed for this experiment. The treatments are compost dose (derived from Waste Management Faculty of Agriculture UNS) and Mycorrhizal dose (obtained from BPPT Serpong). The result showed that the Mycorrhiza treatment was able to improve the growth and yield of soybean. The most efficient dose of is Mycorrhiza treatment at 0.64 ton ha⁻¹ [7].

Arbuscular Mycorrhizae Fungi (AMF) inoculations may improve growth and nutrient uptake of cotton (*Gossypium hirsutum* L.) plant. Although the importance of mycorrhizal symbioses for growth and nutrient acquisition of cotton plant is known, less is known about mycorrhizal dependency on Phosphate and Zinc nutrition under low Zinc fertile soil conditions. A greenhouse experiment was conducted to investigate the effect of different P and Zn fertilizer addition on cotton plant growth as well as Zinc and Phosphate uptake. Sterilized and non-sterilized low Zn fertile Konya series soil was treated with different levels of P and Zn. Soils

were inoculated with two mycorrhizae species like *Funneliformis mosseae* and *Claroideoglomus etunicatum* after sterilization. Results showed that mycorrhizal inoculation on plant growth and nutrient uptake has significant effect when soil was sterilized. *Claroideoglomus etunicatum* mycorrhizae species has greater effect than *Fluorine mosseae* mycorrhizae species. Root colonization increased 23–65% due to mycorrhizal amendment. The shoot: root ratio increased by 13 and 22% for non-sterile and sterile condition respectively in mycorrhiza amended soil. Mycorrhizal dependency varies 1–55% and 3–64% for non-sterile and sterile soil respectively on mycorrhizae, P and Zn amended soil. Mycorrhizal dependency analysis showed that cotton plant in both sterile and non-sterile soil conditions depends on mycorrhizae species, P nutrition, however is less depend on Zn nutrition. This study concluded that the inoculation of cotton plant with selected mycorrhizae is necessary under both sterile and non-sterile soil conditions [8].

4. CONCLUSION

This study investigates the symbiotic impact of Arbuscular Mycorrhizal Fungi (AMF) on the growth, nutrient uptake, and yield of chickpea (*Cicer arietinum* L.), a vital pulse crop for global food security. Despite chickpea's importance as a primary source of vegetable protein, its productivity is often limited by phosphorus deficiency, drought, and soil salinity. This research focuses on how mycorrhizal inoculation serves as a sustainable biological tool to mitigate these constraints.

Furthermore, the study highlights the role of AMF in abiotic stress resilience. Inoculated chickpeas maintain higher relative water content and photosynthetic rates during terminal drought. Under salinity stress, AMF stimulates antioxidant defence mechanisms (SOD, CAT, and POX), reducing oxidative damage. The research also confirms a synergistic effect when AMF is co-inoculated with nitrogen-fixing *Rhizobium* bacteria, resulting in superior nodulation and increased crude protein content in seeds.

In conclusion, mycorrhizal biotechnology offers a cost-effective and eco-friendly alternative to chemical fertilizers. Integrating AMF into chickpea cultivation not only ensures higher yields and improved grain quality but also promotes long-term soil health and climate-resilient agriculture. These results advocate for the widespread adoption of mycorrhizal bio-fertilizers in major chickpea-producing regions.

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