www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(1): 3019-3023

www.thepharmajournal.com
Received: 25-11-2022
Accepted: 27-12-2022

Rohulla Fazli
Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu and Kashmir, India

MC Dwivedi
Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu and Kashmir, India

Ramphool Puniya
Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu and Kashmir, India

Vikas Sharma
Division of Soil Science and Agricultural Chemistry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu and Kashmir, India

Manish Kr. Sharma
Division of Statistics and Computer Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu and Kashmir, India

Anil Kumar
Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu and Kashmir, India

Corresponding Author:
Rohulla Fazli
Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu and Kashmir, India

Effect of seaweed extract under different doses of NPK on growth parameters of wheat

Rohulla Fazli, MC Dwivedi, Ramphool Puniya, Vikas Sharma, Manish Kr. Sharma and Anil Kumar

Abstract
A field experiment was conducted during (*Rabi*) season of 2020-21 at Research farm of SKUAST- J University Chatha, Jammu, India to study the effect of foliar application of seaweed extract, under different doses of NPK at various vegetative stage of wheat. Treatment comprised of seed priming with seaweed extract @ 3 ml/kg seed, seed treatment with seaweed extract @ 3 ml/kg seed, and control without seaweed extract in main plot, foliar application of seaweed extract @ 2 ml/litre water and 4 ml/litre water at tillering and heading stage in seven treatments control spired with water in sub plot and two graded levels of NPK *viz.*, 75 and 100% recommended fertilizer in sub-sub plot laid out in a split-split plot design and replicated thrice. The result revealed that seed priming and treatment with seaweed extract did not show any significant influence on growth parameters of wheat, however, foliar application of seaweed extract in (T6) 4 ml/litre water at tillering and heading stage was observed significantly higher growth parameters after 30 DAS *viz.*, leaf area index, dry matter accumulation, as compared to (F7) control. also statistically at par with (F5) foliar application of seaweed extract 2 ml/litre water at tillering and heading stage, on the other hand plant height and number of tillers showed non-significant effect. Among two graded level of NPK 100% significantly higher than 75% between all growths parameters at all stage except 30 DAS. As a final point the interaction effect was noted significantly maximum under (F6) foliar application of seaweed extract @4 ml/litre water at tillering and heading stage with 100% NPK, also at par with (F5) foliar application of seaweed extract @ 2 ml/litre water + 75% NPK.

Keywords: Seed treatments, seaweed extract, foliar application, NPK doses, growths, wheat

Introduction

Cereals play a pivotal role to satisfy the global food demand of growing population, particularly in developing nations where cereal-based production system is the only predominant source of nutrition, protein and calorie intake. Wheat (*Triticuma estivum* L.) is the most important cereal crop for the majority of world's populations. It is cultivated on an area of 217 million hectares with production and productivity of about 731 million tones and 3.27 tones ha^{-1}, respectively (Ramadas *et al*., 2020) [11]. A large number of seaweed products (15 million tonne) are produced every year across the world (FAO, 2006) [7]. Among which a considerable portion is used for nutrient supplements or bio-stimulants or bio fertilizers to improve plant growth and productivity. Recently, it has become popular as a foliar spray for improving growth and yield of cereals, vegetables, fruit orchards and other horticultural crops (Zodape *et al*., 2008) [21].

Seaweeds are the macroscopic marine algae. They are used as food for human, fodder for cattle, as a substitute of chemical fertilizer and source of various fine chemicals. Besides this, it is used for obtaining many industrial products such as agar and alginate (Khan *et al.,* 2009) [9]. In recent years, natural seaweeds are being used as substitute of synthetic fertilizer. Seaweed extracts are marketed as liquid fertilizers and bio-stimulants because they contain multiple growth regulators such as Cytokinins (Durand *et al.,* 2003) [4], Auxins and gibberellins (Sahoo, 2000) and various macro and micronutrients necessary for plant growth and development. Moreover, it helps in promoting the growth of beneficial soil microorganisms (Khan *et al*., 2009) [9]. It also create tolerance to environmental stress (Zhang *et al.,* 2003) [22], increase nutrient uptake from soil (Turan and Kose, 2004) [19] and enhancing antioxidant properties. In recent years, the use of seaweed extracts is gaining popularity due to their potential use in organic and sustainable agriculture. (Russo and Beryln, 1990) [12] found that seaweed extract is useful to avoid excessive fertilizer applications and to improve mineral absorption especially in rainfed crops. In India about 700 species of marine algae are found in both intertidal and deep-water regions of the Indian coast and out of these nearly 60 species are found to be commercially important. The dominating seaweed producing states are Tamil Nadu, Gujarat, Maharashtra, Goa, Lakshadweep, Andhra Pradesh and Karnataka Andaman and Nicobar Islands, few species are also found in West Bengal and Orissa (Tandel *et al*., 2016) [20]. Though, a very few species are used for agricultural purpose. Seaweed and seaweed-derived products have been widely used as bio stimulants in crop production due to presence of multiple growth regulators such as Cytokinin, Auxins, Gibberellins, Betaines, as well as presence of macronutrients such as Ca, K, P, and micronutrients like Fe, Cu, Zn, B, Mn, Co and Mo, which are necessary for plant growth and development. Numerous studies have revealed a wide range of beneficial effects of seaweed extract on plants, such as early seed germination and establishment, better crop performance and higher yield, inducing resistance to biotic and abiotic stress and many more.

The foliar spray of liquid extract from seaweed causes cereals, vegetables, fruit plants, and horticultural crops to grow faster and produce more (Elansary *et al.*, 2016) [6]. In many commercial crops, foliar spraying with seaweed extract is a popular practice to increase yield (Khan *et al.*, 2009) [9]. So, Seaweed has long been used to help plant growth, especially before the advent of commercial fertilizer production. It provides many benefits to plants above and beyond conventional fertilizers to promote stronger, healthier plants. When plants are stronger and healthier they are better able to withstand environmental stresses such as drought, salinity, insect pests, and diseases.

Materials and Methods

A field experiment was conducted during *Rabi* seasons of 2020-21 and 2021-22 at Research Farm Main Campus, Chatha SKUAST-J. The soil of experimental site was sandy loam in texture with slightly alkaline in reaction (pH 7.47), low in organic carbon (4.8 g/kg) and available nitrogen (212.30 kg/ha) but medium in available phosphorus (13.82 kg/ha) and potassium (141.16 kg/ha). The experiment was conducted in spilt-spilt plot design with three replications. The treatments consisted of three seed treatment with seaweed extract *viz.*, seed treatment @ 3 ml/kg seed, seed priming @ 3 ml/kg seed, and without seed treatment (control) in main plot, seven foliar application of seaweed extract, *viz*., F_1: foliar application of seaweed extract @ 2 ml/L water at tillering stage, F_2: foliar application of seaweed extract @ 4 ml/L water at tillering stage, F_3: foliar application of seaweed extract @ 2 ml/L water at heading stage, F_4: foliar application of seaweed extract @ 4 ml/L water at heading stage, F_5: foliar application of seaweed extract @ 2 ml/L water at tillering stage & heading stage, F_6: foliar application of seaweed extract @ 4 ml/L water at tillering stage & heading stage, F_7: control in sub plot, and two level of NPK, *viz*., 75% NPK and 100% NPK in sub-sub plot. The recommended dose of fertilizer was 100 kg N + 50 kg P + 40 kg K/ ha. Accordingly, half of the total dose of recommended nitrogen, full dose phosphorus and potash were applied at the time of sowing and the remaining half dose of nitrogen was applied at CRI boot stage of crop in two split. The wheat verity HD-3086 was sown with *Kera* method at 20 cm row spacing using seed rate of 100 kg/ha in the 3th week of November during both years.

Results and Discussion

Effect of seaweed extract on growth parameters

The effect of seaweed extracts under different doses of NPK, on growth parameters *viz.*, plant height, numbers of tillers, leaf area index, dry matter accumulation, is presented in Table 1 and 2. The main plot factor- A (S1, S2 and S3) did not showed a significant variations in growth parameters. Though, factor (B) sub- sub plot significantly growth parameters recorded after 30 DAS only for leaf area index and dry matter accumulation because foliar application of seaweed extract applied after 30 DAS (tillering and heading stage), so at 90 DAS F6, with the foliar application of seaweed extract at @ 4 ml/litre water at tillering and heading stage recorded higher leaf area index and dry matter accumulation, it was statistically at par with (F5, F2 and F1) also minimum note down in F7 sprayed with water. However 120 DAS significantly greater leaf area index and dry matter accumulation observed with T6, it was statistically at par with F5. This may be due to the stimulating effect of substances that promote growth, such as IUA, IMA, gibberellins, cytokinins, vitamins, amino acids and trace elements. The result supported with founding Shah *et al.* (2012) [15] Biswajit *et al.* (2013) [2] Devi and Mani (2015) [5] this increase may be due to the presence of plant growth regulators, i.e. cytokinin, gibberellin, trace elements, vitamins and trace elements in the extract. Thus, physiological responses were induced by foliar feeding of seaweed juice, which improved nutrient mobilization as well as partitioning, increased leaf area, dry matter production, and crop growth rate.

Factor (C) NPK doses significantly maximum growth parameters *viz.*, plant height, numbers of tillers, leaf area index, dry matter accumulation, observed after 30 DAS at all growth stage with 100% NPK than 75% NPK, it might be due to high doses of fertilizers.

Table 1: Effect of foliar application of seaweed extract under different levels of NPK on plant height and number of tillers on wheat

Treatments	Growth parameters					
	Plant height			Number of tillers		
	30 DAS	90 DAS	At harvest	30 DAS	90 DAS	At harvest
Factor- A Seed treatments						
S1- Seed treatment	16.93	69.41	99.18	199.07	364.69	348.74
S2- Seed priming	17.40	69.76	99.93	201.07	366.26	350.05
S3- Control	16.83	68.93	97.95	198.76	358.38	347.21
SEm (±)	0.25	0.72	1.14	2.95	5.90	6.03
CD (5%)	NS	NS	NS	NS	NS	NS
Factor – B Foliar application of seaweed extract						
F1	16.96	69.86	97.41	199.83	364.5	351.67
F2	16.87	70.38	98.08	199.56	366.39	352.33
F3	17.41	69.95	98.59	200.11	361.17	353.78
F4	17.03	70.64	99.07	199.33	361.93	354.61
F5	17.24	72.66	101.85	199.50	365.33	356.42
F6	17.09	73.55	102.93	199.39	366.18	358.82
F7	17.32	68.91	95.90	199.72	359.61	343.44
SEm (±)	0.45	1.05	1.59	6.56	9.81	8.41
CD (5%)	NS	NS	NS	NS	NS	NS
Factor- C (NPK) different doses						
N1- 75% NPK	16.94	68.03	96.93	198.57	340.62	324.53
N2- 100% NPK	17.18	70.64	100.64	200.70	363.9	352.49
SEm (±)	0.19	0.53	0.54	2.27	5.15	4.41
CD (5%)	NS	1.52	1.54	NS	19.89	16.78
A x B	NS	NS	NS	NS	NS	NS
A x C	NS	NS	NS	NS	NS	NS
B x C	NS	NS	NS	NS	NS	NS
A x B x C	NS	NS	NS	NS	NS	NS

Table 2: Effect of foliar application of seaweed extract under different levels of NPK on leaf area index and dry matter accumulation on wheat

Treatments	Growth parameters					
	Leaf area index			Dry matter accumulation		
	30 DAS	90 DAS	120 DAS	30 DAS	90 DAS	120 DAS
Factor- A Seed treatments						
S1- Seed treatment	0.23	3.58	3.50	15.62	562.67	995.19
S2- Seed priming	0.24	3.60	3.53	15.70	563.60	996.02
S3- Control	0.22	3.54	3.48	15.02	560.10	994.31
SEm (±)	0.02	0.05	0.06	0.18	5.61	8.20
CD (5%)	NS	NS	NS	NS	NS	NS
Factor – B Foliar application of seaweed extract						
F1	0.23	3.66	3.46	15.40	568.34	991.63
F2	0.23	3.75	3.47	15.28	586.41	992.81
F3	0.22	3.45	3.41	15.29	544.79	993.46
F4	0.23	3.48	3.46	15.62	548.54	995.46
F5	0.24	3.85	3.77	15.44	574.45	1007.66
F6	0.22	3.89	3.84	15.51	595.25	1030.28
F7	0.23	3.17	3.05	15.35	538.32	954.89
SEm (±)	0.02	0.07	0.07	0.26	9.66	10.26
CD (5%)	NS	0.38	0.27	NS	27.70	29.42
Factor- C (NPK) different doses						
N1- 75% NPK	0.22	3.48	3.40	15.14	549.30	977.08
N2- 100% NPK	0.23	3.67	3.60	15.75	574.95	1013.26
SEm (±)	0.01	0.05	0.04	0.14	4.66	5.04
CD (5%)	NS	0.14	0.12	0.41	13.30	14.39
A x B	NS	NS	NS	NS	NS	NS
A x C	NS	NS	NS	NS	NS	NS
B x C	NS	S	S	S	S	S
A x B x C	NS	NS	NS	NS	NS	NS

However, the interaction effect that existing in Tables (2.1, 2.2, 2.3, 2,4, 2,5 and 2,6) among seed treatment factor (A) and foliar application of seaweed extract factor (B) did not show significant impact on growth parameters, but the interaction effect among foliar application of seaweed extract factor (B) and NPK level factor (C) had a significant outcome on growth parameters *viz*., leaf area index, dry matter accumulation under (F6) with foliar application of seaweed extract @ 4 ml/liter water at tillering and heading + RDF 100% which was statistically at par (F5) with foliar application of seaweed extract @ 2 ml/liter water at tillering and heading + RDF 75%, while minimum was recorded in control (F7) water sprayed + 100% RDF. As a final point interaction effects between seed treatment (A) × foliar application of seaweed extract (B), and NPK doses (C) A × B × C showed a non-significant effect on growth parameters. Similar kind of results were reported on (Bai *et al*., 2008; Pramanick *et al*., 2012 [10] and Shankar *et al*., 2015) [1, 10, 18] The result was in agreement with the findings of Bastia *et al*. (2013) and Rathore *et al*. (2009) [13]. Khan *et al*. (2009) [9], Singh *et al*. 2018 [14].

Table 3: Interaction effect of foliar application of seaweed extract and NPK doses on Leaf area index at 60 days

NPK- Doses	Foliar application of seaweed extract							
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**Mean**
N1:75%	3.00	3.02	2.73	2.70	3.02	3.00	2.71	2.88
N2: 100%	3.19	3.23	2.89	2.90	3.18	3.23	2.91	3.07
Mean	3.10	3.12	2.81	2.80	3.10	3.11	2.81	
SEm (±)	0.11							
CD (5%)	0.31							

Table 4: Interaction effect of foliar application of seaweed extract and NPK doses on Leaf area index at 90

NPK- Doses	Foliar application of seaweed extract							
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**Mean**
N1:75%	3.58	3.67	3.39	3.40	3.72	3.76	2.99	3.48
N2: 100%	3.75	3.82	3.51	3.56	3.97	4.01	3.36	3.67
Mean	3.66	3.75	3.45	3.48	3.85	3.89	3.17	
SEm (±)	0.12							
CD (5%)	0.33							

Table 5: Interaction effect of foliar application of seaweed extract and NPK doses on Leaf area index at 120 days

NPK- Doses	Foliar application of seaweed extract							
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**Mean**
N1:75%	3.30	3.30	3.22	3.25	3.63	3.70	2.87	3.40
N2: 100%	3.62	3.64	3.61	3.76	3.85	3.91	3.24	3.60
Mean	3.46	3.47	3.41	3.46	3.77	3.84	3.05	
SEm (±)	0.11							
CD (5%)	0.26							

Table 6: Interaction effect of foliar application of seaweed extract and NPK doses on dry matter accumulation g/m^2 at 60 days

NPK- Doses	Foliar application of seaweed extract							
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**Mean**
N1:75%	198.17	196.50	183.94	184.31	198.81	195.95	184.03	191.67
N2: 100%	205.42	212.68	191.13	192.89	205.02	212.65	195.37	202.97
Mean	201.80	204.39	187.53	188.60	201.92	204.30	189.70	
Sem (±)	6.04							
CD (5%)	17.24							

Table 7: Interaction effect of foliar application of seaweed extract and NPK doses on Dry matter accumulation g/m^2 at 90 days

NPK- Doses	Foliar application of seaweed extract							
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**Mean**
N1:75%	554.19	578.01	527.43	531.44	561.39	588.50	523.66	552.08
N2: 100%	582.50	594.82	562.15	565.64	587.52	602.11	546.99	577.39
Mean	568.34	586.41	544.79	548.54	574.45	595.30	538.32	
Sem (±)	12.33							
CD (5%)	35.03							

Table 8: Interaction effect of foliar application of seaweed extract and NPK doses on Dry matter accumulation g/m^2 at 120 days

NPK- Doses	Foliar application of seaweed extract							
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**Mean**
N1:75%	975.78	976.52	977.13	977.59	993.47	1002.00	937.08	977.08
N2: 100%	1007.48	1009.10	1009.78	1013.32	1021.86	1058.57	972.70	1013.26
Mean	991.63	992.81	993.46	995.46	1007.66	1030.28	954.89	
Sem (±)	13.34							
CD (5%)	38.09							

Conclusion

The research finding on the basis of one years experimentation reveal that foliar application of seaweed extract 4 ml/litre water at tillering and heading stage + 100% NPK observed maximum growth parameters, also statistically at par 75% NPK with foliar application of seaweed extract @ 4 ml/water at tillering and heading stage, as compared to control water sprayed.

Acknowledgement

The authors are acknowledging to ICAR and Government of India for providing fellowship to complete my Ph.D. degree, also thanks to SKAUAST-J to make available all the accommodation and necessary facilities to undertake the studies. I would like to express my heartfelt thanks to Dr. B.C Sharma professor and Head Division of Agronomy for his valuable suggestions, and express my deep gratitude to all my advisory committee for their guidance and support.

Conflict of Interest: Nil.

References

1. Bai NR, Banu NR, Prakash JW, Goldi SJ. Effect of seaweed extracts (SLF) on the growth and yield of *Phaseolus aureus* L. Journal of Indian Hydrobiology. 2008;11:113-119.
2. Biswajit PK, Koushik BI, Arup GH. Effect of seaweed saps on growth and yield improvement of green gram. African Journal of Agricultural. 2013;8(13):1180-1186
3. Dwivedi SK, Meshram MR, Pal A, Pandey N, Ghosh A. Impact of natural organic fertilizer (seaweed saps) on productivity and nutrient status of blackgram (*Phaseolus mungo* L.). Bioscan. 2014;9(4):1535-1539
4. Durand N, Brian X, Meyer C. The effect of marine bioactive substances (N PRO) and exogenous cytokinins on nitrate reductase activity in *Arabidopsis thaliana*. Physiologia. Plantarum. 2003;119(4):489-493.
5. Devi NL, Mani S. Effect of seaweed saps *Kappaphycus alvarezii* and *Gracilaria* on Growth, Yield and Quality of Rice. Ind J of Sci and Tech. 2015;8(19):47610, ISSN (Print): 0974-6846.
6. Elansary HO, Skalicka-Wozniak K, King IW. Enhancing stress growth traits as well as phytochemical and antioxidant contents of Spiraea and Pittosporum under seaweed extract treatments. Plant physiology and biochemistry. 2016;105(2):310-320.
7. FAO. Yearbook of fishery statistics, Food and Agricultural Organisation of the United Nations, Rome. 2006;98:1-199.
8. Gomathi R, Kohila S, Ramachandiran K. Evaluating the Effect of Seaweed Formulations on the Quality and Yield of Sugarcane. Madras Agric. J. 2017;104(4-6):161-165.
9. Khan W, Rayirath UP, Subramanian S, Jithesh MN, Rayorath P, Hodges DM, *et al*. Seaweed extracts as biostimulants of plant growth and development. Journal of Plant Growth Regulation. 2009;28(4):386-399.
10. Pramanick B, Brahmachari K, Ghosh A. Effect of seaweed saps on growth and yield improvement of green gram. African Journal of Agricultural Research. 2012;8(13):1180-1186.
11. Ramadas S, Kiran KTM, Pratap Singh G. Wheat Production in India: Trends and Prospects. Recent Advances in Grain Crops Research, 2020, 1-18.
12. Russo RO, Beryln GP. The use of organic bio-stimulants to help low inputs. Journal of Sustainable Agriculture. 1990;1(2):9-42.
13. Rathore SS, Chaudhary DR, Boricha GN, Ghosh A, Bhatt, BP, Zodape ST. Effect of seaweed extract on the growth, yield and nutrient uptake of soybean (*Glycine max*) under rainfed conditions. S. Afr. J Bot. 2009;75(2):351-355
14. Singh SK, Thakur R, Singh CS, Pal SK, Singh A. Studies on Efficacy of Seaweed Extract and Fertility Levels on Growth, Yield and Economics of Rice. Int. J Curr. Microbiol. App. Sci. 2018;7:3056-3065.
15. Shah MT, Zodape ST, Doongar Ram Chaudhary, Karuppanan Eswaran, Jitendra Chikara. Seaweed sap as an alternative liquid fertilizer for yield and quality improvement of wheat. Journal of Plant Nutrition. 2012;36(2):192-200.
16. Satpathy BS, Pun KB, Singh T, Rautaray SK. Effect of liquid seaweed sap on yield and economics of summer rice. Oryza. 2014;51(2):131-135.
17. Sethi SK, Adhikary SP. Effect of seaweed liquid fertilizer on vegetative growth and yield of black gram, brinjal and tomato. Seaweed Res. Utiln. 2008;30:241-248.
18. Shankar T, Malik GC, Banerjee M, Ghosh A. Effect of Sea Weed Extracts on the Growth, Yield Attribute and Nutrient Uptake of Sesame (*Sesamum indicum* L.). International Journal of Bio-resource and Stress Management. 2015;6(3):420-423.
19. Turan M, Köse C. Seaweed extracts improve copper uptake of grapevine. Acta Agriculturae Scandinavica. 2004;4(2):213-220.
20. Tandel KV, Joshi NH, Tandel GM, Patel MR, Tandel JT. Seaweed Cultivation in India, a New Opportunity of Revenue Generation Advances in Life Sciences. 2016;5(7):2487-2491.
21. Zodape ST, Kawarkhe VJ, Patolia JS, Warade AD. Effect of liquid seaweed fertilizer on yield and quality of okra (*Abelmoschus esculentus* L.). Journal of Scientific and Industrial Research. 2008;67(3):1115-1117.
22. Zhang X, Ervin EH, Schmidt ER. Plant growth regulators can enhance the recovery of Kentucky bluegrass sod from heat injury. Crop Sci. 2003;43(3):952-956.