

## Effects of different foliar applications and soil applied fertilizers on growth and yield of *Vigna radiata* L.

Shadeeka Sandeepani, Somasundaram Sutharsan, Shanmugalingam Srikrishnah

Department of Crop Science, Faculty of Agriculture, Eastern University, Vantharumulai, Sri Lanka

### Abstract

Foliar application is method of providing supplementary dosages of minor and major nutrient, plant hormones, and other beneficial elements to plant. Fruit tonic, Jeewamirtha and Maxicrop™ are organic liquid fertilizers. A polybag experiment was conducted at the Crop Farm, UCIARS, Hambanthota in Sri Lanka to identify the Effects of Different Foliar Applications and Soil Applied Fertilizers on Growth and Yield of *Vigna radiata* L. The experiment was laid out in Factorial Randomized Complete Block Design with six treatments and six replicates. The treatments were F1M1, F1M2, F1M3, F2M1, F2M2, and F2M3 tested their performance on the growth and yield of *Vigna radiata* L. The crop performance was recorded from two weeks after planting (WAP) to eight WAP. Among the treatments, both treatments which F1M1 (Maxicrop™ foliar application with soil applied DOA fertilizer) and F1M2 (Maxicrop™ foliar application with soil applied Jeewamirtha) significantly increased growth and yield of *Vigna radiata* L. The interaction effect between foliar application and soil applied fertilizer also significantly increased plant height, mean number of leaves, number of branches per plant, fresh weight of shoot, fresh weight of root, number of flowers and number of pods per plant, number of root nodules, number of seeds and 100 seeds weight and total yield per plant in comparison to other treatments. In the overall performance, application of Maxicrop™ produce higher result compared to the foliar application of fruit tonic. This might be due to presence of macro and micronutrients as well as growth promoting substances like IAA, GA and Cytokine in Jeewamirtha and maxi crop. From the findings it could be concluded that, application of soil applied Jeewamirtha with Maxicrop™ could be recommended for green gram cultivation as an environmentally friendly practice to improve growth and yield.

**Keywords:** Foliar application, soil application, Maxicrop™, jeewamirtha, fruit tonic

### Introduction

Increasing world population and their consumption requirements are placing extraordinary demands on agriculture. Nowadays most farmers are using an exorbitant number of agrochemicals and synthetic fertilizers to increase the growth and yield. And recent crop practices using heavy doses of pesticide, fungicides, and herbicides. They have killed soil life and increase non-communicable disease in humans. There are several environmental issues like soil carbon storage, water pollution and Eutrophication. To build up environment sustainable crop production plays a very important role [1]. Sustainable agriculture is very important optional to prohibit poverty and hunger at the same time as improving the environmental performance of agriculture. The green gram is a leguminous crop, valued for its seed and it is economically important due to its nutritional value that has the potential to improve food security. Organic agriculture is a way of farming sustainably and has Global data on organic production and markets are therefore of high relevance for policy makers and contribute to understanding the importance of organic farming in the different countries [2]. The Jeewamirtha also comes under the low-cost organic fertilizer formulation which is responsible for soil enrichment with indigenous microorganisms, necessary for better soil mineralization and helps to improve plant growth[3]. Compost is known as the slow-release nutrient source of macronutrient and micronutrient to the soil. Most farmers apply compost based on plant required Nitrogen (N) or phosphorous (P) rates, compost also serve as a source of Potassium (K), sulfur (S),

Calcium (Ca) and Magnesium (Mg) [4]. Seaweed extract is used as an alternative nutritional supplement, bio stimulant or bio fertilizer in agriculture and horticulture to increase the plant growth and yield [5]. Algae extracts are now commercially available under various brand names such as Maxicrop™ [6]. Seaweeds contain all the trace elements and plant growth regulators, such as Auxins, Gibberellins, and Cytokinin, they accelerate the metabolic activities of plants and increase and improving productivity of crops [7]. Plant tonic is an environmentally friendly product [8]. Fruits contain a high number of antioxidants that are beneficial to our health in different ways. The culture prepared here contains a very high population of microbes. This mixture regenerate infertile land within a very short period, increase soil organic matter content and have beneficial effects on soil physical properties [9]. Ripened fruit contain huge amounts of micronutrients such as Ca, Na, K, Zn and Mg which are necessary for plant growth.

### Materials and Methods

The pot experiment was carried out in University of Colombo Institute of Agrotechnology and Rural science (UCIARS) in, Hambanthota. Sri Lanka, to find out the Effects of Different Foliar Applications and Soil Applied Fertilizers on Growth and Yield of *Vigna radiata* L. variety "MI-6". Experiment was carried out in a factorial Randomized complete block Design (RCBD) with six treatments having thirty-six replicates. Once a two-week Maxicrop™ and fruit tonic foliar application was applied at different soil Medias. The treatments were F1M1

(Maxicrop™ foliar application with soil applied DOA fertilizer), F1M2 (Maxicrop™ foliar application with soil applied compost), F1M3 (Maxicrop™ foliar application with soil applied Jeewamirtha), F2M1 (fruit tonic foliar application with soil applied DOA fertilizer), F2M2 (fruit tonic foliar application with soil applied compost), F2M3 (fruit tonic foliar application with soil applied Jeewamirtha) and tested their performance on the growth and yield of *Vigna radiata* L. All other management practices were followed uniformly.

### Preparation of Jeewamirtha liquid fertilizer

Components for preparation of Jeewamirtha liquid fertilizer are Fresh cow dung(15kg), Cow urine (15 L), Jaggery (2kg), Pulse powder (2kg), Water (200 L), Living soil(A hand full). All these ingredients were mixed in a plastic barrel and stirred well.

Then the barrel was covered with a gunny mat and placed under shade. The mixture was stirred clockwise twice a day in order to accelerate microbial activities. The prepared Jeewamirtha were applied after 24 hours of fermentation. Jeewamirtha were diluted 10 times with water before application.

### Preparation of fruit tonic fertilizer

Components for preparation of fruit tonic liquid fertilizer over ripen banana (3kg), Over ripen papaw (3kg), Pumpkin (3kg), Eggs (2), Jaggary (3kg), water (10L).Over ripen fruit and Jaggary were chopped and these ingredients were put in to plastic container. All ingredients were mixed clock wise direction.

Then it was kept for 45 day. Upper layer was removed that floating on the surface after 10 days. After 45 days it was filter using cotton cloth dilute the prepared fruit tonic 20 times.

### Preparation of Pot

This experiment was conducted using Black polythene bags (35cm\*20 cm). Few holes were made at near to the bottom of each pot to facilitate the drainage of water. Bulk soil sample was collected at 0-15cm depth from the cultivated area. The soil was removed the all debris and stones. Filled the soil according to the treatment and distance of 5cm was left unfilled from the top of the soil to facilitate irrigation. They were properly labeled and arranged according to the design.

### Physicochemical analysis of fruit tonic

Physio-chemical properties of fruit tonic were analyzed at soil and plant nutrition laboratory, Tea Research Institute, Walahanduwa, Sri Lanka (Table 1).

**Table 1:** Nutrient Composition of Fruit Tonic liquid fertilizer

Variables	Unit	Value
Color		Yellow
pH		3.40
EC	Us/cm	1244
Nitrogen	Li-g	0.74
Phosphorous	Li-g	0.64
Potassium	Li-g	0.98
Magnesium	Li-g	0.21

### Treatment applications

Prepared Jeewamirtha was diluted ten times with water and applied tow week interval, for this experiment at recommended level 570L/ha. Compost was mixed with top soil according to recommendation (10 t/ha). Inorganic fertilizer was applied mixed with soil for this experiment at recommended level as a basal and top dressing for three medias and Maxicrop™ and fruit tonic was diluted and applied one a tow week interval.

### Measurements

Vegetative growth parameters are plant height, leaf area, Number of leaves, Fresh weight of shoot (g), number of flowers per plant and root length were measure two weeks interval after planting. Yield parameters viz. number of pods/plants, number of seeds/pods, 100 seeds weight and plant biomass, root length and number of root nodules were measured at the time of harvesting.

### Statistical analysis

Data measured were statistically analyzed using SAS 9.1 and the mean comparison within treatments was performed by Duncan Multiple Range Test at 5 % significant level.

### Results and discussion

#### Plant height (cm)

The results showed that changes in foliar application and soil applied fertilizer significantly ( $p < 0.05$ ) affected the plant height of *Vigna radiata* L (Table 2). The interaction effect of foliar applications and soil applied fertilizer was also significant 8 weeks after planting. The highest plant heights at 8 weeks after planting were recorded *Vigna radiata* L. planted in Maxicrop™ foliar application with the soil application of DOA fertilizer and it was followed by the plants on Maxicrop™ foliar application with the soil application of Jeewamirtha. Jeewamirtha contains the three major plant nutrients, nitrogen, phosphorus and potassium (NPK), as well as many essential nutrients such as Ca, Mg, S, Zn, B, Cu, Mn, etc [10]. Presence of micro nutrients in Maxicrop™ foliar sprays increased plant height. Plant height increased also might be due to the micro nutrients [11].

#### Number of leaves

The results showed that changes in foliar application and soil applied fertilizer significantly ( $P < 0.05$ ) affected the number of leaves of *Vigna radiata* L (Table 2). The interaction effect of foliar applications and soil applied fertilizer was also significant at 8 weeks after planting. The highest number of leaves at 8 weeks after planting was recorded where *Vigna radiata* L. planted in Maxicrop™ foliar applications with the soil application of Jeewamirtha and plants on Maxicrop™ foliar application with the soil application of DOA fertilizer. Based on the results obtained, Maxicrop™ foliar application increased the number of leaves compared to fruit tonic foliar application. It might be due to the presence of macro (Nitrogen, Potassium, Phosphorous and Magnesium), micro (Cobalt, Iron, Manganese and Zinc) nutrients, and growth promoting substances in Maxicrop™ [12]. Boraiah *et al.*, (2017) [13] reported that application of Jeewamirtha has recorded higher number of leaves compared to other treatments.

**Table 2:** Effects of Different Foliar Applications and Soil Applied Fertilizers on Growth and Yield performances of *Vigna radiata* L.

Media		Plant height	Number of leaves	Leaf area (cm <sup>2</sup> )	Number of branches	Fresh weight of root
Foliar application (f)	Soil media(M)	8 WAP	8 WAP	8 WAP	8 WAP	8 WAP
Maxicrop	DOA	40.26±0.80 <sup>a</sup>	15.66±0.42 <sup>a</sup>	139.52±5.49 <sup>ab</sup>	6.50±0.49 <sup>a</sup>	28.28±1.75 <sup>a</sup>
	Compost	30.86±1.22 <sup>c</sup>	11.66±0.42 <sup>c</sup>	124.62±4.49 <sup>b</sup>	4.66±0.33 <sup>c</sup>	18.27±0.64 <sup>c</sup>
	Jeewamirtha	38.06±0.84 <sup>a</sup>	14.00±0.77 <sup>a</sup>	142.80±7.08 <sup>a</sup>	6.83±0.30 <sup>a</sup>	24.59±1.30 <sup>b</sup>
Fruit tonic	DOA	32.30±0.95 <sup>c</sup>	11.00±0.57 <sup>c</sup>	128.16±2.60 <sup>b</sup>	5.33±0.33 <sup>b</sup>	20.07±0.46 <sup>c</sup>
	compost	30.96±0.81 <sup>c</sup>	10.33±0.33 <sup>c</sup>	99.12±3.22 <sup>c</sup>	4.16±0.16 <sup>c</sup>	14.53±1.18 <sup>d</sup>
	Jeewamirtha	35.20±0.85 <sup>b</sup>	11.50±0.08 <sup>c</sup>	133.29±5.31 <sup>ab</sup>	3.83±0.19 <sup>c</sup>	19.24±0.49 <sup>c</sup>
	F	**	**	*	**	**
	M	**	**	**	**	**
	F×M	**	**	ns	**	*

Values represent mean± standard error of six replicates. Means followed by the same superscripts in a same column are not significantly different at 0.05 probability level according to DMRT. \*, \*\* and “ns” represents significant at  $P<0.05$ ,  $P<0.01$  and not significant, respectively.

### Leaf area (cm<sup>2</sup>)

The result showed the significant effect of foliar applications and soil applied fertilizers on leaf area and the interaction effect of foliar applications and soil applied fertilizers was also not significant on leaf area (Table 2). The higher leaf area was recorded where *Vigna radiata* L. planted on Maxicrop™ foliar application with soil application of Jeewamirtha and it was followed by the plants on Maxicrop™ foliar application with soil application of DOA and fruit tonic foliar application with soil application of Jeewamirtha. Jeewamirtha content three major plant nutrients, nitrogen, phosphorus and potassium (NPK), as well as many essential nutrients such as Ca, Mg, S, Zn, B, Cu, Mn, etc. [14]. Nadim *et al.*, (2012) [15] observed significantly higher leaf area by the application of micronutrients to wheat.

### Number of branches

The maximum number of the branches per plant at 8 weeks after planting was recorded where *Vigna radiata* L. planted in Maxicrop™ foliar applications and soil applied Jeewamirtha organic fertilizers and Maxicrop™ foliar applications and soil applied DOA recommended fertilizers on 8 weeks after planting (Table 2). It may be due to cumulative stimulating effect of availability of significant quantity of vitamins and natural Phyto regulators in Maxicrop™ in a balanced form resulting in increased dry matter content. The results were in accordance with the report of Amaresawari and Sujathamma (2014) [16]. Further the seaweed extract has been found to contain growth stimulators such as auxins, gibberellins and cytokinin [17]. Another possible reason may be due to the presence of high level of nitrogen in Jeewamirtha which promotes vegetative growth of the plants.

### Fresh weight of root

The maximum fresh weight of root per plant at 8 weeks after planting was recorded where *Vigna radiata* L. planted on Maxicrop™ foliar applications with soil applied DOA fertilizers and Maxicrop™ foliar applications with soil applied Jeewamirtha and it is followed by fruit tonic foliar applications with soil applied DOA fertilizers and

Maxicrop™ foliar application with soil applied compost at 8 weeks after planting (Table 2). Beneficial effect of Jeewamirtha which was attributed to huge quantity of microbial load and growth hormones which in turn might have enhanced the soil biomass, there by sustaining the availability up take of applied as well as native soil nutrients which ultimately have resulted in better growth and yield of crops [13]. Direct application of soluble seaweed constituents to specific plant organs such as leaves and roots may due to increase growth those organs [18].

### Number of root nodules

The results showed that changes in foliar application and soil applied fertilizers significantly ( $P<0.05$ ) influenced the number of root nodules of *Vigna radiata* L. The maximum number of root nodules per plant at 8 weeks after planting was recorded where *Vigna radiata* L. planted in Maxicrop™ foliar applications with soil applied Jeewamirtha and it was followed by Maxicrop™ foliar applications with soil applied DOA fertilizer. Phosphorus and potassium in foliar fertilizers have significant effect on the atmospheric nitrogen fixation [19]. Jeewamirtha treated soils had higher population of Acetobacter and Rhizobium [16].

### Number of flowers per plant

The statistical analysis revealed that foliar applications and soil applied fertilizer significantly ( $P<0.05$ ) influenced to the mean number of flowers per plant of *Vigna radiata* L. (Table 3). The highest number of flowers per plant at 6 and 8 weeks after planting were recorded where *Vigna radiata* L. planted in Maxicrop™ foliar application with soil application of Jeewamirtha and it was followed by the plants on Maxicrop™ foliar application with the soil application of DOA fertilizer.

This may due to the presence of hormonal substances in the Maxicrop™, especially Cytokinin. Crop yield is associated with number of flowers at maturity. The numbers of plants produced are associated with the development stages of plant.

The treatment receiving Maxicrop™ starting flowering earlier than without Maxicrop™ application [20].

**Table 3:** Effects of Different Foliar Applications and Soil Applied Fertilizers on Growth and Yield performances of *Vigna radiata* L.

Media		No. of Nodules	No. of Flowers	No. of pods	No. of seeds/pod	Hundred seed weight
Foliar ap. (f)	Soil media(M)	8 WAP	8 WAP	8WAP	8 WAP	8 WAP
Maxicrop	DOA	44.00±0.88b	14.16±2.38b	21.16±2.38a	11.60±0.42a	6.28±0.20a
	Compost	38.00±1.11c	10.50±0.76ab	10.50±0.76c	6.60±0.51c	3.80±0.17cd
	Jeewamirtha	50.50±0.89a	16.50±1.74a	20.33±1.74a	10.00±0.72a	7.40±0.13a
Fruit tonic	DOA	26.5±0.94e	10.16±2.55ab	14.16±2.55b	8.00±0.51b	4.33±0.14b
	compost	30.50±0.66d	05.50±0.55c	5.50±0.55d	6.36±0.20c	2.66±0.09d
	Jeewamirtha	43.50±1.11b	11.16±0.90ab	13.16±0.90c	8.83±0.40b	3.00±0.08ab
	F	**	*	**	*	**
	M	**	*	**	**	*
	F×M	**	*	*	*	*

Values represent mean± standard error of six replicates. Means followed by the same superscripts in a same column are not significantly different at 0.05 probability level according to DMRT. \*, \*\* and “ns” represents significant at  $P<0.05$ ,  $P<0.01$  and not significant, respectively.

### Number of pods per plants

The highest number of pods was recorded where Maxicrop™ foliar application with soil applied DOA and Maxicrop™ foliar application with soil applied Jeewamirtha followed by application of fruit tonic foliar application with soil applied DOA fertilizer (Table 3). It was in agreement with Craigie, (2011) [18]. Seaweed extracts contains major and minor nutrients, amino acids, vitamins, cytokinin, auxin and abscisic acid like growth promoting substances and have been reported to stimulate the growth and yield of plants. Dihil *et al.*, (2011) [21] was reported that Zn, Cu and Mn with foliar fertilizer application significantly increase number of pods per plant.

### Number of seeds per pod

The highest number of seed per pods were recorded in Maxicrop™ foliar application with soil applied DOA fertilizer and Maxicrop™ foliar application with soil applied Jeewamirtha (Table 3). This might be due to the presence of Macro and Micro nutrient as well as growth substances (Cytokinin) present in Maxicrop™. Cytokinins are active and regulate a number of plant functions including the cell division [22].

### Hundred seeds weight (g)

The results showed that changes in foliar application and soil media significantly ( $P<0.05$ ) influenced the 100 seeds weight of *Vigna radiata* L. The interaction effect of foliar application and soil media was significant on 100 seeds weight (Table 3). The highest 100 seeds weight was recorded on Maxicrop™ foliar application with soil applied DOA fertilizer and Maxicrop™ foliar application with soil applied Jeewamirtha. This might be due to [6, 20] observed that in case only liquid fertilizers composed of N.P.K. The presence and Macro and Micro nutrient as well as growth substances (Cytokinin) present in Maxicrop™ Has a great influence in increasing growth, fertility by increasing availability of nutrients thorough foliar application. Yildirim *et al.* [17] stated that different growth regulators applied in their study had positive effects on 1000 bean weight and one of them was Maxicrop™.

### Total yield per plant

The data showed that changes in soil medias and foliar applications significantly ( $p<0.05$ ) affected of *Vigna radiata* L (Table 4).

The interaction effect of soil medias and foliar applications was also significant.

Treatment might be due to the presence of macro and micronutrients in Jeewamirtha and Maxicrop™. Regulates a number of plant function including cell division, stimulate flowering, root development. These effects ultimately increased growth and yield of plants [17].

**Table 4:** Effect of different foliar applications and soil applied fertilizers on total yield per plant of *Vigna radiata* L.

Treatments		Total yield per plant (g)
Foliar application (F)	Soil media (M)	8 WAP
Maxicrop	DOA	8.85±1.05 <sup>a</sup>
	Compost	6.02±0.97 <sup>b</sup>
	Jeewamirutha	8.53±0.43 <sup>a</sup>
Fruit tonic	DOA	4.08±1.60 <sup>c</sup>
	Compost	3.91±0.39 <sup>d</sup>
	Jeewamirutha	4.21±0.76 <sup>c</sup>
	F	*
	M	*
	F*M	*

Values represent mean± standard error of six replicates. Means followed by the same superscripts in a same column are not significantly different at 0.05 probability level according to DMRT. \*, \*\* and “ns” represents significant at  $P<0.05$ ,  $P<0.01$  and not significant, respectively.

### Conclusion

This study was conducted to evaluate the effect of foliar application and soil applied fertilizers on growth and yield of *Vigna radiata* L. According to the results of this study Maxicrop™ foliar application with soil application of Jeewamirtha and Maxicrop™ foliar application with DOA fertilizer significantly increased the growth and yield of *Vigna radiata* L. The interaction effect between foliar application and soil applied fertilizer also significantly increased plant height, mean number of leaves, number of branches per plant, fresh weight of shoot, fresh weight of root, number of flowers and number of pods per plant, number of root nodules, number of seeds and 100 seeds weight and total yield per plant in comparison to other treatments. The present study concluded that Maxicrop™ foliar application with soil application of Jeewamirtha and Maxicrop™ foliar application with DOA fertilizer significantly increased the growth and yield of *Vigna radiata* L. The organic fertilizers are environmentally friendly than inorganic fertilizer. Therefore, Jeewamirtha organic fertilizer usage is eco-friendly method in sustainable agriculture.

## References

1. Hoing H, Wasserthal PS, Weber H. Chemoenzymatic synthesis of en antio metrically pure hydroxy amino acid chemistry, biology and medicine, 2012, 134.
2. Seufer V, Ramankutty N, Mayerhofer T. What is this thing called organic- How organic farming is codified in regulations. Food policy. 2017; 68:10-20.
3. Akande MO, Oluwatoyinbo F, Mmakinde E, Adepoju A, Adepoju I. Response of Okra to Organic and Inorganic Fertilization. Nature and Science. 2010; 8(11):261-266.
4. Chaney RL, Ryan JA, Kukier U, Brown SL. Heavy metal aspects of compost use," compost utilization in horticultural cropping. 2001; 323-359.
5. Hernández-herrera RM, Fernando S, Mario A, Jeffref N. Effect of liquid seaweed extracts on growth of tomato seedlings (*Solanum lycopersicum* L.). J Appl Phycol 2016; 26(1):619-628. doi: 10.1007/s10811-013-0078-4.
6. KalaivanyV, Sutharsan S, Srikrishna S. Effects of Natural and Commercially Available Seaweed Liquid Extracts on Growth and Yield of *Vigna unguiculata* L, 2019. doi: 10.3923/ajbs.
7. Chbani A, Majed S, Maulavi H, Kammoun M. The use of seaweed as a bio-fertilizer : Does it influence Proline and Chlorophyll concentration in plants treated. Arabian Journal of Medicinal & Aromatic Plants. 2015; 1(1):67-77.
8. Abed-Ashtiani F, Arzanlou M, Nasehi A, Kadir J. Plant tonic, a plant-derived bioactive natural product, exhibits antifungal activity against rice blast disease, Industrial Crops and Products. Elsevier. 2018; 105-112. doi: 10.1016/j.indcrop.2017.11.013.
9. Leroy BL, Herath M, Neve SD, Gabrils D, Bommele L, Reheul D. Effect of vegetables, fruit and garden waste compost on soil physical properties, Compost science and utilization.2018;16(1):43-51.
10. Fuentes B, Bolan N, Naidu R, Mora L. Phosphorus in Organic Waste-Soil Systems, Revista de la ciencia del suelo y nutrición vegetal. 2006; 6(2):64-83. doi: 10.4067/s0718-27912006000200006.
11. MeenaVS, Sindu S, Parmer P, Phour M, Sehrawat A. Potassium solubilizing microorganisms for sustainable agriculture', Potassium Solubilizing Microorganisms for Sustainable Agriculture. 2016, 1-331. doi: 10.1007/978-81-322-2776-2.
12. Hankins SD, Hockey HP. The effect of a liquid seaweed extract from *Ascophyllum nodosum* (Fueales, Phaeophyta) on the two-spotted red spider mite *Tetranychus urticae*. Hydrobiologia. 1990; 204-205(1):555-559. doi: 10.1007/BF00040286.
13. Boraiah B, Devakumar N, Shubha S. Effect of Panchagavya, Jeevamrutha and Cow Urine on Beneficial Microorganisms and Yield of Capsicum (*Capsicum annuum* L. var. grossum). Int. J Curr. Microbil. APP. Sci. 2017; 6(9):3226-3234.
14. Millmier, Lorimor AJ, Hurburgh C, Fullhage C. Near-infrared Sensing of Manure Ingredients', Transactions of the ASAE. 2000; 43(4):903-908.
15. Nadim MA, Baloch M, Khan E, Naveed K. Response of wheat (*Triticum aestivum* L.) to different micronutrients and their application methods. Journal of Animal and Plant Sciences. 2012; 22(1):113-119.
16. Amareswari PU, Sujathamma P. Jeevamrutha as an alternative of chemical fertilizer in rice production. Agricultural science digest A reerth journal. 2014; 34(3):240-242.
17. Yildirim B, Okut N, Turkozu D, Terzioglu O. The effects of maxicrop leaf fertilizer on the yield and quality of soybean (*Glycine max* L. Merrill). African Journal of Biotechnology. 2008;7(12):1903-1906. doi: 10.5897/ajb2008.000-5039.
18. Craigie JS. Seaweed extract stimuli in plant science and agriculture. Journal of Applied Phycology. 2011; 23(3):371-393. doi: 10.1007/s10811-010-9560-4.
19. Effect of foliar fertilization on nodulation and grain yield of pea (*Pisum sativum*)," turk tarim ve doga bilimeleri dergisi 1, Vols. ozel sayi-1. 2014; 668-672.
20. Eifediyi K, Remison SU. Growth and yield of cucumber (*Cucumis sativus* L.) as influenced by farmyard manure and inorganic fertilizer. Repot and opinion. 2010; 2(11):1-5.
21. Dihil BB, Denden M, Abound S. Foliar potassium fertilization and quality and its effect on growth, yield and quality of potato growth under loam sandy soil and semiarid condition, intrnational journal of agriculture reserch. 2011; 6(7):593-600.
22. Ashour M, EL-sharif A, Khairy HM. Effect of *Pterocladia capillacea* Seaweed Extracts on Growth Parameters and Biochemical Constituents of Jew's Mallow. Agronomy. 2020; 10(3):26-29.