International Journal of Plant & Soil Science

34(22): 1313-1321, 2022; Article no.IJPSS.90927
ISSN: 2320-7035

Effect of Nitrogen Levels and Seaweed Extract (*Kappaphycus alvarezii*) on Growth and Yield of Summer Maize (*Zea mays* L.)

Bhetala Magi Jerusha [a*] and Shikha Singh [a]

[a] Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i2231501

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/90927

Original Research Article

Received 18 June 2022
Accepted 21 August 2022
Published 06 September 2022

ABSTRACT

The trail was conducted in Crop Research Farm, Department of Agronomy of Naini Agricultural Institute, SHUATS, Prayagraj (U.P), during *Zaid* 2022. The experiment consists of three Nitrogen levels i.e., 50%, 75% and 100% N along with Seaweed extract (*Kappaphycus alvarezii*) applied at different Concentration i.e., 5%, 10% and 15%. The experiment was laid out in Randomized block Design with ten treatments each replicated thrice. The results showed that plant height (165.73 cm) and dry weight (88.13 g/plant), were recorded significantly highest in the treatment 7 which is with the application of 100% Nitrogen + 15% K-sap as compared to all other treatments. The significantly highest number of cobs/plant (3), number of rows/cob (14.47), grains/row (28.27), grain yield (4.05 t/ha), stover yield (15.37 t/ha), and seed index (26.2) were recorded with application of 100% Nitrogen + 15% K-sap as compared to all other treatments.

Keywords: Maize; nitrogen; seaweed extract (K-sap); growth and yield.

**Corresponding author: E-mail: magijerushabhetala@gmail.com, 20msagro006@shiats.edu.in;*

1. INTRODUCTION

Maize (*Zea mays* L.), a monocotyledonous plant and belongs to the family *Poaceae.* It is an important cereal crop grown across the world [1]. According to FAO 1992, Maize is ranked the 3 most important cereal crop after rice and wheat [2]. Among the maize growing countries India rank 4th in area and 7th in production. In India during 2021 the production of maize is 32.4 m/t from an area of 9.86 m/ha with the productivity 2.43 t/ha. Among Indian states area of maize of U.P state is 8% with 6.1% production. It serves as a source of nutrients for human and animal and as raw materials for various Industries. In developed world it is used as a animal feed while it is used majorly as food in the developing world. [3] According to Varheye 2010, maize is presently grown in more than 100 countries and it has served as a diversification from the traditional root crops in the local diets.

Nitrogen is considered one of the most important nutrients affecting yield and quality of Maize (*Zea mays* L.) [4]. Maize usually requires a considerable amount of nitrogen (N) for its better growth and development because of its exhaustive nature [5]. It is a major component of numerous plant biological compounds that play a crucial role in photosynthetic 11 activities and consequently influence crop yield capacity. Adequate N levels result in dark green leaves, whilst, deficiencies cause leaf chlorosis.

Tajul MI et al. [6] Nitrogen is the essential constituent of chlorophyll, protoplasm and enzymes. Inappropriate soil and asymmetric nutrients management are the major causes for poor yield output. Precision of nitrogen management is efficient for maize crops in terms of economy and the environment. Adoption of optimum amount of N increases the N use efficiency as well as reduces the N loss, and ensure optimal use of N with help of certification system. Nitrogen also mediates the utilization of phosphorous, potassium and other element in the plant.

Maitra S et al. [7] Higher nitrogen levels are reported to increase plant height, stem thickness, leaf area, leaf area index, dry matter accumulation; net assimilates ratio and yield per hectares. In maize the amount of maize grain produced per unit of nitrogen applied depends upon the uptake from fertilizer and soil N and its utilization in producing grains [8]. As such nitrogen being the most limiting nutrient its supply along with other nutrients become a matter of paramount concern to maintain fertility of the soil for the sustain high crop production.

Seaweeds and various seaweed extracts have been utilized in agricultural practices since long. Sea weed extracts contain different phytohormones like Auxins, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Betaine and Polyamines and other growth promoters along with trace elements, vitamins, amino acids, antibiotics and micronutrients which enhance the yield and yield attributes of crops, when applied exogenously. Unlike chemical fertilizers, extract derived from seaweeds are biodegradable, non-toxic, non-polluting and non-hazardous to humans, animal and birds [9].

Seaweed aids in the production of beneficial soil microorganisms, [10] develops tolerance against environment stress., increases nutrient uptake from soil [11]. Liquid seaweed fertilizer is a unique combination of micronutrients, especially K and trace elements, polysaccharides and sugar that are in dissolve, In many commercial crops, foliar spraying with seaweed extract is a popular practice to increase yield.

Kapppahycus alvarezii (Rhodophyta, Gigartinales) is a Red algae. *Kapppahycus alvarezii* a native of the Phillippines, has been introduced and domesticated in many countries including Indonesia, Mexico, Fiji, Vietnam, Brazil, China and India for commercial cultivation. In India *Kappaphucus alvarezii* was first introduced by the Central Salt and Marine Chemicals Research Institute (CSMCRI) and therefore its cultivation technology was perfected. Currently *K. alvarezii* is acclimatized and also is being extensively farmed on the east coast of Mandapam in Tamilnadu and along the west coast in Diu and more recently along the Gujarat coast. There are results showed that single application of K sap even a late crop stage can be beneficial under normal irrigates conditions [12]. India's share is about >2% in global *K. alvarezii* production [13]. The protein content of *K. alvarezii* varied from 12.69 ± 0- 6 to 23.61 ± 0.02 g/100 g DW, and the fiber content varied between 9.68 ± 0.08 to 18.57 ± 0.15 g/100 g DW.

Nitrogen management in maize production system is one of the main concerns since it is the most important and primary nutrient for growth and development of the crop [14]. Higher nitrogen levels are reported to increase plant

growth attributes and yield attributes. Deficiencies may also result in slow stunted growth and weak plants; such plants normally mature early which may significantly reduce grain quality and quantity. Maize grain quality and quantity are improved with adequate nitrogen levels in the soil. seaweed extract has been found to increase the yield of several crops as well as impart drought tolerance. As for applicaton [15] the foliar spray of liquid extract from seaweed causes cereals, vegetables, fruit plants, and horticultural crops to grow faster and produce more.

2. MATERIALS AND METHODS

The experiment was carried out during *Zaid* season of 2022 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (Allahabad) which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude, and 98 m altitude above the mean sea level. This area is situated on the right side of the river Yamuna by the side of Allahabad Rewa Road about 5 km away from Prayagraj (Allahabad) city. The meteorological data including the weekly average of maximum and minimum temperature, relative humidity, and rainfall recorded at the Agro Meteorological Observatory Unit, School of Forestry and Environment Sciences, Sam Higginbottom University of Agriculture Technology & Sciences, Prayagraj (Allahabad) during the cropping period are presented in Fig. 1.

2.1 Soil of the Experimental Field

The soil of the experimental field constituting a part of central Gangetic alluvium is neutral and deep. With the use of an auger, pre-sowing soil samples were gathered from a depth of 15 cm. Chemical and mechanical analyses were performed on the composite samples. The texture of the soil was sandy loam, with low organic carbon, medium available nitrogen, phosphorus, and low potassium. Tables 1 and 2 show the mechanical, chemical, and physico-chemical properties of the soil in the experimental field, as well as the methods employed to determine them.

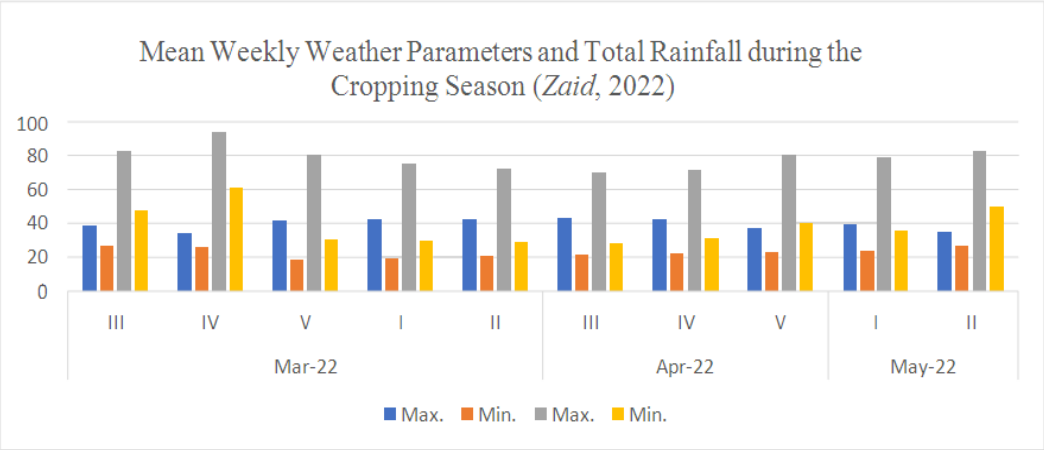

Fig. 1. Meteorological data on means weekly weather parameters during the croppingseason (Zaid, 2022)

Mechanical Analysis of Soil during Zaid 2022

Table 1. The mechanical analysis of soil (0-15 cm depth) is represented below

Particulars	Result (%)
Sand (%)	63.00 (%)
silt (%)	22.60 (%)
Clay (%)	14.40 (%)
Textural class	Sandy Loam

Chemical Analysis of Soil during Zaid 2022

Table 2. Mechanical analysis of soil

Parameter	Result (Unit)	Method
Organic carbon	0.69%	Walkely and Black Method
Available Nitrogen	271.81 kg/ha	Alkaline Permanganate Method
Available Phosphorous	30.19 kg/ha	Olsen's Colorimetric Method
Available Potassium	331 kg/ha	Flame photometer method
Ph	7.1	Lass electrode pH meter
EC	0.21 (d/Sm)	Method No.4, USDA Handbook No.60

Table 3. Skeleton of ANOVA

Source of variation	df	SS	MSS	F Cal.	F(tab) at 5%	Result
Replications	(r-1)	SSR	$\frac{SSR}{df}$	$\frac{MSSR}{MESS}$	-	S/NS
Treatments	(t-1)	SSTr	$\frac{SSTr}{df}$	$\frac{MSSTr}{MESS}$	-	S/NS
Error	(r-1)(t-1)	SSE	$\frac{SSE}{df}$	-	-	-
Total	(rt-1)	TSS		-	-	-

2.2 Experimental Details

Randomized Block Design was used to set up the experimental. It is a bifactoral experiment with two factors 1. Nitrogen Levels (which has 100,75 and 50% Nitrogen) and the 2. Foliar application of Seaweed extract (*Kappaphycus alvarexii*) which includes Concentration of 5,10 and 15% K-sap). The Treatment comprised and 3 different Nitrogen levels and 3 different concentrations of Seaweed extract. Each of the ten treatments was divided into thirty (30) plots with treatments distributed at random. With different treatment combinations as follow, 1. 100% Nitrogen + 5% K.sap 2. 75% Nitrogen + 5% K.sap 3. 50% Nitrogen + 5% K.sap 4. 100% Nitrogen + 10% K.sap 5. 75% Nitrogen + 10% K.sap 6. 50% Nitrogen + 10% K.sap 7. 100% Nitrogen + 15% K.sap 8. 75% Nitrogen + 15% K.sap 9. 50% Nitrogen + 15% K.sap 10. RDF + water spray.

2.3 Statistical Analysis

The data recorded during the investigation was subjected to statistical analysis by "Analysis of variance technique". The data were statistically analyzed using the F-test as per the procedure given by Gomez and Gomez (1984). CJ valves at P=0.05 were used to determine the significance of different treatment means. For testing the hypothesis, Skeleton for analysis of variance has been given in the Table 3.

$$SEd \pm = \sqrt{\frac{2 \times MESS}{rs}}$$

CD at 5% = SEd × t error df at 5% probability level

3. RESULTS AND DISCUSSION

Results and Discussions include all the growth and yield attributing characters of the crop that have been observed. Showed that the values of the growth contributing characters viz, plant height (cm), plant dry weight (g/m^2), Crop Growth Rate (g/m^2/day), Relative Growth Rate (g/g/day) and yield attributes like number of cobs/plant, number of rows/cob, number of grains/row, seed index, grains (t/ha), Stover yield (t/ha), and Harvest Index.

3.1 Pre-harvest Readigs

3.1.1 Effects on growth of maize

Plant Height: At 80 DAS, significantly highest plant height (172.63 cm) was recorded with Treatment 7 (100% Nitrogen + 15% K.sap). However, Treatment 4 (100% Nitrogen+ 10% K sap) *i.e.,* (171.03 cm) was statistically at par with Treatment 7. Whereas lowest plant height was seen in Treatment 10 (RDF + water spray) *i.e*., (141.43 cm). it is a vitally associated with the activity of every living cell. Thus, [16] greater availability of nitrogen at higher fertilizer doses might have improved protein synthesis and photosynthesis leading thereby to rapid cell division and enlargement, which ultimately resulted in to vigorous plant growth and similar findings [17] Seaweed extract stimulate various aspects of plant development plant height (59.13 cm) [18]. Observed higher plant height (196.73 cm) under 100% recommended nitrogen dose.

3.1.2 Plant Dry weight (g/plant)

At 80 DAS, significantly highest plant dry weight (88.18 g) was recorded with Treatment 7 (100% Nitrogen + 15% K.sap). However, Treatment 4 (100% Nitrogen+ 10% K sap) *i.e.,* (86.54 g) was statistically at par with Treatment 7. Whereas lowest plant dry weight was seen in Treatment 10 (RDF + water spray) *i.e*., (68.92 g). Latha and prasad (2008) reported higher dry matter accumulation in Maize with more trogen dose in intercropping system with mung bean [19]. Reported that application of 100% RDN (120 kg N/ha) increase significantly highest dry matter production (1150.03 g/m^2).

3.1.3 Crop Growth Rate (g/m^2/day)

During 60-80 DAS, no significant difference is recorded among the treatments. The maximum value for CGR (24.55 g/m^2/day) is recorded with application of 50% Nitrogen + 15% K.sap. Crop growth rate of maize uncreased progressively with time reaching maximum at 80 DAS. Application of higher amount of N developed larger canopy and showed greater CGR of maize. It is not unlikely to have negative CGR values in the later crop growth stages [20]. The fertilizer treatment had significant effect on the crop growth rate at different growth stages, with increasing nitrogen levels, crop growth rate (CGR) was increased. Significantly highest CGR (52.7 g/m^2/day) were obtained from 180 kg N/ha and was at par with 120 kg N/ha (50.7 g/m^2/day).

3.1.4 Relative Growth Rate

During 60-80, no significant difference is recorded among the treatment. The maximum reading of RGR (0.017 g/g/day) with T3 (50% Nitrogen + 5% K.sap).

3.2 Post-harvest Readings

3.2.1 Effects of Yield attributes of Maize

Number of cobs/plant

At the time harvest, significantly highest no. of cobs/plant (3 cobs/plant) recorded in Treatment 7. However, Treatment 4 (3 cobs/plant) which was statistically at par with Treatment 7. Whereas lowest No. of cobs/plant (2) is recorded in Treatment 10 [21] reported significant highest in cobs/plant (3 cobs/plant) and weight of cob of maize were noted with application of increasing levels of nitrogen fertilizers.

3.2.2 Number of rows/cob

The significantly highest no. of rows/cob (14.47) was recorded in Treatment 7. However, Treatment 4 (14.46) which was statistically at par with Treatment 7. Whereas lowest no. of rows/cob is recorded in Treatment 10 (10.1) [22]. Showed an extraordinary effect of seaweed extract on corn growth and performance.

3.2.3 Number of grains/row

The significantly highest no. of grains/row (28.27) was recorded in Treatment 7. However, Treatment 4 (27.7) which was statistically at par with7. Whereas lowest no. of grains/row is recorded in Treatment 10 (23.23).

3.2.4 Seed Index (g)

The significantly highest Seed Index (26.2) was recorded in Treatment 7. However, Treatment 4 (25.7) which was statistically at par with 7. Whereas lowest Seed Index is recorded in Treatment 10 (20.97).

3.3 Grain Yield (t/ha)

An appraisal review of the table shows that the grain yield differed significant. The significantly highest grain yield was observed in Treatment 7 (4.05 t/ha). However, Treatment 4 (3.87 t/ha) is statistically at par with Treatment 7. Whereas lowest grain yield is seen in treatment 10 (2.16 t/ha) [13]. Stated that the increased growth and yield attributes may be due to the presence of some growth promoting substances such as Indole 3-acetic acid (IAA) and Idole 3-butyric acid (IBA), gibberellins, cytokinins, micronutrients, vitamins and amino acids.

Mohamed et al. [24] stated that the adequate fertilization are key factors to exploit the full potential of the genotype. Baby corn with N 150-200 kg/ha to harvest maximum yield. This may be due to supplying of adequate percent of fertilizers through different available sources which leads to the improvement in the yield and yield parameters in corn.

Table 4. Effects of Nitrogen levels and Seaweed extract (*Kappaphycus alvarezii*) on growth attributes of summer Maize

Treatment combinations	Plant height (cm)	Plant dry weight (g)	CGR ($g/m^2/day$)	RGR (g/g/day)
100% Nitrogen + 5% K.sap	167.37	84.08	22.81	0.014
75% Nitrogen + 5% K.sap	161.47	81.64	24.44	0.016
50% Nitrogen + 5% K.sap	155.3	77.51	24.21	0.017
100% Nitrogen + 10% K.sap	171.03	86.54	23.51	0.014
75% Nitrogen + 10% K.sap	163.7	81.98	23.72	0.015
50% Nitrogen + 10% K.sap	156.7	77.55	22.86	0.015
100% Nitrogen + 15% K.sap	172.63	88.18	22.39	0.013
75% Nitrogen + 15% K.sap	165.73	83.49	22.94	0.014
50% Nitrogen + 15% K.sap	158.53	80.74	24.55	0.016
RDF + water spray	141.43	68.92	20.05	0.015
F-test	**S**	**S**	**NS**	**NS**
S.EM	**0.86**	**1.91**	**-**	**-**
CD(5%)	**2.57**	**4.02**	**-**	**-**

Table 5. Effects of Nitrogen Levels and Seaweed extract (*Kappaphycus alvarezii*) on yield attributes and yield of summer Maize

Treatment combinations	No. of cobs/plant	No. of rows/cob	No. of Grains/row	Seed Index (g)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
100% Nitrogen + 5% K.sap	3	14.4	27.3	24.87	3.73	14.5	20.46
75% Nitrogen + 5% K.sap	2	13.57	26.8	24	2.77	13.77	16.74
50% Nitrogen + 5% K.sap	2	11.83	26.03	22.97	2.2	13.13	14.35
100% Nitrogen + 10% K.sap	3	14.46	27.7	25.7	3.87	14.93	20.58
75% Nitrogen + 10% K.sap	2	13.83	26.53	24.33	3.13	13.97	18.30
50% Nitrogen + 10% K.sap	2	13.2	26.8	23.27	2.4	13.33	15.25
100% Nitrogen + 15% K.sap	3	14.47	28.27	26.2	4.05	15.37	20.85
75% Nitrogen + 15% K.sap	2	13.8	27.13	24.4	3.35	14.4	18.87
50% Nitrogen + 15% K.sap	2	13.53	26.67	23.67	2.7	13.67	16.49
RDF + water spray	2	10.1	23.23	20.97	2.16	10.77	16.70
F-test	**S**	**S**	**S**	**S**	**S**	**S**	**S**
SEm(±)	**0.10**	**1.25**	**0.87**	**0.91**	**0.06**	**0.72**	**0.62**
CD(5%)	**0.31**	**2.63**	**2.55**	**2.72**	**0.18**	**2.16**	**1.84**

3.4 Stover Yield (t/ha)

An appraisal review of the table shows that the stover yield differed significant. The significantly highest stover yield (15.37 t/ha) was observed in Treatment 7. However, treatment 4 (14.93 t/ha) is statistically at par with treatment 7. Whereas lowest stover yield is seen in treatment 10 (10.77 t/ha). [25] in a field experiment was conducted University of Agricultural Sciences, Dharwad. similarly, significantly higher stover yield (16.37 t/ha).

3.5 Harvest Index

Effects of Nitrogen Levels and Seaweed Extract on harvest index was found to be significant among different combination. However, significantly highest harvest index (23.47) was recorded in the treatment 4 followed by the Treatment 1 (22.5), and lowest harvest index was observed in Treatment 6 (15.25) [26] Seaweed extracts stimulate various aspects of plant development [27,28].

4. CONCLUSION

The results revealed that at harvest significantly, higher growth attributes like plant height, plant dry weight, CGR, RGR is recorded in treatment 7 with a combination of 100% Nitrogen + 15% K-sap. Significantly, higher yield attributes like number of cobs/plant, number of rows/cob, number of grains/row, seed index, harvest index, grain yield and stover yield was highest in the same treatment.

From the experiment it can be concluded that treatment 7 where 100% Nitrogen + 15% K-sap was considered as best treatment combination wth maximum grain yoeld and stover yield. However, the experimental results were based on one-year trail, further trails are needed for conformity and recommendation.

ACKNOWLEDGEMENTS

I am thankful to the Department of Agronomy, Naini Agriculture Institute, SHUATS, Prayagraj, for there immense support during my trail.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. FAO. Maize in human nutrition, Food and Agriculture Organization of the United Nations Rome. FAO Food Nutr S. 1992;25.
2. Ismail MM, El-Shafay SM. Variation in taxoomical position and biofertilizing efficiency of some seaweed on germination of *Vigna unguiculata* (L.). International Journal of Emerging Sciences and Engineering. 2015;6: 47-57.
3. ICAR. Indian institute of maize research. 2015. Nuturing diversity, resilience, livelihood and industrial inputs, ISO 9001:2015 certified.
4. Varheye W. Growth and production of maize: traditional low-input cultivation. Soil, plant growth and crop production. Encyclopedia of life support systems (EOLSS); 2010.
5. Asibi AE, Chai Q, Coulter J. Mechanisms of nitrogen use in maize. Agronomy. 2020;9(12):775.
6. Tajul MI, Alam MM, Hossain SMM, Naher K, Rafii MY, Ltif MA. Influence of Plant population and nitrogen-Fertilizer at various Levels on Growth and Growth Efficiency of Maize. Sci World. 2013;1:9.
7. Maitra S, Zaman A, Mandal TK, Palai JB. Green manures in agriculture. J PharmPhytochemistry. 2018;7(5):1319-27.
8. Cheem MA, Farhad MF, Saleem HZ, Khan A, Munir MA, Wahid F et al. Nitrogen management strategies for sustainable maize production. Crop. Environment. 2010;1:49-52.
9. Scharf PC, Wiebold WJ, Lory JA. Corn yield response to nitrogen fertilizer timing and deficiency level. Agron J. 2002; 94(3):435-41.
10. Dhargalkar VK, Pereira N. Seaweed promising plant of the Millennium Science and Culture. 2005;71:60-6.
11. Zhang X, Ervin EH, Schmidt ER. Plant growth regulator can enhance the recovery of Kentucky bluegrass sod from heat injury. Crop Science society of American; 2003.
12. Mondal D, Ghosh A, Prasad K, Singh S, Bhatt N, Zodape ST et al. Elimination of gibberellin from Kappaphycus alvarezii seaweed sap foliar spray enhances corn stover production without compromising the grain yield advantage. Plant Growth Regul. 2015;75(3):657-66.
13. Mandal SK, Veeragurunatha V, Ganesh M. Present status of the Kappaphycus alvareziii in India Scenario, CSIR-Central Salt and Marine Chemicals Research Institute (CSMCRI). J Appl Phycol. 2017; 26(2):775-81.
14. Kumar SK, Ganesan K, Rao SPV. Seasonal variation in Nutritional composition of Kappaphycus alvarezii were an edible seaweed. J Food Sci Technol. 2015;52(5):2751-60.
15. Blumenthal JM, Baltensperger DD, Cassman KG, Mason SC, Pavlista AD CHAPTER 3. Importance and effect of nitrogen on crop quality and health nitrogen in the environment: source, problems, and management. 2nd ed; 2008.
16. Elansary HO, Skalicka-Woźniak K, King IW. Enhancing stress growth traits as well as phytochemical and antioxidant contents of Spiraea and Pittosporum under seaweed extract treatments. Plant Physiol Biochem. 2016;105:310-20.
17. Kumar R, Kumawal N, Kumar S, Singh AK, Bohra.J.S. Effects of NPKS and ZN fertilization on growth, yield and quality of baby corn. Int J Curr Microbiol Appl Sci. 2017;6(3):1392-428.
18. Pramanick B, Brahmachari K, Ghosh A. Effect of seaweed saps on growth and yield improvement of green gram. Afr J Agric Res. 2013;8(13): 1:180-1, 186.
19. Layek J, Shivakumar BG, Rana DS, Munda S, Lakshman K. Growth pattern, physiological indices and productivity of different soybean (Glycine max) based intercrops as influenced by nitrogen nutrition. Indian J Agron. 2012; 57(4):349-56.
20. Bindhani A, Barik KC, Garnayak LM, Mahapatra PK. Nitrogen management in baby corn (*Zea mays* L.). Indian J Agron. 2007;52:135-8.
21. Hokmalipour S, Darbandi MH. Physiological growth indices in corn (Zea mays L.) cultivars as affected by nitrogen fertilizer levels. World Appl Sci J. 2012;16(6).
22. Sahoo SC, Mahapatra PK. Yield and economics of sweet corn (Zea mays L.) as affected by Plant population and fertility levels. Indian J Agron. 2007;52(3):239-42.
23. Partani T 2013. Determination of the effect rates of seaweed extract on growth and

performance of corn (Sc704) in Gorgan. International Journal of Agricultural Crop Sciences. 6:219-24.
24. Mohamed SB, Dalia AHS, Rania MAN, Azza MS. Influence of foliar spray with seaweed extract on growth, yield and its quality, profile of protein pattern and anatomical structure of chickpea plant (*Cicer arietinum* L.). Middle East. J Appl Sci. 2016;6:01.
25. Thakur DR, Prakash O, Kharwara PC, Bhall SK, Prakash O. Effect of nitrogen and plant spacing on yield, nitrogen uptake and economics in baby corn. Indian J Agron. 2000;43(4):668-71.
26. Rajeshwari RS, Hebsur NS, Pradeep HM, Bharamagoudar TD. Effect of integrated nitrogen management on growth and yield of maize. Karnataka J Agric Sci. 2007; 20(2):399-400.
27. Kaur P, Singh SK, Kaur R, Sidhu MK. Response of Different Levels of nitrogen and Spacing on Growth and yield of cauliflower Growth under Central Region of Punjab. Int J Bio-Resource Stress Manag. 2020;11(4):320-6.
28. Latha PM, Prasad PVN. Productivity and economics of maize + greengram intercropping at different NPK levels. Agric Sci Dig. 2008;28(1):30-2.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/90927