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Effect of liquid biofertilizer on physiological differentiation in chickpea (*Cicer arietinum*), cowpea *(Vigna Uungiculata L.)* and leafy vegetable coriander (*Coriandrum sativum*)

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Abstract
To study the influence of biofertilizer on the growth of chickpea, cowpea and coriander. Biofertilizers are natural fertilizes which are living microbial organic fertilizers of bacteria, algae, fungi alone or in combination where they augment the availability of nutrients to the plants. Treatments like T1LB1 Control, T2LB2 (Soil+10% Liquid Biofertilizer), T3LB3 (Soil+ 20% Liquid Biofertilizer), T4LB4 (Soil+30% Liquid Biofertilizer) and T5LB5 (Soil+ 40% Liquid Biofertilizer), T6LB6 (Soil+ 50% Liquid Biofertilizer), T7LB7 (Soil+ 60% Liquid Biofertilizer), T8BA8 (Soil+ 70% Liquid Biofertilizer), T9LB9 (Soil+ 80% Liquid Biofertilizer) and T10LB10 (Soil+ 90% Liquid Biofertilizer). Biochemical chemical parameters like chlorophyll pigment composition, Specific leaf area, Stomatal frequency, Relative water content and Relative humidity. Germination percentage was noticed for each treatment. Randomly selected seedlings from each treatment were transplanted in pots containing same treatments as in trays. Various growth parameters like root length, Shoot height, plant height, leaves number, total plant biomass and total dry weight were recorded for each treatment. Germination percentage was found the maximum at T8BL8 compared to control. There was a significant increase found under increase of liquid bio fertilizer dose on different crops by assessing significant difference in growth all the growth parameters, among different treatments T8BL8 showed better performance compared to control under treatment duration. In this context, liquid biofertilizers would be the viable option for farmers to increase productivity.

Keywords: Liquid Biofertilizers, Growth, Cowpea, Chickpea, Coriander, pH

Introduction
The use of hybrid seeds and high-yielding varieties that are highly sensitive to large doses of chemical fertilizers and irrigation is emphasized by modern agriculture. Indiscriminate use of synthetic fertilizers often led to soil and water basins were depleted and degraded. This has driven to the deprivation of vital plant nutrients and organic matter from the soil. It has contributed to the extinction of valuable micro- organisms and insects, which has indirectly decreased soil fertility and made crops more vulnerable to disease.

It is anticipated that by 2020, to achieve the targeted output of 321 million massive amounts of food grain, the requirement of nutrient will be 28.8 million metric tons, while their availability would be only 21.6 million metric tons being a deficit of about 7.2 million tonnes thus depleting feedstock/fossil fuels (energy crisis) and increasing cost of fertilizers which might be unsustainable to small and marginal farmers, thus intensifying depleting levels of soil fertility due to widening gap between nutrient removal and supplies.

Chemical fertilizers that are now widely used since the green revolution have depleted soil health by rendering soil biodiversity ungovernable for soil micro flora and micro fauna, which are predominantly responsible for preserving soil fertility and supplying plants with some vital and important nutrients. Biofertilizers are products containing one or more species of microorganisms which via biological processes such as nitrogen fixation, nutrient uptake, excretion of plant growth promoting substances or cellulose, and biodegradation in soil, compost and other environments, are able to mobilize nutritionally important elements from non-usable to usable forms.

In other words, biofertilizer are natural nutrients that, alone or in combination, are living microbial inoculants of bacteria, algae, fungi and maximize the nutrient availability of plants. Particular significance is given to the role of biofertilizers in agriculture, particularly in the current context of the increased cost of chemical fertilizers and their harmful effects on soil health.

The term 'biofertilizer' refers to preparations containing living cells of effective N2-fixing strains, solubilizing phosphorus or cellulolytic microorganisms capable of enriching soil fertility, either as living organisms or as associated with host plants. All biological nutrient inputs for plant growth are simply denoted by the term bio fertilizer. (SubbaRao,1982) [19].

Biofertilizers are preparations containing living cells or spores that can be supplied by inoculation with one or a few plant food components. Instead of providing it as an individual organism, the farming group now shows a lot of interest in the use of bioinoculants in a single package as a Biomix of Azopus or Rhizopus. The compatibility of N2 fixing and 'P' solubilizing microorganisms was suggested in several field studies on dual inoculation. (Subbarao, 1982) [19]. The positive response of combined inoculation of N2 fixing and P Solubilizing microorganisms was reported by Brown (1974) [1]. This illustrates the compatibility of the inoculants and synergistic action. Similarly, the compatibility of inoculants of Rhizobium and phosphobacteria in cowpea was recorded earlier. Therefore a tentative attempt has been made to research the effectiveness of cowpea nodulation with Rhizopus. There seems to be no argument that the chemical fertilizer enhanced efficiency but also produced many adverse effects. Therefore, the use of biofertilizers in developing countries such as India is both economical and environmentally friendly. As proposed by Subba Rao, biofertilizers are "microbial inoculants" used to enhance soil fertility (1982) [19].

Cowpea (*Vigna unguiculata* L. Walp) is considered Egypt's most significant yield, although as an inexpensive source of protein (Mohamed *et al.*, 2013) [29]. Cowpea is globally grown as a source of fruits, cover and cash crops. It is an ample quality of protein and has a degree of vigor almost equal to that of cereal grains. Compared with cereal seeds, cowpea protein is rich in Lysin0.310 & T0.0.120ryptophan (Rabia *et al.*, 2015) [28].

Chemical nitrogen fertilization plays a role in improving crop yield (Abyorni *et al.*, 2008), Cowpea nitrogen application had a positive impact on yield and Cowpea components.

Biofertilizers should be viewed as effective alternatives from the standpoint of sustainable agriculture in order to prevent environmental degradation resulting from the overuse of inorganic fertilizer.

Pulses are major source of protein for the vegetarians. Pulses constitute an important component in Indian agriculture since centuries. India is the premier pulse growing country. India, being the world's largest pulse producer, consumer and importer, accounts for 27 per cent of the global pulse production. Chickpea is commonly known as gram which is one of the important pulse crops of the State. The chickpea or chick pea (*Cicer arietinum* L.) is a legume of the family Fabaceae, subfamily Faboideae. The chickpeas are also known as garbanzo bean, Ceci bean, Sanagalu, Chana, hummus and Bengal gram.

The plant grows to between 20-50 cm (8-20 inches) high and has small feathery leaves on either side of the stem. Chickpea crop grows well under good moisture conditions with ideal temperatures between 24 ºC and 30 ºC. This crop is grown on moderately heavy soils, black cotton soils and sandy loam soils. Ideal pH range of 5.5 to 7.0 is suitable for chickpea farming.

Among the pulses, chickpea (*Cicer arietinum* L.) is world's third most important pulse crop. It contains about 21.1% protein, 61.5% carbohydrates, 4- 5% fat, 0.49% lysine, 0.04% tryptophane and 0.11% methionine. It is rich in calcium, phosphorus and iron. In India, during the year 2011-12 chickpea occupied an area of 8.32 million hectares with the total production of 7.58 million tonnes and average productivity of 912 kg/ha.

Coriander (*Coriandrum sativum* L.) an annual herb of the parsley family (Umbelliferae) and native to the Mediterranean region have been cultivated since human antiquity (Telci *et al.*, 2006). The seeds contain essential oil (EO) and linalool is the main component (Omidbaigi 2005) [6]. Coriander is economically important since it has been used as a flavouring agent in food products, perfumes and cosmetics.

Coriander seeds are popular as spice and finely ground seed is a major ingredient of curry powder. The seeds are mainly responsible for the plant's medicinal use and have been used as a drug for indigestion, against worms, rheumatism and pain in the joints.

Biofertilizers can be defined as a substance contains living microorganisms, which colonize the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability by primary nutrients to the host plant when applied to seed. Plant when applied to seed, plant surface or soil.

Chickpea (*Cicer arietinum* L.) is the fourth largest grain legume crop in the world, with a total production of 13.1 M tonnes from an area of 13.5 M ha and productivity of 0.97 tonnes/ha (FAO STAT 2013). India is one of the important chickpea growing countries in Asia with an area of 9.6 M. ha and production of 8.83 M tonnes with a productivity of 920 kg per ha (FAO STAT, 2013). India ranked first in area and production in the world.

Chickpea also plays an important role in sustaining soil productivity by improving its physical, chemical and biological properties and trapping atmospheric nitrogen in their root nodules. Because of its nutritional benefits chickpea cultivation is gaining importance not only in India, but also all over the world. Nutritive value of chickpea is Protein (18-22%), Carbohydrate (61-62%), Fat (4.5 %),

Calcium (280 mg/100 g) Iron (12.3 mg/100 g) and Phosphorus (301 mg/100 g). Generally Rhizobium inoculation increased plant growth, yield and yield components and nitrogen fixation in Chickpea (Fatima, *et al.*, 2008) [16, 31]. Chickpea play essential role in ensuring nutritional security and environmental safety as they have inbuilt mechanism to fix atmospheric nitrogen. In legume crop Rhizobium symbiosis is an important facet of symbiotic nitrogen fixation which is exploited to benefit agriculture and its sustainability.

Micronutrients play an important role in increasing yield of chickpea. Micronutrients also play an important role in increasing yield of pulses and oilseed legumes through their effects on the plant itself and on the nitrogen fixing symbiotic process. Nutrients depletion particularly micronutrients in the soil is increasing. Micronutrient deficiency problems are also aggravated by the high demand of modern crop cultivars. Micronutrients application increase crop yields have been reported in many parts of the world. There is a direct relationship between micronutrients level in crops and human health mainly Zn and B. Graham *et al.*, (2001) [32] reported that more than 3 billion people in the world suffer from Zn deficiencies. Major dietary nutritional disorder of the poor households of a country who heavily subsist on rice is Zn deficiency. Among the various micronutrients, zinc has assumed greater significance due to wide occurrence of its deficiency in different agro climatic regions of the country and spectacular response of field and fruit crops to its application. Chickpea is mainly cultivated as a rainfed crop and water stress often affects both the productivity and the yield stability of the chickpea. Rainfed soils are generally degraded with poor native fertility.

Micronutrients play an important role in increasing legume yield through their effects on the plant itself, on the nitrogen fixing symbiotic process and the effective use of the major and secondary nutrients, resulting in high legume yields. Zinc is the main micronutrient that limits chickpea productivity. The availability of molybdenum is low in acidic soils. The availability of micronutrients is the greatest in the very slight to medium acid range soil except Molybdenum. Ahlawat *et al.*, (2007) reported that each tonne of chickpea grain removes 38 gram of Zn from the soil and it is estimated that 35 g of B and 1.5 g of Mo are removed from the soil as well. Zn deficiency is perhaps the most widespread deficiency among micronutrients (Roy *et al.*, 2006; Ahlawat *et al.*, 2007) [18, 12] and it is common among all chickpea growing regions of the world. Chickpea is generally considered as sensitive to Zn deficiency (Khan, 1998) [17], although there are differences in sensitivity to Zn deficiency between varieties (Khan, 1998; Ahlawat *et al.*, 2007) [17, 12].

A comparison between several crop species has shown that chickpea is more sensitive to Zn deficiency than cereal and oil seeds (Tiwari and Pathak, 1982). Depending on soil type the critical Zn concentrations in soils vary from 0.48 mg/kg to mg/kg (Ahlawat *et al.*, 2007) [12], if Zn concentration in soil is less than 1.1 mg/kg that means soil indicated the low availability of Zn (DTPA extraction). Zn deficiency decreases crop yield and delays crop maturity. Zn deficiency reduces nodulation and nitrogen fixation (Ahlawat *et al*., 2007) [12] and according to Khan *et al.*, (2004) [17] Zn deficiency also reduces water use and water use efficiency and which contributes to reduce in crop yield. Boron which also limits chickpea productivity but it is a less important factor than Zn (Ahlawat *et al*., 2007) [12].

According to Srivastava *et al.*, (1997) some regions of acidic soils B has been shown to be a major reducer of chickpea yields. Application of B in chickpea crop responses higher in comparison with others cereals crop (Wankhade *et al.*, 1996); although differences between chickpea cultivars concerning B deficiency have also been observed (Ahlawat *et al.*, 2007) [12]. According to Ahlawat *et al.*, (2007) [12] the application of B is important when the concentration of B in the soil is less than 0.3 mg/kg. Soils have low B availability when the concentration of B in the soil is less than 0.6 mg/kg (hot water extraction and soil may have a B deficiency when the concentration in the soil is less than 0.5 mg/kg depending on the conditions i.e., the extraction time and the soil. B deficiency also causes poor podding, flower drop and subsequently chickpeas poor yields (Srivastava *et al.*, 1997) [22].

Boron may cause yield losses up to 100% (Ahlawat *et al.*, 2007) [12]. According to Sims, (2000) [20] total Molybdenum content in soil can vary from 0.2 to 5.0 mg/kg but in the soil Mo is largely unavailable, usually less than 0.2 mg/kg of Mo has been reported to be soluble (Sillanp, 1972). Ankerman and Large (1974) reported that soils have low Mo availability when the concentration of Mo in the soil is less than 0.11 mg/kg (ammonium acid oxalate). If soil have Mo deficient then chickpea produced lesser number flowers, smaller flower size and many of them fail to open or to mature and finally this leads to decreases grain yield (Ahlawat *et al*., 2007) [12]. Roy *et al.*, (2006) [18] says that Mo is directly related to N fixation by legumes. When the pH of the soil is very slight to medium acid range then the availability of Mo is very low. According to Sims (2000) [20] Mo deficiency is very common in acidic soils especially acidic soils especially in crops that are very sensitive to low concentrations of Mo such as legumes. Soil and foliar application are effective practices for the implementation of some micronutrients (Roy *et al.*, 2006) [18]. This work was conducted to determine the effect of Zn. B, Mo and Rhizobium application on growth and yield of chickpea.

Material and methods

The experiment was undertaken with the main objective to evaluate the Effect of Liquid Biofertilizer on physiological differentiation in Chickpea (*Cicer arietinum),* Cowpea *(Vigna Uungiculata L.)* and leafy vegetable Coriander (*Coriandrum sativum*). For this, pot culture experiments were conducted. Experimental plants were maintained
in pot culture. Observations on growth, physiological and biochemical parameters were recorded during crop period.

The experiment was conducted in department of Plant Physiology located at Sampoorna International Institute of Agriculture Sciences and Horticultural Technology, situated at Belekere, Channapatna. Planting material, crops like Chickpea (*Cicer arietinum),* Cowpea *(Vigna Uungiculata L.)* and leafy vegetable Coriander (*Coriandrum sativum*) plants were used for the study. The seed materials were procured from Sampoorna International Institute of Agriculture Sciences and Horticultural Technology. The experiment was laid out in CRD with nine treatments and two replications.

Procedure

After successful germination test (Plate 01) we shifted to pots, potted plants (3 plants/pot 2kg potting mixture) were used for this experiment. Plants were maintained different percentage of liquid bio fertilizers treatment. Observations were taken at biweekly intervals, till stress period of two weeks (Plate 02). Observation were taken from average of three replication

Observations: Growth Parameters

1. Number of Leaves

Total numbers of leaves in the experimental plants were counted.

2. Root Weight (g)

The roots of plants were cut at the base level and washed free of adhering soil with low jet of water. The roots were then oven dried and dry weight was recorded.

3. Dry Shoot Weight (g)

Shoot weight was measured by weighing the above ground part of the plants in a weighing balance after oven drying at 70oC.

4. Total Dry matter Production (g)

The sum of root and shoot dry weights were taken as the total dry matter yield.

Physiological and Biochemical parameters

Chlorophyll pigments (mg g-1)

Chlorophyll content of leaf samples were estimated as per the procedure described by Arnon (1949). A weighed quantity of leaf sample (0.5g) was taken from fully expanded third leaf and cut into small bits. These bits were put in test tubes and incubated overnight at room temperature, after pouring 10 ml DMSO: 80% acetone mixture (1:1 v/v). The coloured solution was decanted into a measuring cylinder and made up to 25 ml with the DMSO-acetone mixture. The absorbance was measured at 663, 645, 480 and 510nm. The chlorophyll content was measured by substituting the absorbance values in the given formulae.

$$TotalChl(a+b) = (8.02 \times A_{663} - 20.2 \times A_{645}) \times \frac{V}{1000} \times \frac{1}{fresh\,weight}$$

Specific Leaf Area (SLA) (cm2 g-1)

From each plant, fully expanded third leaf (from main stem apex) was collected. Leaflets were separated, petioles were discarded and leaf area was measured. Leaflets were dried at 800C for 2 days and the dry weight was taken. SLA was calculated using the formula.

$$SLA(cm^2/g) = \frac{leaf\ area}{dry\,weight}$$

Stomatal Frequency (no.cm-2)

Stomatal frequency refers to the number of stomata per unit area of leaf. A thick mixture of thermocol and xylene was prepared and this was smeared on both the surfaces of leaves and allowed to dry. It was peeled gently after drying and the peel was observed under microscope and counted using a 40X objective and 10X eyepiece. The field of the microscope was measured using a stage micrometre and stomatal frequency per unit area was calculated.

$$Stomatal\,frequency = \frac{Number\ of\ stomata}{Area\ of\ the\ microscopic\ field}$$

Relative Water Content

Relative water content was estimated as per Barr and Weatherly (1962) by measuring the fresh weight, turgid weight and dry weight of known number of leaf discs from the experimental plants. After measuring the fresh weight of the sample, it was submerged in distilled water for 3 hours and then the turgid weight was taken. The dry weight of the sample was measured after keeping the samples in oven at 80oC for 3 consecutive days. The RWC was calculated using the following formula.

$$RWC = \frac{Fresh\,weight - Dry\,weight}{Turgid\,weight - Dry\,weight} \times 100$$

Statistical analysis

The experiment used a CRD with three treatments and each treatment was analysed with three replications. Statistical analysis was performed using ANOVA. P values d $\leq$ 0.05 were considered as significant.

Results and discussion

The current experiment entitled Effect of Liquid Biofertilizer on physiological differentiation in Chickpea (*Cicer arietinum)*, Cowpea *(Vigna Uungiculata L.)* and leafy vegetable Coriander (*Coriandrum sativum*) was undertaken with the objective to study the effect of biofertilizer on cowpea, chickpea and coriander under varying different biofertilizer percentages. Three sets of pot culture experiments were conducted during 2020. The experiments were laid out in CRD factorial.

Alteration in growth performance of cowpea, chickpea and coriander under the studied by treatment of liquid biofertilizers analyzing the parameters viz leaf number, leaf area, shoot weight, root weight and dry matter accumulation were significantly increasing (Fig 01).

In this study highest values of growth parameters (Table1,2 and 3) were recorded in T8BL8 cowpea, chickpea and coriander for number of leaves per plant (11.37, 15.38 and 11.54), Plant height (20.56, 23.46 and 12.37 cm), root length (12.65, 19.38 and 4.35 cm), shoot length (11.58, 13.26 and 11.16 cm), total fresh weight (30.56, 21.34 and 32.54 g/plant) and total dry matter production (8.36, 6.82 and 10.89 g) Fig 01, 02 and 03), germination percentage (90.81, 91.81 and 93.81 %) (Fig 04) was also observed under different percentage of liquid biofertilizers. In cowpea, chickpea and coriander, highest values in biochemical parameters were recorded for total chlorophyll content (1.65, 2.61 and 2.58 mg g-1), Specific leaf area (486.89, 198.85 and 3677) (Fig 05), stomatal frequency (2811.29, 126.06 and 64.19 cm-2) (Fig 06) and relative water content (85.24, 67.73 and 87.92 %) (Fig 07 and 08) (Table 4). Among the different crops chickpea responded better under low concentration in T8BL8 treatment.

Native rhizobium pseudomonas co-inoculation as compared to single rizobium inoculation increased growth and nodulation *Phaseolus vulgaris* under field conditions (Sanchez *et al.*, 2014). The usefulness of band application since lesser quantity produced better results compared to more quantity of nutrient applied as brodcast reported by Dutta and Bandyopadhyay (2009) [26] and increased HI in chickpea for micro nutrient application.

All the components jointly consist of many stimulants substances and sources of promoter hormones which had positive and beneficial effects on improving the vegetative growth of plants. In this concern other investigators found increment and enhancement in some growth characters of chickpea plants due to the application of macro elements NPK biofertilizer included PSB (Dutta and Bandyopadhyay 2009) [26] as well as NSB and yeast fungi. Increase of yield due to application of fertilizer influenced significantly the growth attributes modulation yield components, seed and straw yields of chickpea. This could be most probably that stimulated the nodulation more through its effects on Bacteria than on the host (Dutta and Bandyopadhyay 2009) [26].

Biofertilizers as to replace part of the use of chemical fertilizers reduce amount and cost of chemical fertilizers (Abou Aly *et al.*, 2016). Bradyorhizobium is the value root Bacteria, due to their ability to alter atmospheric N into a useful form in association with legume plants (Weir, 2002). Therefore, the main target of this study was to evaluate the possibility of using biofertilizers for maintaining higher growth, productivity and yield quality of cowpea. Application of different biofertilizers like Rhizobium and PSB as well as mycorrhiza fungi exhibited positive influence on seed and stover yields of chickpea (Kumar *et al.*, 2002) [3].

Since the available P in soil was low. PSB might helped in reducing P fixation by its chelating effect and also solubilized the fixed form of P leading to more uptake of nutrients and the same was reflected in better growth and yield attributes. Similar findings were also reported by Dutta and Bandyopadhyay (2009) [26]. Favorable effects of inoculation with N2 fixation and phosphate solubilizing microorganisms and significant increase in nodulation, N2 fixation and yield of legume crop have been reported by Khan *et al.*, 1998 [17]. Nitrogen uptake was higher in biofertilizer applied treatment positive effect in soybean. Increased availability of P by PSB facilities better N and K utilization. Most arable and horticultural crops, an adequate supply of N is the main key to yield. It is the main component of plant amino acids, nucleic acid and chlorophyll, and is usually acquired by plants in greater quantity from the soil than any other element. N is the most widely used fertilizer nutrient and its consumption has increased substantially in recent decades (Pathak *et al.*, 2006) [8].

Table 1: Effect of liquid biofertilizer effect on physiological growth parameters under different percentage in cowpea.

Treatments	Number of leaves	Plant height	Root length	Shoot height	Total plant biomass	Total dry weight	Germination %
T1LB1 Control	10.25	11.26	6.89	10.35	28.65	7.34	81.26
T2LB2(Soil+10% Liquid Biofertilizer)	9.86	19.68	7.39	10.75	29.31	7.59	83.37
T3LB3(Soil+20% Liquid Biofertilizer)	10.32	19.79	7.56	10.78	29.46	7.63	85.12
T4LB4(Soil+30% Liquid Biofertilizer)	10.26	20.12	7.58	10.89	29.38	7.68	83.56
T5LB5(Soil+40% Liquid Biofertilizer)	11.01	19.98	7.59	11.27	29.56	7.88	89.15
T6LB6(Soil+50% Liquid Biofertilizer)	10.57	20.12	7.48	11.29	30.12	7.98	87.21
T7LB7(Soil+60% Liquid Biofertilizer)	10.35	20.36	7.55	11.31	30.21	8.12	90.31
T8LB8(Soil+70% Liquid Biofertilizer)	11.37	20.56	12.65	11.58	30.56	8.36	90.81
T9LB9(Soil+80% Liquid Biofertilizer)	11.11	20.13	12.30	11.38	30.58	8.22	81.45
T10LB10(Soil+90% Liquid Biofertilizer)	10.95	20.05	12.37	11.39	30.48	8.13	84.32
CD (0.05)	1.318	0.004	0.003	1.215	1.635	1.013	1.265
SE± (m)	0.444	0.001	0.001	0.346	0.536	0.236	0.368
SE± (d)	0.627	0.002	0.001	0.562	0.836	0.457	0.278

Significant differences at CD (0.05), Replication-3, T- Treatment

Table 2: Effect of liquid biofertilizer effect on physiological growth parameters under different percentage in chickpea 20 DAS.

Treatments	Number of leaves	Plant height	Root length	Shoot length	Total plant biomass	Total dry weight	Germination %
T1LB1 Control	13.54	8.26	13.65	9.85	20.38	4.35	82.26
T2LB2(Soil+10% Liquid Biofertilizer)	10.65	10.68	15.36	8.36	18.21	3.46	84.37
T3LB3(Soil+20% Liquid Biofertilizer)	11.03	15.25	16.89	8.45	17.38	3.21	86.12
T4LB4(Soil+30% Liquid Biofertilizer)	11.56	18.56	15.23	9.01	16.76	3.46	84.56
T5LB5(Soil+40% Liquid Biofertilizer)	12.38	21.35	18.65	10.82	16.98	3.89	88.15
T6LB6(Soil+50% Liquid Biofertilizer)	12.59	22.25	13.87	9.98	17.13	4.01	89.21
T7LB7(Soil+60% Liquid Biofertilizer)	13.89	22.51	18.73	9.31	17.48	4.16	91.31
T8LB8(Soil+70% Liquid Biofertilizer)	15.38	23.46	19.38	13.26	21.34	6.82	91.81
T9LB9(Soil+80% Liquid Biofertilizer)	15.13	22.32	15.36	10.13	16.83	4.13	82.45
T10LB10(Soil+90% Liquid Biofertilizer)	15.11	22.14	15.01	9.71	17.98	3.78	83.32
CD (0.05)	1.318	0.004	0.003	1.215	1.635	1.013	1.265
SE± (m)	0.444	0.001	0.001	0.346	0.536	0.236	0.368
SE± (d)	0.627	0.002	0.001	0.562	0.836	0.457	0.278

Significant differences at CD (0.05), Replication-3, T- Treatment

Table 3: Effect of liquid biofertilizer effect on physiological growth parameters under different percentage in Coriander.

Treatments	Number of branches	Plant height (cm)	Root length (cm)	Shoot height (cm)	Total plant biomass (gm)	Total dry weight (gm)	Germination %
T1LB1 Control	8.18	8.26	2.65	7.36	26.34	7.28	84.26
T2LB2(Soil+10% Liquid Biofertilizer)	7.82	9.68	2.38	8.91	27.38	8.33	86.37
T3LB3(Soil+20% Liquid Biofertilizer)	8.20	9.82	2.46	8.83	27.56	8.46	88.12
T4LB4(Soil+30% Liquid Biofertilizer)	8.36	9.78	3.02	9.23	29.18	7.38	86.56
T5LB5(Soil+40% Liquid Biofertilizer)	8.48	9.64	2.49	9.48	29.34	7.86	89.15
T6LB6(Soil+50% Liquid Biofertilizer)	9.26	10.18	3.46	9.76	30.22	8.41	89.21
T7LB7(Soil+60% Liquid Biofertilizer)	9.51	10.42	3.84	10.21	31.27	8.92	92.31
T8LB8(Soil+70% Liquid Biofertilizer)	11.54	12.37	4.35	11.16	32.54	10.89	93.81
T9LB9(Soil+80% Liquid Biofertilizer)	9.60	10.36	3.92	10.38	31.02	9.29	84.45
T10LB10(Soil+90% Liquid Biofertilizer)	9.23	10.42	3.98	10.42	29.13	9.64	82.32
CD (0.05)	1.318	0.004	0.003	1.215	1.635	1.013	1.265
SE± (m)	0.444	0.001	0.001	0.346	0.536	0.236	0.368
SE± (d)	0.627	0.002	0.001	0.562	0.836	0.457	0.278

Significant differences at CD (0.05), Replication-3, T- Treatment

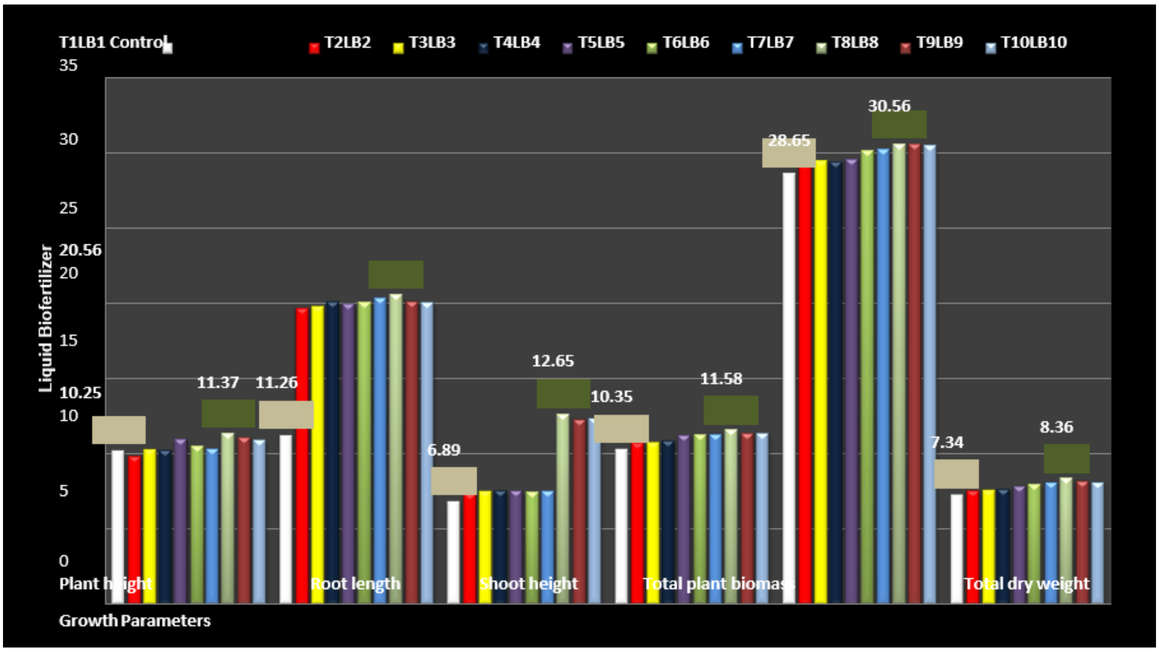

Fig 1: Effect of liquid biofertilizer effect on physiological growth parameters under different percentage in cowpea

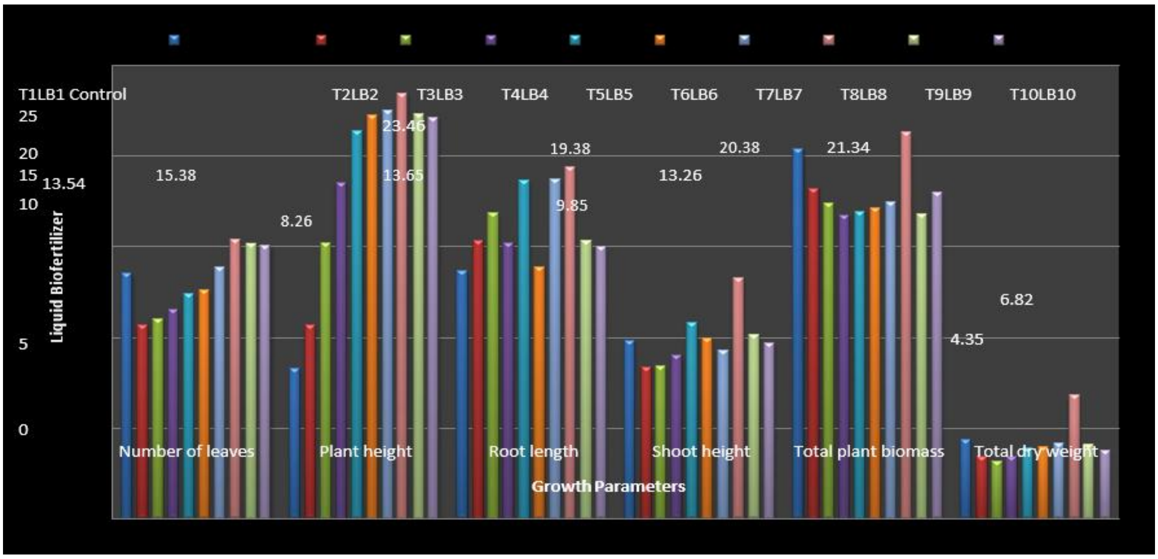

Fig 2: Effect of liquid biofertilizer effect on physiological growth parameters under different percentage in chickpea 20 DAS

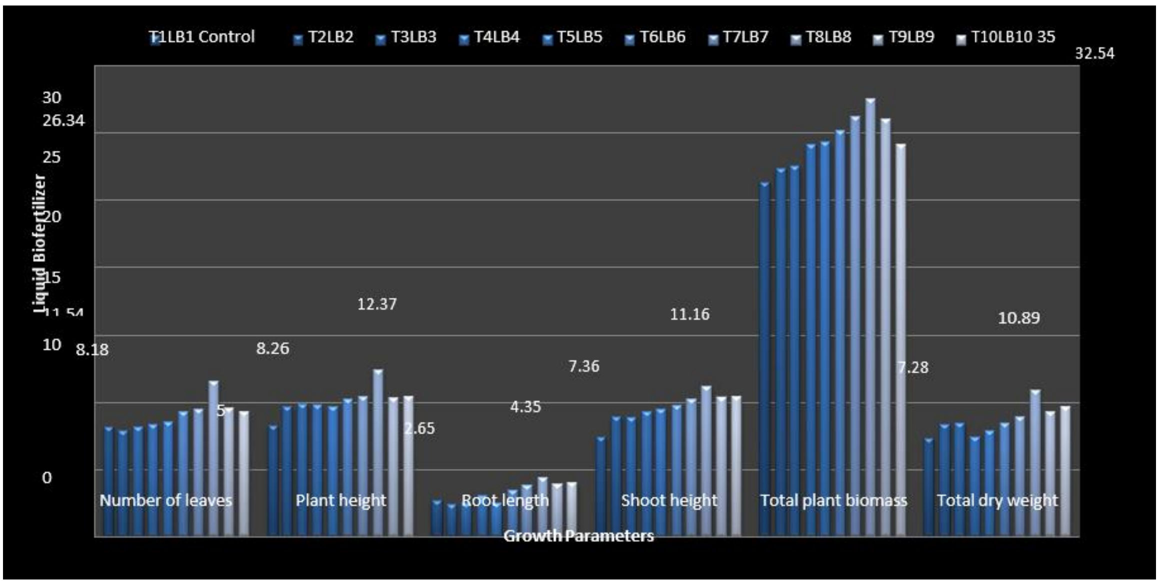

Fig 3: Effect of liquid biofertilizer effect on physiological growth parameters under different percentage in Coriander.

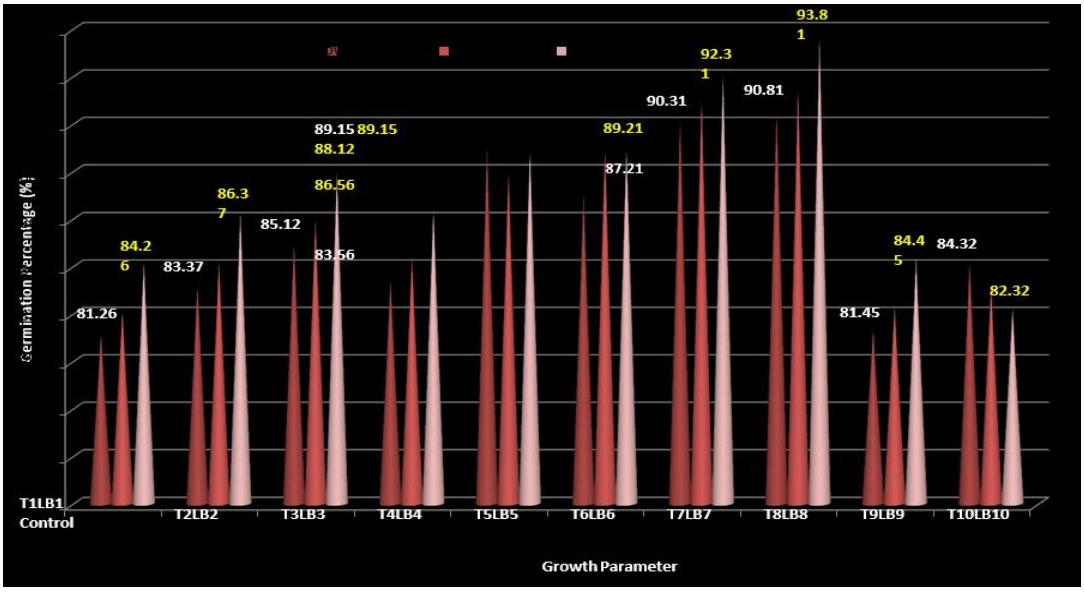

Fig 4: Effect of liquid biofertilizer effect on germination in cowpea, chickpea and coriander

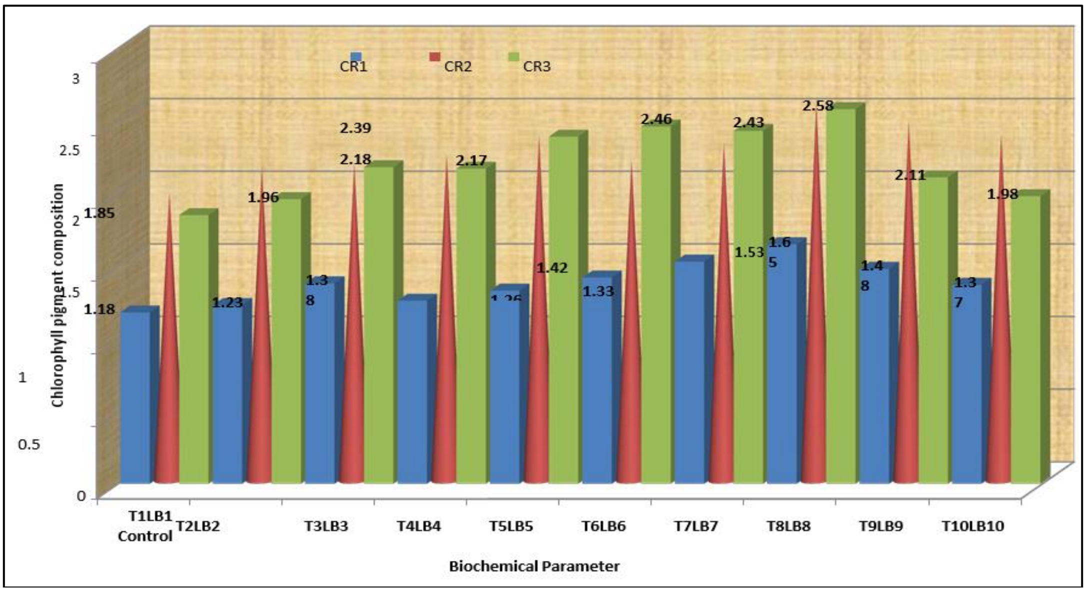

Fig 5: Effect of liquid biofertilizer effect on Chlorophyll pigment composition under different percentage in Cowpea CR1, Chickpea CR2 and Coriander CR3.

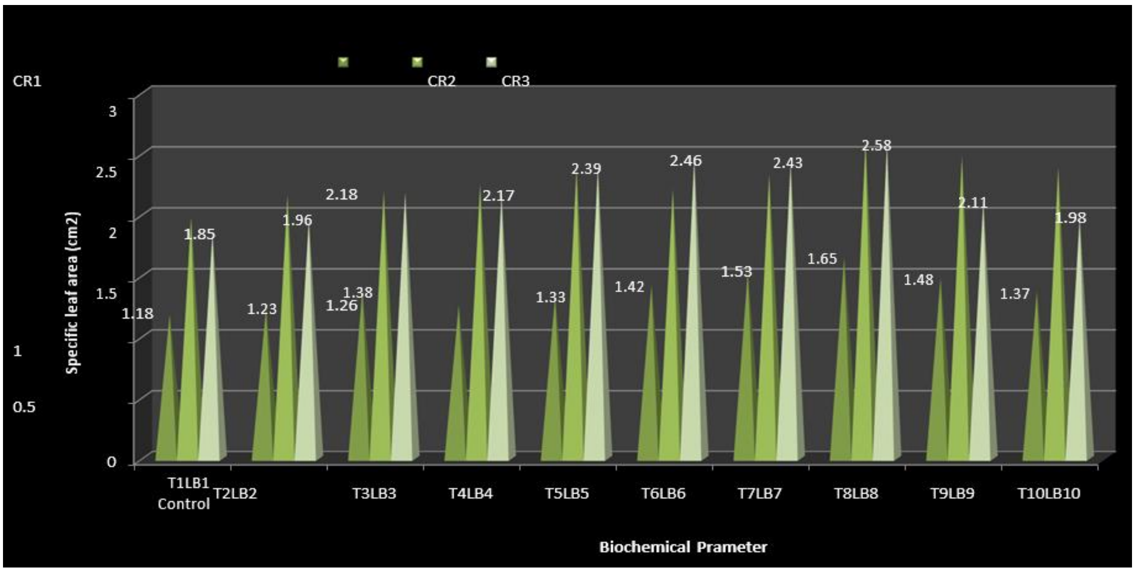

Fig 6: Effect of liquid biofertilizer effect on Specific leaf area (cm2) under different percentage in Cowpea CR1, Chickpea CR2 and Coriander CR3.

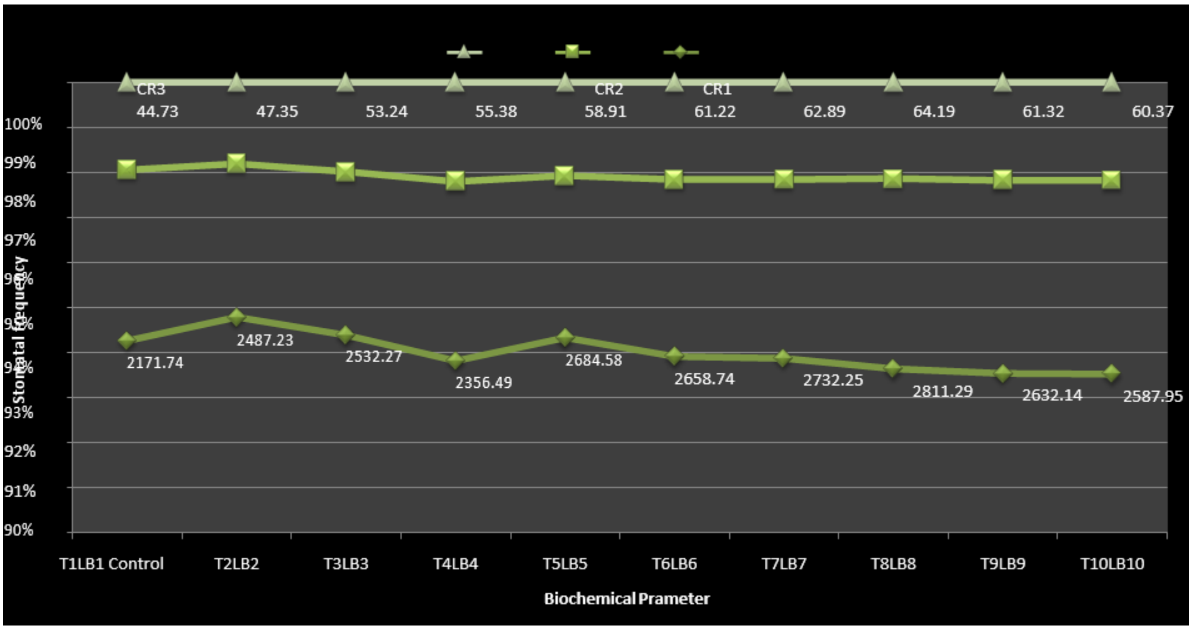

Fig 7: Effect of liquid biofertilizer effect on Stomatal frequency under different percentage in Cowpea CR1, Chickpea CR2 and Coriander CR3.

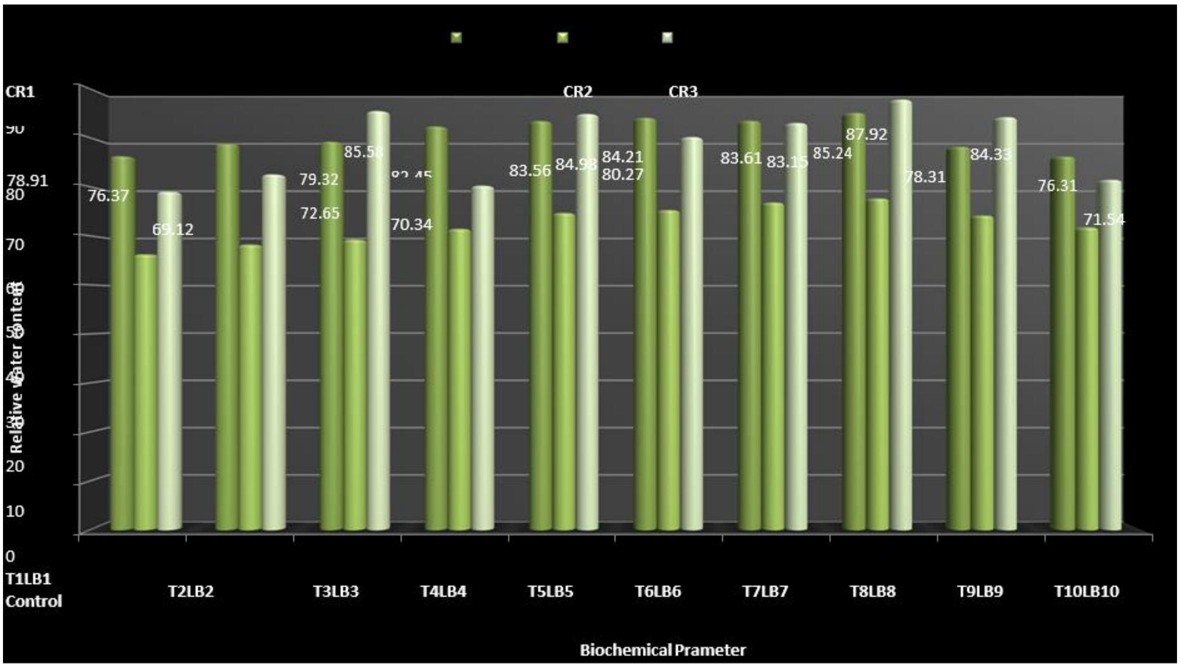

Fig 8: Effect of liquid biofertilizer effect on Relative water content under different percentage in Cowpea CR1, Chickpea CR2 and Coriander CR3.

Plate 1: Effect of liquid biofertilizer effect on physiological growth under different percentage

Plate 2: Effect of Liquid Biofertilizer on seed Germination Petri plates and pot filling preparation

Conclusion

Biofertilizers being essential components of organic farming play a vital role in maintaining long term soil fertility and sustainability by fixing atmospheric di-nitrogen, mobilizing fixed macro and micro nutrients in the soil into forms available to plants. Currently there is a gap of ten million tons of plant nutrients between removal of crops and supply through chemical fertilizers. In context of both the cost and environmental impact of chemical fertilizers, excessive reliance on chemical fertilizers is not practicable in the long run because of the cost, both in domestic resources and foreign exchange involved in setting up of fertilizer plants and sustaining the production. In this context, biofertilizers would be the viable option for farmers to increase productivity per unit area. In conclusion after all the analysis study revealed that application of biofertilizer along with micronutrients upto second level gave maximum result in most of the parameters.

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