*International Journal of Bio-resource and Stress Management* 2015, 6(3):420-423 DOI:10.5958/0976-4038.2015.00064.0

**Short Research Article**

# Effect of Sea Weed Extracts on the Growth, Yield Attribute and Nutrient Uptake of Sesame (*Sesamum indicum* L.)

**Tanmoy Shankar[1*], G. C. Malik[1], M. Banerjee[1] and A. Ghosh[2]**

[1]Dept. of ASEPAN, Institute of Agriculture, Visva-Bharati, Sriniketan, Birbhum, West Bengal (731 236), India

[2]Central Salt and Marine Chemicals Research Institute, Bhavnagar, Gujarat (364 002), India

**Article History**

Manuscript No. AR777
Received in 18th May, 2014
Received in revised form 8th April, 2015
Accepted in final form 6th June, 2015

**Correspondence to**

*E-mail*: tanmoy.shankar125@gmail.com

***Keywords***

Sesame, *Gracilaria, Kappaphycus,* sea weed extracts

**Abstract**

A field experiment was conducted during the summerseason at Agriculture farm in 2011-12 to study the effects of seaweed saps on growthand nutrient uptake of sesame in red lateritic soil of West Bengal. The foliar spray was applied thrice at seedling, pre-flowering and flowering stages with different concentrations (5.0, 7.5, 10.0 and 15.0%) of seaweed extracts (namely *Kappaphycus* and *Gracilaria*). Foliar applications of seaweed extract significantly enhanced the growth and nutrient uptake. The maximum plant height, dry matter, LAI and CGR was also achieved with the application of 15% seaweed extract. The highest dry matter production, seed yield nutrient uptake was recorded with applications of 15% *Gracilaria* sap+recommended dose of fertilizer (RDF), followed by 10% and 15% *Kappaphykus* sap+RDF extract resulting in an increased percentage of growth and nutrient uptake by the plant, respectively compared to the control. A wide range of beneficial effects have been reported from the use of liquid seaweed extracts, including increased crop yields, increased uptake of inorganic constituents from the soil. Hence this simple practice of application of eco-friendly seaweed liquid fertilizers to crops may be useful for the growers for attaining better growth and yield parameter. Findings of this work are useful to further research to evaluation the plant vigour and yield. Integrated use of sea weed liquid fertilizer in combination with the chemical fertilizer and their proper management for better growth and yield.

## 1. Introduction

Sesame is an important edible oilseed crop. The seed contains all essential amino acids and fatty acids increased grain yield and its quality (Shilpi et al., 2012). Marine bioactive substances extracted from marine algae are used in agricultural and horticultural crops, and many beneficial effects, in the terms of enhancement of yield and quality have been reported (Blunden, 1991; Crouch and Van Staden, 1994). The benefits of seaweeds as sources of organic matter and fertilizer nutrients have led to their use as soil conditioners for centuries. Liquid extracts obtained from seaweeds have recently gained importance as foliar sprays for many crops including various grasses, cereals flowers and vegetable species. An improvement in agricultural system that results in higher production should reduce the negative environmental impact and enhance the sustainability of the system. Long-standing haphazard use of them invites the crucial problem of soil health disorder vis-a-vis reduced input use efficiency, more precisely, fertilizer use efficiency. Due to these reasons the farmers are being compelled gradually day by day to turn towards various options like organic manures, biostimulants, growth regulators etc. One such approach is the use of biostimulants, which can enhance the effectiveness of conventional mineral fertilizers. One of such options is the use of seaweed extracts as plant nutrient bearing fertilizer. Especially in rainfed crops, as a means to avoid excessive fertilizer applications and to improve mineral absorption. Unlike, chemical fertilizers, extracts derived from seaweeds are biodegradable, non-toxic, non-polluting and non-hazardous to humans, animals and birds (Dhargalkar and Pereira, 2005). The objectives of this study were to investigate the effect of sea weed extract on Growth, Yield, productivity and quality of sesame crop.

## 2. Material and Methods

### *2.1. Study area*

A field experiment was conducted during summer season of 2012 to study the effect of sea weed extracts on the growth,

yield attribute and nutrient uptake of sesame at the farm of the Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal, India located at 23°39´ N latitude, 87°42´ E longitude and an elevation of 58.9 m above msl. Thirteen treatments namely; $T_1$ (Control+RDF) , $T_2$ (5% K+100% RDF) , $T_3$ (7.5% K+100% RDF) , $T_4$ (10% K+100% RDF), $T_5$ (15% K+100% RDF), $T_6$ (5% G+100% RDF), $T_7$ (7.5% G+100% RDF), $T_8$ (10% G+100% RDF), $T_9$ (15% G+100% RDF), $T_{10}$ (7.5% K+75% RDF), $T_{11}$ (7.5% G+75% RDF), $T_{12}$ (7.5% K+50% RDF) and $T_{13}$ (7.5% G+50% RDF) were designed in RBD replicated thrice. The fertilizers were applied considering 80:40:40 kg of $N:P_2O_5:K_2O$ $ha^{-1}$ as recommended dose other than decomposed organic manure. The sources of fertilizers were urea for N; Single super phosphate (SSP) for P and Muriate of potash (MOP) for K. Half dose of N and full dose of Pand K were applied as basal dose before sowing of seeds. The remaining half of nitrogen was applied as top dressing at 35 days after sowing i.e. at branching stage. Irrigation a light irrigation was given just after sowing (3 DAS) to facilitate germination since there was moisture shortage at the time of sowing. Thereafter, four irrigations were given to the crop at 18, 33, 48, 65 days after sowing i.e. pre-sowing, pre-flowering, flowering and capsule formation stage, respectively. Other cultural practices were taken care as and when necessary. Sap Spray the sea weed saps of *Kapphaphycus* and *Gracilaria* as per treatments were sprayed in the sesame field on 11.04.2012 (30 DAS), on 21.04.12 and on 15.05.2012. The concentration of sap application varied from 5.0%, 7.5%, 10% and 15% (v/v basis) as per treatments using water @ 600 l $ha^{-1}$ in each spray. The water spray in the control plot was also done on the same days with the same amount of water. Adjuvant was mixed in the tanks before spraying. For each spray, about 6-8 labours were hired. The observation on plant height was recorded from 10 plants in each plot at different stages. At 60 DAS Plant height, SPAD chlorophyll reading,dry matter, leaf area index, crop growth rate are recorded.

## 3. Results and Discussion

### *3.1. Growth attributes*

The observed taken at 60 DAS of the sesame crop. The highest plant height of 102.5 cm was recorded with the treatment of $T_9$ (15% *Gracilaria*along with 100% RDF) which was statistically at par with $T_7$, $T_8$, $T_6$, $T_5$ and $T_3$, respectively and significantly higher than all other treatments. The least plant height of 85.7 cm was observed from the $T_1$ (water+RDF) which was statistically at par with $T_2$, $T_4$, $T_{10}$, $T_{11}$, $T_{12}$ and $T_{13}$ and was significantly lower than all other the treatments. Even at 60 DAS, the maximum dry matter was recorded in the treatment $T_9$ (15% *Gracilaria*+100% RDF) which was statistically at par with $T_8$ (10% *Gracilaria*+100% RDF) and significantly higher than all other treatments. The lowest dry matter was recorded in treatment $T_1$ (Water+RDF). The higher value of LAI at 40-60 DAS was due to better growth and productivity of the crop. Lower LAI values were observed at maturity stage, due to senescence of green leaves. The lowest LAI values at all growth stages were observed in $T_1$ (water+RDF) and the values were statistically at par with $T_{10}$ and $T_{12}$. Crop growth rate (CGR) at 60-80 DAS was influenced significantly by different treatment combinations under study in (Table 1). The CGR was decreased with advancement of the crop growth period. The highest CGR during 60-80 DAS was recorded in $T_9$ -125, 15% G+100% RDF which was statistically at par with treatments $T_8$ and $T_{12}$. Due to maximum plant height and branching directly affect in dry mater with maturity of different crops which was reported by Atzmon and Staden (1994), Sivasankari et al. (2006); Benjamaet al. (2011-2012) also woke on dry matter production, The results of this experiment confirmed with the findings obtained by Pramanick et al. (2013), and they reported that the CGR decreased with advancement of the crop growth period.

### *3.2. Yield components*

Data recorded on number of capsules $plant^{-1}$ at maturity (90 DAS) were statistically analyzed and placed in Table 1. The number of capsules $plant^{-1}$ increased significantly due to use of seaweed extract with different fertilizer doses which was recorded according to the study. the highest number of capsules $plant^{-1}$ i.e. 167.33 was observed in $T_9$ where 15% *Gracilaria*+100% RDF and it was significantly greater than all other treatments except the treatment 10% *Kappaphycus*+100% RDF, 15% *Kappaphycus*+100% RDF and 10% G+100% RDF respectively, which was statistically at par. The lowest number of capsules $plant^{-1}$ was observed in ($T_1$) water+RDF and it was significantly lower than all other treatments except the treatment $T_{10}$, $T_2$, $T_{11}$, $T_{12}$, $T_4$, $T_{13}$ and $T_3$. The data on the number of effective branches (capsule bearing branches) $plant^{-1}$ as recorded at harvest were statistically analyzed and presented in (Table 1). The results showed that crop receiving application of 100% recommended dose of fertilizer along with 15% *Gracilaria* ($T_9$) recorded significantly higher number of branches $plant^{-1}$ as compared to those of the crop having other treatment and it was statistically at par with $T_7$ and $T_8$, respectively. The lowest Number of branches $plant^{-1}$ (10.01) was observed in $T_1$ where water+RDF was applied and it was significantly lower than all other treatments except the treatment $T_3$, $T_6$, $T_{10}$, $T_2$, $T_{11}$, $T_{12}$, $T_4$, $T_{13}$ and $T_5$ which were statistically at par. Data recorded on number of seeds $capsule^{-1}$ at maturity (90 DAS) were statistically analyzed and placed in Table 1. All the treatments showed considerable effect on

Table 1: Effect of sea weed extract applied on growth and yield components of summer sesame

| Treatment levels | Growth attributes | | | | | Yield components | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plant ht (cm) 60 DAS | SPAD 60 DAS | Dry matter 60 DAS | LAI (40-60 DAS) | CGR ($gm^{-2}$ $day^{-1}$) (60-80 DAS) | Capsules $plant^{-1}$ | Branches $plant^{-1}$ | Seeds $capsule^{-1}$ | Test weight (g) |
| $T_1$: Water+RDF | 85.70 | 33.57 | 90.30 | 1.72 | 1.90 | 121.01 | 10.01 | 53.97 | 3.10 |
| $T_2$: 5% K+100% RDF | 89.10 | 36.31 | 121.50 | 2.00 | 2.13 | 130.33 | 10.50 | 63.33 | 3.20 |
| $T_3$: 7.5% K+100% RDF | 94.00 | 36.51 | 124.10 | 2.40 | 2.22 | 137.67 | 11.10 | 61.93 | 3.20 |
| $T_4$: 10% K+100% RDF | 93.70 | 36.08 | 128.50 | 2.70 | 2.10 | 152.67 | 11.50 | 60.60 | 3.20 |
| $T_5$: 15% K+100% RDF | 94.00 | 36.66 | 131.30 | 2.85 | 1.98 | 156.33 | 12.00 | 62.50 | 3.60 |
| $T_6$: 5% G+100% RDF | 96.40 | 36.92 | 140.20 | 2.33 | 2.11 | 144.33 | 12.50 | 63.57 | 3.15 |
| $T_7$: 7.5% G+100% RDF | 97.60 | 36.15 | 160.00 | 2.73 | 2.93 | 147.67 | 13.83 | 65.03 | 3.20 |
| $T_8$: 10% G+100% RDF | 98.70 | 32.83 | 177.20 | 2.80 | 3.70 | 149.00 | 13.50 | 66.67 | 3.60 |
| $T_9$: 15% G+100% RDF | 102.50 | 37.98 | 185.20 | 2.85 | 3.86 | 167.33 | 15.33 | 72.67 | 3.15 |
| $T_{10}$: 7.5% K+75% RDF | 89.90 | 34.77 | 120.60 | 1.90 | 2.35 | 125.67 | 10.50 | 62.70 | 3.20 |
| $T_{11}$: 7.5% G+75% RDF | 93.00 | 35.20 | 121.10 | 1.92 | 2.27 | 132.33 | 11.50 | 66.03 | 3.15 |
| $T_{12}$: 7.5% K+50% RDF | 86.20 | 35.13 | 117.70 | 1.88 | 2.37 | 133.67 | 11.50 | 60.00 | 3.25 |
| $T_{13}$: 7.5% G+50% RDF | 90.00 | 34.47 | 118.00 | 1.91 | 2.27 | 134.33 | 11.00 | 60.50 | 3.30 |
| SEm± | 2.90 | 1.12 | 5.53 | 0.09 | 0.09 | 6.39 | 0.81 | 4.55 | 0.10 |
| CD ($p$=0.05) | 8.60 | 3.29 | 16.14 | 0.26 | 0.27 | 18.67 | 2.39 | 13.29 | 0.29 |

increasing number of seeds $capsule^{-1}$ over that of the water plots. The maximum number of seeds $capsule^{-1}$ (72.67) was obtained from the plots treated with 15% *Gracilaria* (G)+100% recommended dose of fertilizer significantly higher number than all other treatment and it was statistically at par with the treatment $T_8$, $T_{11}$, $T_7$, $T_6$, $T_2$, $T_{10}$, $T_5$, $T_3$, $T_4$, $T_{12}$ and $T_{13}$. This might be due to better nutrition of the crop particularly during seed development period by this combination of nutrient management. The lowest number of seeds $capsule^{-1}$ (53.97) was observed in $T_1$ (water+RDF). The results indicated that test weight was marginally higher in 10% *Gracilaria*+100% RDF ($T_9$) and 15% *Kappaphycus*+100% RDF ($T_5$). The lower values of test weight were observed in treatments where only water+100% RDF was applied either solely or in combination and it was statistically at par with $T_5$ (15% K+100% RDF). It can be inferred that availability of greater amount of nutrients probably resulted in bolder seeds which might have been instrumental in improving the test weight. All the yield attributes indicated that the use of both seaweed extract and inorganic sources of plant nutrient was most conducive in improving growth and yield components of sesame. The results validate by the findings of Ferreira and Lourens (2002), Zodape et al. (2009); Pramanick et al. (2013); Shah et al. (2012) in several other crops.

*3.3. Total nutrient uptake*

The highest total N, P and K uptake value was observed in the treatment $T_9$ (15% G+100% RDF) which was statistically at par with the treatment $T_8$ (10% *Gracilaria*+100% RDF) and it was significantly higher than all other treatment. Higher uptake of nutrients with above treatments was attributed to higher biological yield due to sufficient availability of nutrients in suitable proportion from diversified sources, prolonged availability of nutrients and probably availability of growth regulators to crop. The lowest value was recorded in the water plots. The highest total P uptake was observed in the treatment $T_9$ (15% *Gracilaria*+100% RDF). The lowest quantity of P was taken up by the plants without receiving sea weed extract in treatment $T_1$ (Water+RDF). The highest total K uptake was observed in the treatment $T_9$ (15% *Gracilaria*+100% RDF) which was statistically at par with the treatment $T_8$ (10% *Gracilaria*+100% RDF) and it was significantly higher than all other treatment. The lowest in water treatment. So, it improves crop quality as well as uptake of nitrogen (N), phosphorus (P) and potassium (K) that was observed with seaweed extract applications and presented in (Table 2). Rathore et al. (2009); Pramanick et al. (2013) worked on green gram and shah et al. (2012) studiedon wheat, where they reported the increase in uptake of N, P and K with the foliarapplication of seaweed extract.

Table 2: Effect ofsea weed extracton total nutrient uptake

| Treatments | Uptake N (kg ha$^{-1}$) | | | Uptake P (kg ha$^{-1}$) | | | Uptake K (kg ha$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Seed | Stick | Total | Seed | Stick | Total | Seed | Stick | Total |
| $T_1$ | 7.56 | 2.00 | 9.56 | 1.45 | 0.29 | 1.74 | 1.12 | 6.45 | 7.57 |
| $T_2$ | 12.67 | 5.93 | 18.60 | 4.60 | 0.67 | 5.27 | 2.69 | 13.20 | 15.89 |
| $T_3$ | 12.95 | 6.95 | 19.90 | 4.93 | 0.69 | 5.62 | 2.80 | 14.27 | 17.07 |
| $T_4$ | 14.38 | 8.29 | 22.67 | 5.62 | 0.74 | 6.36 | 3.09 | 17.51 | 20.60 |
| $T_5$ | 16.72 | 9.30 | 26.03 | 5.97 | 0.79 | 6.76 | 3.27 | 20.43 | 23.70 |
| $T_6$ | 20.47 | 6.55 | 27.02 | 6.11 | 0.80 | 6.91 | 3.36 | 21.18 | 24.54 |
| $T_7$ | 21.01 | 8.00 | 29.01 | 6.40 | 0.78 | 7.18 | 3.73 | 21.24 | 24.97 |
| $T_8$ | 21.96 | 9.16 | 31.12 | 6.77 | 0.85 | 7.62 | 3.67 | 25.36 | 29.03 |
| $T_9$ | 24.62 | 10.11 | 34.73 | 7.94 | 1.03 | 8.97 | 4.21 | 28.10 | 32.31 |
| $T_{10}$ | 11.25 | 5.29 | 16.54 | 2.97 | 0.70 | 3.68 | 2.25 | 10.29 | 12.54 |
| $T_{11}$ | 11.18 | 5.76 | 16.95 | 3.13 | 0.73 | 3.86 | 2.46 | 12.59 | 15.05 |
| $T_{12}$ | 10.72 | 4.30 | 15.01 | 2.75 | 0.65 | 3.40 | 1.99 | 10.06 | 12.04 |
| $T_{13}$ | 10.91 | 5.05 | 15.97 | 2.96 | 0.64 | 3.60 | 2.23 | 11.15 | 13.38 |
| SEm± | 0.94 | 0.43 | 1.37 | 0.28 | 0.04 | 0.28 | 0.16 | 0.87 | 1.14 |
| CD ($p$=0.05) | 2.75 | 1.27 | 4.00 | 0.83 | 0.11 | 0.83 | 0.47 | 2.53 | 3.34 |

## 4. Conclusion

In sesame crop, 15% *Gracilaria* sap+recommended dose of fertilizer recorded maximum plant height, dry matter, LAI and CGR dry matter production, seed yield nutrient uptake. Application of eco-friendly seaweed liquid fertilizers may be advised for farmers' practice of cultivation, however needs confirmation of findings before recommendation.

## 5. Reference


Atzmon, N., Staden, J.V., 1994. The effect of seaweed concentrate on the growth of pinuspinea seedlings. South African Journal of Botany 8(3), 279-288.

Benjama, O., Masniyom , P., 2011. Nutritional composition and physicochemical properties of two green seaweeds (ulvapertusa and u. Intestinalis) from the pattani bay in southern Thailand. Songklanakarin Journal of Science and Technology 33(5), 575-583.

Benjama, O., Masniyom, P., 2012. Biochemical composition and physicochemical properties of two red seaweeds (*Gracilaria fisheri* and *G. tenuistipitata*) from the pattani bay in southern thailand.songklanakarin. Journal of Science and Technology 34(2), 223-230.

Blunden, G., 1991. Agricultural uses of seaweeds and seaweed products. In: Guiry, M.D., Blunden, G. (Eds.), Seaweed Resources in Europe: Uses and Potential. John Wiley and Sons, Chichester, 65–81.

Crouch, I.J., Van Staden, J., 1994. Commercial seaweed products as biostimulants in horticulture. Journal of Home and Consumer Horticulture 1, 19-76.

Dhargalkar, V.K., Pereira, N., 2005. Seaweed: promising plant of the millennium. Science and Culture 71, 60-66.

Ferreira, M.I., Lourens, A.F., 2002. The efficacy of liquid seaweed extract on the yield of Canola plants. South. Africa Journal of Plant Soil 19, 159-161.

Pramanick, B., Brahmachari. K., Ghosh, A., 2013. Effect of seaweed saps on growth and yield improvement of green gram: African Journal of Agricultural Research 8(13), 1180-1186.

Rathore, S.S., Chaudhary, D.R., Boricha, G.N., Ghosh, A., Bhatt, B.P., Zodape, S.T., Patolia, J.S., 2009. Effect of seaweed extract on the growth, yield and nutrient uptake of soybean (*Glycine max*) under rainfed conditions. South African Journal of Botany 75, 351-355.

Shah, M.T., Zodape, S.T., Chaudhary, D.R., Karuppanan E.J.C., 2012. Seaweed sap as an alternative liquid fertilizer for yield and quality improvement of wheat. Journal of Plant Nutrition 36(2), 192-200.

Shilpi, S., Islam, M.N., Sutradhar, G.N.C., Husna, A., Akter, F., 2012. Effect of Nitrogen and Sulfur on the Growth and Yield of Sesame. International Journal of Bio-resource and Stress Management 3(2), 177-182.

Sivasankari, S., M., Chandrasekaran, K., Kannathasan and Venkatesalu, V. 2006. Effect of seaweed extracts on the growth and biochemical constituents of Vignasinensis.Bioresource Technology 97(14), 1745-1751.

Zodape S.T., Mukherjee, S., Reddy, M.P, Chaudhary, D.R., 2009. Effect of *Kappaphycus alvarezii* (Doty) Doty ex silva. extract on grain quality, yield and some yield components of wheat (*Triticum aestivum* L.). International Journal Plant Production 3(2), 97-101.