

Original Research Article

Establishment of algae as bio-fertilizer for coffee plant

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ABSTRACT

Background: *Coffea arabica* L. belongs to the Rubiaceae, is worldwide value for the coffee beverage. This experiment aims to prove algae as bio-fertilizer in *Coffea arabica* L. The role of BGA and moss prevent the soil as dry condition which also provide the nutrients for the crops.

Methods: Experiment was conducted in the plastic house in Kangwon National University, using the 2 yrs. *Coffea arabica* L. seedling dividing into four groups; Algae+NPK, Algae, NPK, Control.

Results: The height, branching and number of leaves is higher in case of Algae+NPK. The following order is observed in each group; Algae+NPK > Algae > NPK > Control with water.

Conclusions: The algae proves that the positive role of *Coffea arabica* for growth and development which can be used for the manure in the coffee farm.

Keywords: Blue green algae, *Coffea arabica* L., Growth and development, Nutrients, Plastic house

INTRODUCTION

Coffee-trees belong to the tribe *Coffea* in the family *Rubiaceae*.¹ The subgenus *Coffea* consists of approximately 100 species so far identified in African and Madagascan inter tropical forests. *Coffea arabica* L. is both the most widely cultivated species of *Coffea* and the only tetraploid species (2x=44) in the genus. *Coffea* is a genus of flowering plants, whose seeds called coffee bean. First trials to produce transgenic coffee plants with reduced caffeine content in beans are being carried out.² In 1995, coffee (*Coffea* spp.) and cacao (*Theobroma cacao*) plantations worldwide totaled 16,700,000 ha (FAO, 1996). The effects of maintaining shade trees over perennial crops were described as early as the late nineteenth century. The main aromatic compounds were 2-Furanmethanol (32.799%), Furfural (6.367%), 2-Furancarboxaldehyde, 5-methyl-(7.630%), Pyrazine, methyl-(4.673%), Furan, 2-ethyl-5-methyl-(3.641%), Pyrazine, ethyl-(1.103%), 1H-Pyrrole-2-carboxaldehyde, and 1-methyl-(1.269%).³ It is believed some herbicides can exert a direct or indirect negative effect on

photosynthesis by reducing the metabolic rate in a way that can affect the water use efficiency.⁴

Plastic house is the applicable condition for maintaining the temperature, rain fall and light intensity. Seed contain necessary stored material for the early growth and development of the next generation of plant. Information of seed germination behavior contributes to better understanding of certain biological like reproductive strategy, life history trait and adaptation to habitat.⁵

Algae (BGA) in supplying the partial nitrogen needs of coffee. BGA partners *Azolla* inside its lobes and is capable of harvesting atmospheric nitrogen. The symbiotic association of the algae aids in the creation of a huge amount of biomass on the surface of the water. It is then harvested, dried and used as bio-fertilizer to supplement the needs of nitrogen in coffee farms.

Both the partners harvest solar energy via photosynthesis and the total nitrogen requirement can be supplied by the assimilation of nitrogen fixed by anabaena, the micro

symbiotic (each leaf of moss has the potential of harboring 75,000 *Anabaena* cells containing 3 to 3.5% nitrogen)

The aim of the study is application of algae in coffee seedling and reduce the inorganic fertilizer for preserve the environment future sustainable also enable coffee farmer's worldwide in realizing the benefits of using algae either as fresh green manure or as an organic material in the preparation of compost.

METHODS

Collection of algae with live condition from the Kangwon National University pond. After that algae were preserved container (Figure 1A) than left for the condition of growing their self-multiplication with water (Figure 1B).



Figure 1: (A) Algae culture container with plastic bag; (B) Algae growing in container.

After that, the measurement of plant height, branches, and number of leaf were noted in each group. After, frequently checked the germination, photograph was taken by the help Camera (Canon IXUC 220 HS) made in Japan. Photographs were arranged using Photoshop CS6 without modification.

The plant material was selected *Coffea arabica* L. for the experiment. And, experiment was done in the plastic house in Kangwon National University (KNU), Chuncheon, Korea. Seed were sowing in different condition as tray and directly ground in plastic house condition, supplied minimum amount water each days. Experiment was design using the 2 years seedling coffee in same environment condition divides as four group; Algae+NPK, Algae, NPK and Control with Water. For each group, 5 plants were used and, every 1 day's gap added 1000 ml of Water in different from.

1. Algae+NPK (1000 ml water+algae+NPK fertilizer)
2. Algae (1000 ml water+algae)
3. NPK fertilizer (1000 ml water+NPK)
4. Control (Water 1000 ml).

RESULTS

The height of the *Coffea arabica* L. was in order; Algae+NPK >Algae >NPK >Control with water (Table 1).

Table 1: Measurement of seedling height of *Coffea arabica* L. in interval of time.

Date	Plant height of coffee seedling (cm)			
	Algae+NPK	Algae	NPK	Control
1/6/2015	47.60	47.20	41.20	36.6
16/6/2015	48.90	47.80	42.00	39.9
1/7/2015	49.98	46.76	42.30	40.32
16/7/2015	50.46	47.52	43.12	41.88
1/8/2015	52.64	48.22	43.28	45.20
1/9/2015	54.80	48.90	43.60	46.00
16/9/2015	55.24	51.18	43.74	44.66
1/10/2015	58.18	51.82	45.22	45.22
16/10/2015	57.40	53.46	49.38	45.84
1/11/2015	57.80	53.56	49.94	47.58

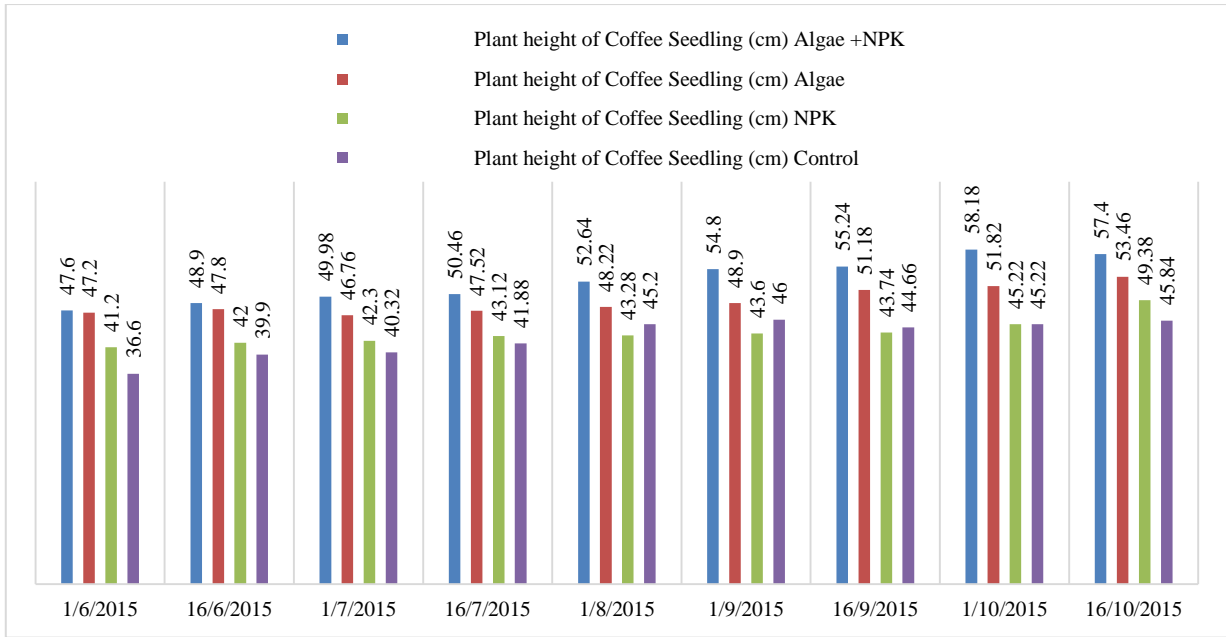


Figure 2: Plant height (*Coffea arabica* L.) in different time interval.

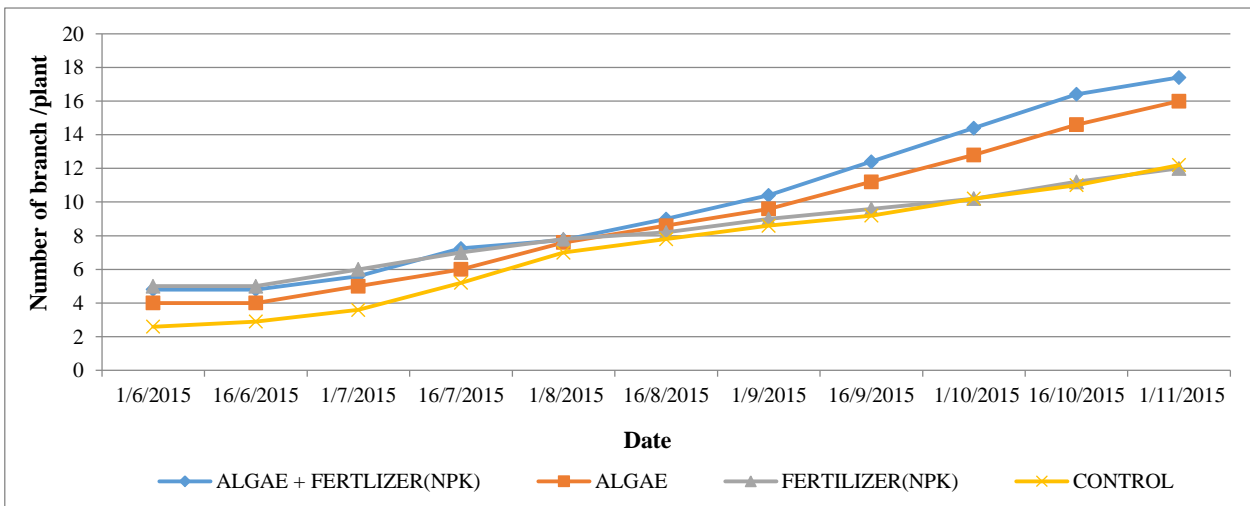


Figure 3: The relation between the time and branching per seedling.

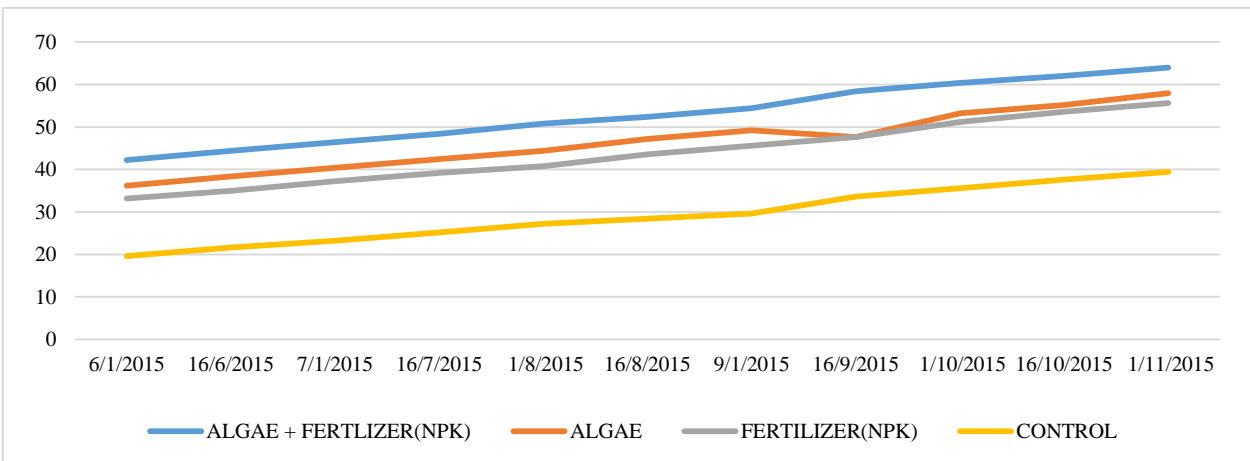


Figure 4: Number of leaf per seedling according to different interval of time.

Figure 2 implies that plant height was highest in case of algae+bio-fertilizer after that second height represents when algae was used.

In Figure 3, Number of branch is highest in Algae+NPK combination also in second order in algal used. The number of leaf is also higher in case of Algae+NPK, Algae shows second order in Figure 4.

DISCUSSION

Anabaena-Moss symbiosis, the moss is generally referred to as the macro symbiont and the blue green algae, namely *Anabaena* is known as the micro symbiont. The

two partners live in a very close relationship with one another. The moss provides the protection to the micro symbiotic from oxygen damage from the external environment and the anabaena in turn provides the nitrogen to the moss for its growth and multiplication. Temperature and light control of plastic house creates the productivity increase in Korea. Algae either as fresh green manure or as an organic material is preparation of compost. BGA are helpful in restoring soil nutrients by secreting exo-polysaccharides and bioactive substances.⁶ In rice-wheat cropping system can save at least 90-120 kg N/ha/year with increased yield of both the crop.⁷ Impact of interrupted irrigation on the synchronism of reproductive bud development in coffee after pruning of the primary lateral branches and the tree top.⁸



Figure 5: (*Coffea arabica* L.) (A) Coffee seedling; (B) Coffee seedling using algae; (C) coffee seedling grows without algae; (D) BGA in coffee seedling; (E) Two leaf stage coffee seedling ; (F) BGA in earlier seedling; (G) Coffee seedling well growing in tray applying NPK+ algae; (H) Two leaf in coffee seedling in small plastic pot individually; (I) Algae applied in large coffee seedling pot; (J) Entire coffee plant; (K) Matured flower; (L) Coffee berry in colony.

80 tons/ha maize stover as soil mulch can significantly increase the yield of Arabica coffee and sustains its productivity over years. Growth and physiological responses of coffee (*Coffea arabica* L.) seedlings irrigated with diluted deep sea water.⁹

In general, our result shows that the presence of algae play vital role for the development of coffee seedling. The order of the results told us algae as a bio-fertilizer, which is useful for the coffee farming. Also it helps the preserve soil wet and fertile for the crops. We can conclude above result of the experiment algae are the useful bio-fertilizer in *Coffea arabica* L. Also, by using the algae (BGA) as fertilizer which can protect the acidity of soil even preserve the environment by reducing the overused of inorganic chemical fertilizer.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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