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RESEARCH ARTICLE

Evaluation of Newly Formulated Biostimulant on Improving Productivity of Chilli (*Capsicum Annuum*)

A. Balamurugan*, J. Thambiraj, M. Mullaiventhan, Murugesh Murugan, P. Prakash, K. Sree Vasan, K.Vinoth

Postgraduate and Research Department of Botany, The American College, Madurai 625002, Tamilnadu, India

ABSTRACT

Agriculture provides continuous supply of vegetables and fruits. Chilli is one among the vegetables which is consumed by all people from all parts of the world. Production of chilli meets the demand and supply gradually due to lack of higher yield. In this scenario, the biostimulant quench the thrust and make up the productivity higher to supply huge quanitiy. Biostimulants are natural or synthetic substances that can be applied to seeds, plants, and soil. These substances cause changes in vital and structural processes in order to influence plant growth through improved tolerance to abiotic stresses and increase seed and/or grain yield and quality.

The present study was designed to evaluate a newly formulated biostimulant on increasing the productivity of chilli. This biostimulant contains a mineral extract of natural compounds based powder formulation as a broad spectrum plant protector. The formulation has growth regulators and plant nutrients with NPK the primary and S, Ca, Mg secondary macro nutrients. Trace amounts of iron and copper are also included. Among the four dosages tested (1g, 2g, 3g and 4g in one litre of water), proved that increased the yield and biometric values. While the concentrations of biostimluant increased will influence the gradual yield improvement of chilli in both pot and field experiments. Since the cost of biostimulant plays major role in farmer's economy point of view, the optimum dose 2g / Litre of water could be considered for recommendation for availing the higher yield of chilli.

Keywords: biostimulant, chilli, productivity, biometric values

1. INTRODUCTION

Agriculture is the backbone of human civilization, encompassing the cultivation of crops, livestock rearing, and the management of natural resources to produce food, fibers, and raw materials. The Chilli plant, scientifically known as *Capsicum annuum*, is a member of the nightshade family Solanaceae. Chilli plants thrive in warm climates with well-drained soil and plenty of sunlight [11]. They are relatively easy to grow, making them popular among other crops. Besides their culinary use, Chilli peppers have been associated with various health benefits due to their high content of vitamins, minerals, and capsaicin, the compound responsible for their heat [8]. The yearly productivity of Chilli in India varies due to several factors. Understanding soil types, composition, and their interactions with crops is crucial for sustainable and productive agriculture [9]. Issues like erosion, nutrient depletion, and soil degradation highlight the importance of preserving and improving soil quality for long-term agriculture success [1]. Some of the factors are directly influencing the balancing and maintaining the sustainability of soil.

A plant Bio-stimulant is any substance or microorganism, in the form in which it is supplied to the user, applied to plants, seeds or the root environment with the intention to stimulate natural processes of plants benefiting nutrient use efficiency and/or tolerance to abiotic stress [2] regardless of its nutrient content, or any combination of such substances and/or microorganisms intended for this use" The bio-stimulants are those products which reduces a plants requirement of nutrients and fertilizers [1]. Many definitions of bio stimulants have been reported [16]. By the application of Bio-stimulants the plant uses the low available nutrients efficiently, so as that there is no requirement of fertilizer application. These Bio- stimulants serve a great purpose and ensure the agricultural sustainability in those areas which possess agricultural lands with less availability of nutrients [15]. These products when applied at low

*Correspondence: A. Balamurugan, Postgraduate and Research Department of Botany, The American College, Madurai 625002, Tamilnadu, India. E.mail: balamurugan@americancollege.edu.in

concentrations are pretty much beneficial to the plant but, when applied in high concentration there will be noticeable fatality responses shown by the plants [7].

The present study was designed to evaluate a newly formulated biostimulant on increasing the productivity of chilli. This biostimulant contains a mineral extract of natural compounds based powder formulation as a broad spectrum plant protector. The formulation has growth regulators and plant nutrients with NPK the primary and S, Ca, Mg secondary macro nutrients. Trace amounts of iron and copper are also included. There are four dosages planned to test (1g, 2g, 3g and 4g in one liter of water), at pot and experiment level. In order to consider for recommendation for availing the higher yield of chilli.

2. MATERIALS AND METHODS

2.1 *Field and Pot experiment*

A commercial grade of biostimulant was procured from vin lab mysore Karnataka .A newly formulated biostimulant on increasing the productivity of chilli. This biostimulant contains a mineral extract of natural compounds based powder formulation as a broad spectrum plant protector. The formulation has growth regulators and plant nutrients with NPK the primary and S, Ca, Mg secondary macro nutrients. Trace amounts of iron and copper are also included.

We selected 20 cent plot of chilly field for conducting experiment area located in Thirumangalam taluk , T kunnathur village Madurai district, Tamil nadu. We divided that plot in to five plots. A single plot carried 2 cents (10 plants). We named that plot into plot A, plot B, plot C, plot D, plot E. Then a pot mixture was prepared by the composition of Garden soil: Red soil: Sand in the ratio of 2:1:1. Vermicompost and humus were added were added to this pot mixture. The above soil mixture was prepared and removed the small stones and sieved well. After adjusting the soil pH, the mixture was filled in the grow bags as per treatment scheduled in the experiment. There are 7 numbers of treatments each replicated five times. Each pot was planted with two number of chilli seedlings and experiment was started. The following treatments were undertaken to carry out the experiments

Various concentration of Bio stimulant were taken for this study and they were evaluated at 1g/l, 2g/l, 3g/l, 4g/l of water as four different dosages in chilly field for its efficacy on yield, disease and pest control

2.2 Observation of Parameters

The biometric and biochemical data were taken and the mean values of replicated plots are given in the tables and figures. At end of the experiments, the height of the plant, leaf area, number of leaves per plant, number of flowers per plant, fruit weight per plant, single fruit weight, shoot fresh and dry weight, root fresh and dry weight, yield per plot, Chlorophyll estimation and Protein estimation Lowry et al (1979).

3. RESULTS AND DISCUSSION

3.1 Observation of Plant Biometric Parameters of Pot Experiment

At the end of the experiment the plant biometric parameters were measured and recorded such as height (Stem and Root), fresh weight (Stem and root), dry weight (Stem and Root), number of leaves per plant, Leaf area, number of buds per plant, number of flowers per plant, Number of fruits per plant, and fruit Length. The results showed the plant biometric parameters (vegetative) of pot experiment; the plants which were maintained in the control soil they had 26cm stem height and 5cm of root height. Then the plant root and stem portion cut down the both are weighted for fresh weight the fresh weight of the root portion is 3.2g and the stem 15g, then it was kept incubated in hot air oven to take the dry weight, the dry weight of stem portion is 5.6g and the weight root portion is 0.50g (Table 1) and the average of the leaves per plot is 45 and the leaf size is (6×3). Also the same trend of observation was given by [14). Similar results were noticed in the present study and our findings were substantiated with their publication [5].

The plants which are all maintained in 1g bio stimulant treated with liquid, the height of the stem 33cm and height of the root 09cm. then the root and stem portion will be weighted for fresh weighted the fresh weight of stem is 21g and the fresh weight of root portion is 5.4g then it will be dries in incubator after that the dry weight will be get the dry weight of stem 6.1g and the dry weight of root is 0.68g (Table 1). The total number of leaves per plants in the treatment is 48, and the leaf size (7x 3.4). The plants which are all maintained in 2g bio stimulant, the height of the stem 38cm and height of the root 11cm. then the root and stem portion will be weighted for

fresh weighted the fresh weight of stem is 25g and the fresh weight of root portion is 5.8g then it will be dries in incubator after that the dry weight will be get the dry weight of stem 7.4g and the dry weight of root is 1.24g [11]. The total number of leaves per plants in the treatment is 38, and the leaf size (7x 3.4). The plants which are all maintained in the 3g bio stimulant they have, the height of the stem 42cm and height of the root 14cm (Table 1). then the root and stem portion will be weighted for fresh weighted the fresh weight of stem is 31g and the fresh weight of root portion is 6g then it will be dries in incubator after that the dry weight will be get the dry weight of stem 7.9g and the dry weight of root is 1.37g. The total number of leaves per plants in the treatment is 18, and the leaf size (8x3.5).

We observed the growth parameter of the plants in chilly field. The parameters like plantlets per bunch, height of the plant, number of leaves, width of the leaf, fresh weight, dry weight, weight of seed (100) & weight of the total seed.

First application of bio stimulant was given on thirty days old chilly plants. Totally three rounds of application was implemented keeping 15 days interval. The plants were uprooted after two months from third spraying of bio stimulant and respective biometric parameters were noted and tabulated. They can act on plant productivity as a direct response of plants or soils to the bio stimulant application or an indirect response of the biostimulant on the soil and plant microbiome with subsequent effects on plant productivity [17] proposed the following definition of a bio stimulant as a formulated product of biological origin that improves plant productivity because of the novel or emergent properties of the complex of constituents; and not as a sole consequences of the presence of known essential plant nutrients, plant growth regulators, or plant protective compounds. Several researches have been developed in order to evaluate the use of bio stimulants in improving plant growth subjected to abiotic stresses [13].

In small concentrations, these substances are efficient, enhancing nutrition efficiency, abiotic stress tolerance, and/or crop quality traits, regardless of its nutrients content [10]. These substances when applied exogenously have similar actions to the groups of known plant hormones, whose main ones are auxins, gibberellins, and cytokinins [8]. In the plants which are all maintained in 1g bio stimulant, they are produce a 2 buds and 6 flowers, and also have 2 fruits and the fruit have a 2.1cm length and 1.4g weight.(Table 2). In the plants which are all maintained in 2g bio stimulant, they are produce a 5 buds and 9 flowers, and also have 9 fruits and the fruit have a 2.5cm length and 2.7g weight.(Table 2). In the plants which are all maintained in 3g bio stimulant, they are produce a 7 buds and 10 flowers, and also have 10 fruits and the fruit have a 3.8cm length and 3.3g weight.(Table 2). And the plants which are all maintained in 4g bio stimulant, they are produce a 7 buds and 10 flowers, and also have 14 fruits and the fruit have a 4.1cm length and 3.5g weight. Similar trend was observed and substantiated the present findings by [18].

3.2 Observation of Plant Biometric Parameters of Field Experiment

Results showed the plant biometric parameters (vegetative) of field experimented, in the table the plants which are all maintained in the control soil they have a 11cm stem height and 7cm of root height. Then the plant root and stem portion cut down the both are weighted for fresh weight the fresh weight of the stem portion is 10.7g and the root 1.9g, then it will be incubated to take the dry weight, the dry weight of stem portion is 4.01g and the weight root portion is 0.34g and the average of the leaves per plot is 30.0 and the leaf size is (5×3). (Table 3). Also the same trend of observation was given by [13]. Similar results were noticed in the present study and our findings were substantiated with their publication. The plants which are all maintained in 1g bio stimulant, the height of the stem 15cm and height of the root 9cm. then the root and stem portion will be weighted for fresh weighted the fresh weight of stem is 13.5g and the fresh weight of root portion is 2.3g then it will be dries in incubator after that the dry weight will be get the dry weight of stem 0.54g and the dry weight of root is 0.54g. The total number of leaves per plants in the treatment is 35, and the leaf size (5x3.2). Similar results were observed by [12].

The plant biometric parameters (Reproductive) also measured in the field experiment plants, such as a Number of buds plant, Number of flower per plant, Number of fruits per plant, Fruit Length, Fruit weight (Table 4). In the plants which are all maintained in the control field soil mixture they are produce a 2 buds and 4 flowers, and also have 2 fruits and the fruit have a 1.9cm length and 1.7g weight, total production by this plot 106.4g and per acre 6250kg. In the plants which are 1g bio stimulant they

produced 5 buds and 7 flowers, and also have 3 fruits and the fruit have a 2.0cm length and 2.3 g weight. Total production by this plot 119.5g and per acre 6980kg (Table 4).Same trend of observations also were noticed by [3,6].

In the plants which are all maintained in 3g bio stimulant, they are produced10 buds and 12 flowers, and also have 6 fruits and the fruit have a 3.0cm length and 3.4g weight, total production by this plot 165.0g and per acre 8055kg,(Table 4).In the plants which are all maintained in 4g bio stimulant, they are produce a 13 buds and 15 flowers, and also have 9 fruits and the fruit have a 3.2 cm length and 4.1g weight, total production by this plot 179.5g and per acre 8250kg. (Table 4). They proved their results as like that of these present observations in the chilli crop [8].

3.3 Chlorophyll and Protein Estimation

In the pot experiment plants both chlorophyll and protein contents were estimated, by the result of this estimation the chlorophyll a, b is combined together and get a finally total value of chlorophyll content. In the result of chlorophyll estimation shows the amount of chlorophyll content of each plant which is all maintained and treated bio stimulant (Fig.1). They proved their results as like that of the present observations in the Chilli crop [6]. Chlorophyll content was observed in field experiment (Fig 2) was as like that of trend which received in pot experiment as like that of finding by [17].

In the chlorophyll and protein estimation in pot experimented plants are given values such as the plant which was given with 2g of biostimulant per litre of water provided satisfactory results of chlorophyll content in both pot and field experiments (Fig 3). The optimum dose of biostimulat registered satisfactory results on chlorophyll and protein content of Chilli plant, this result was substantiated by [5].

Table 1: Effect of biostimulant on biometric parameters (vegetative) of chilli plants under pot experiment

Treatment	Height (cm)		Fresh Weight (g)		Dry Weight (g)		No. of leaves per plant	Leaf area
	Shoot	Root	Shoot	Root	Shoot	Root		
Control	26	05	15	3.2	5.6	0.50	12	6x3
1g bio stimulants/l	33	09	21	5.4	6.1	0.68	14	7x3.4
2g bio stimulants/l	38	11	25	5.8	7.4	1.24	15	7x4.1
3g bio stimulants/l	42	14	31	6.3	7.9	1.37	18	8x3.5
4g bio stimulants/l	48	18	35	6.9	8.5	1.48	23	8x4.8

Values are mean of three replicates

Table 2: Influence of biostimulant on Chilli biometric parameters (reproductive) under pot experiment

Treatment	No. of buds per plant	No. of flowers per plant	No. of fruits	Fruit length (cm)	Fruit weight (g)
Control	02	06	2	2.1	1.4
1g bio stimulants/l	04	07	5	2.5	2.2
2g bio stimulants/l	05	09	9	3.5	2.7
3g bio stimulants/l	07	10	10	3.8	3.2
4g bio stimulants/l	07	18	14	4.1	3.5

Values are mean of three replicates

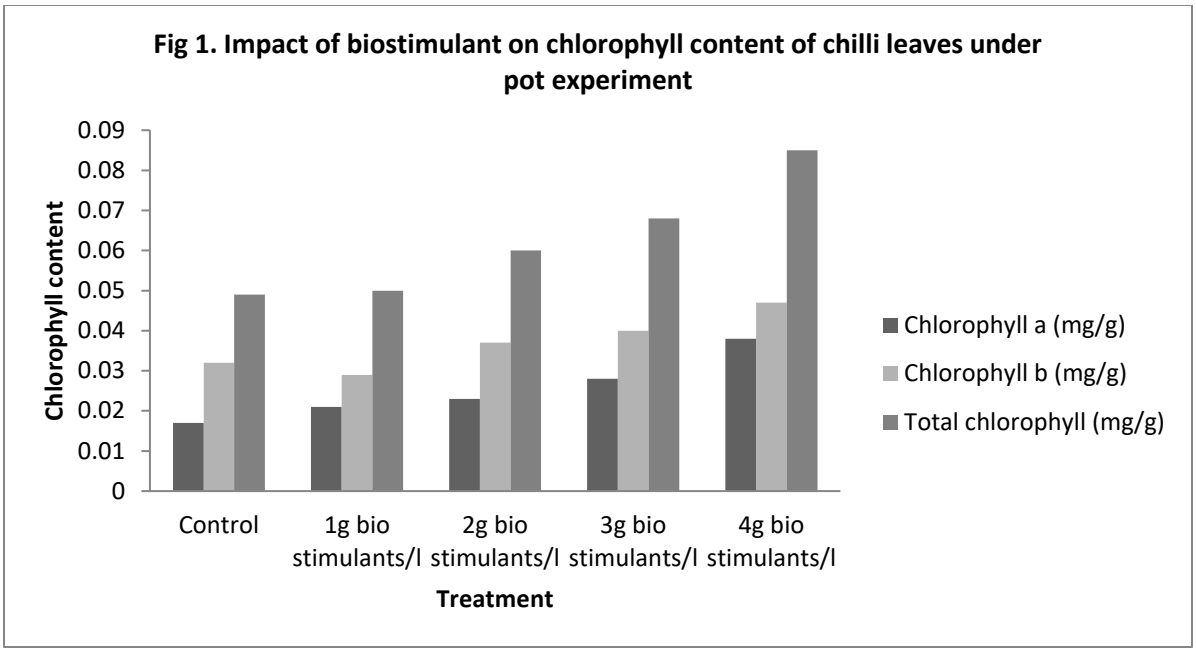


Table 3: Effect of bio stimulants on biometric parameters (vegetative) of Chilli under field experiment

Treatment	Height (cm)		Fresh Weight (g)		Dry Weight (g)		No. of leaves per plant	Leaf area (L×B) cm
	Stem	Root	Stem	Root	Shoot	Root		
Control	11	7	10.7	1.9	4.01	0.34	30.0	5×3
1g bio stimulants/l	15	9	13.5	2.3	5.09	0.54	35.5	5×3.2
2g bio stimulants/l	19	12	17.5	2.8	5.06	0.88	45.5	5.6×3.4
3g bio stimulants/l	25	14	20.7	2.0	7.72	0.91	50.5	7×3.5
4g bio stimulants/l	28	17	21.5	3.2	6.62	1.86	54.5	8.7×5.1

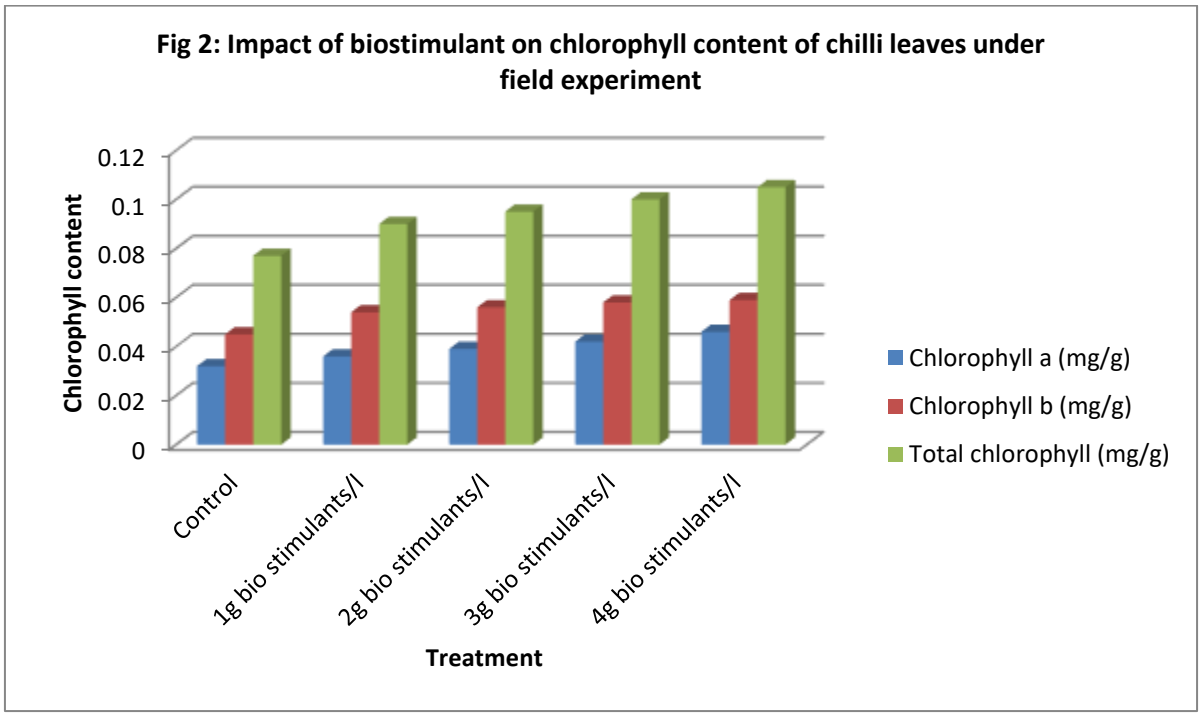
Values are mean of three replicates

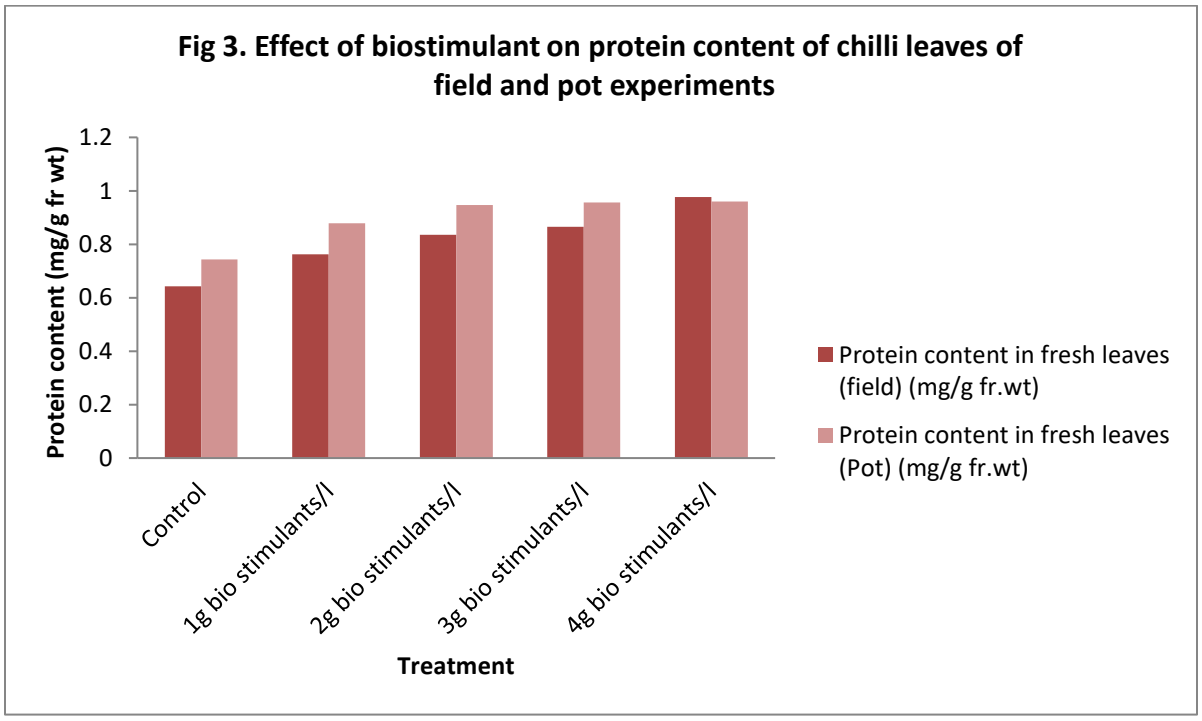
Table 4: Effect of bio stimulants on biometric parameters (reproductive) of Chilli under field experiment

Treatment	No. of buds per plant	No. of flowers per plant	No. of fruits Per plant	Fruit length (cm)	Single fruit weight (g)	Yield per plot (g)	Yield per acre (Kg)
Control	2	4	2	1.9	1.7	106.2	6250
1g bio stimulants/l	5	7	3	2.0	2.3	119.5	6980
2g bio stimulants/l	8	10	5	2.8	2.9	135.5	7850

3g bio stimulants/l	10	12	6	3.0	3.4	165.0	8055
4g bio stimulants/l	13	15	9	3.2	4.1	179.5	8250

Values are mean of three replicates





4. CONCLUSION

The present study concluded that a newly formulated biostimulant proved its influence on increasing the productivity of chilli. Since it contains the required mineral content, it fulfills the maximum supplement of crop energy and increasing the biometric values.

Among the four dosages tested (1g, 2g, 3g and 4g in one litre of water), proved that increased the yield and biometric values. While the concentrations of biostimluant increased will influence the gradual yield improvement of chilli in both pot and field experiments. Since the cost of biostimulants plays major role in farmer's economy point of view, the optimum dose 2g / Litre of water could be considered for recommendation for availing the higher yield of chilli.

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