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Comparative efficacy of brown, red and green seaweed extracts on low vigour sunflower (*Helianthus annus* L.) var. TN (SUF) 7 seeds

K. Sujatha*, V. Vijayalakshmai and A. Suganthi

Department of Seed Science and Technology, Agricultural College and Research Institute, Madurai, Tamil Nadu, India.

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Extracts of the brown seaweeds (*Sargassum myricocystum*) red seaweed (*Gracilaria edulis*) and green seaweed (*Caulerpa racemosa*) have been used as a biostimulant to promote seedling emergence and vigour. The two different concentrations (1 and 5%) and soaking durations of (1:1 seed t solution ratio) were used. Results of the present study suggest that the sunflower seed soaked in 5% *C. racemosa* seaweed extract for 8 h performed significantly in all estimated characters (72% Germination; 15.95 cm Shoot length; 13.60 cm Root length; 0.399 OD Dehydrogenase activity; 0.277 dSm^{-1} electrical conductivity and lowest abnormal seedlings production 3%) can be recommended as a mid storage seed treatment for improving the vigour and viability of aged seeds.

Key words: Seaweed extracts, sunflower seeds and vigour.

INTRODUCTION

Seaweeds are one of the most important marine resources of the world. Seaweed extract is a new generation of natural organic fertilizers containing highly effective nutritious and promotes faster germination of seeds. Unlike, chemical fertilizers extracts derived from seaweeds are bio – degradable, non toxic, non – polluting and non – hazardous to humans, animals and birds (Dhargalkar and Untawale, 1983). Seaweeds are known to contain appreciable concentrations of plant growth regulators (Mooney and Van Staden, 1985), cytokinin (Smith and Van Staden, 1984). IAA (Abe et al., 1972), gibberellins and gibberellins like substabces (Bentley, 1960; Sekar and others, 1995).

Quality seed is the key for successful and sustainable agriculture. Tropical countries like India, due to prevalence of high temperature and relative humidity may greatly accelerate seed ageing. Loss of physiological quality during ageing leads to deterioration of seeds. Any treatment given to seeds at the time of packing for maintaining physiological stamina and germination will be advantageous. Use of organics (or) naturally occurring biological materials like seaweeds is a new approach for seed preservation. With this background the present study was undertaken to explore the possibility of utilizing

*Corresponding author. E-mail: sujathakvk@gmail.com

seaweed extracts in sunflower seeds.

MATERIALS AND METHODS

Seed material

Naturally aged seeds of Sunflower (*Helianthus annus* L.) cv. TN (SUF) 7 with 58% germination were used for this study.

Collection of seaweeds

The seaweeds *Sargassum myricocystum* (Brown algae); *Gracilaria edulis* (red algae) and *Caulerpa racemosa* (green algae) were collected from Mandapam coast, Tamil Nadu, India were washed with seawater initially to remove macroscopic epiphytes and sand particles, finally with fresh water to remove adhering salt.

Preparation of seaweed extracts

Seaweeds were shade dried for 4 to 5 days followed by oven drying at 45°C for 24 h and powdered from which 100 g powder was taken and 100 ml of alcohol was added then kept it for overnight with intermittent stirring and extracted through rotary evaporator and extract collected and stored in air tight container. This constitutes 100% extract.

Seed treatment

Graded seeds of low vigour sunflower treated with *S. myricocystum*, *G. edulis* and *C. racemosa* extracts with different concentrations of 1 and 5% for 8 h with 1:1 ratio (seed to solution) along with water and dry seeds as control.

Experiment

Treated seeds were subjected to germination test in paper medium in quadruplicate using 100 seeds for each treatment with four sub replicates of 25 seeds (ISTA, 1999) and kept in a germination room maintained at 25 ± 1°C and RH 96 ± 2% with diffused light (Approx. 10 h) during the day. Final count on normal seedlings was recorded on 10^{th} day and percentage germination, shoot and root length was computed.

Biochemical analysis

The electrical conductivity was measured by soaking 50 seeds in 50 ml of deionised water for 24 h (Presley, 1958) and dehydrogenase activity (Kittock and Law, 1968) was assessed using embryos from seeds soaked with water for 12 h.

Statistical analysis

The experiments were arranged in a factorial completely randomized design (FCRD) with four replicates. An analysis of variance (ANOVA) was made using SAS software. Correlation was assessed by using Microsoft Excel software. Significance of mean difference of the variable means was separated using LSD at P = 0.05.

RESULTS

Sunflower seed emergence and seedling growth studies

Sunflower seeds treated with *C. racemosa* 5% aqueous solution of seaweed extract showed significantly higher percent emergence, shoot length and root length over control and water. Higher germination of (72%), shoot length (15.53 cm) and root length (11.60 cm) was observed and it was on par with 5% seaweed extract of *S. myricocystum.* when compared to control seeds (51%, 11.17 cm and 9.9 cm for germination, shoot length and root length). The percent increase over control was 21, 39 and 18 for germination, shoot and root length (cm) (Figure 1 and Plate 1a). This suggested that the positive response of *Caulerpa* extract and its organic fractions were the maximum effect on seed emergence and seedling vigour.

Effect of seaweed extracts on biochemical attributes

Dehydrogeanse activity in sunflower seeds was significantly higher than that of the untreated control. When compared to control *Caulerpa* 5% extract showed higher dehydrogenase activity (0.399 OD value). These results suggest that the bio–active compounds that induce the dehydrogenase activity in sunflower are organic compounds that can be readily extracted into organic solvents. Generally the electrical conductivity of seed leachate values are related to membrane integrity and physiological quality of seed. In the present study *Caulerpa* 5% treated seeds showed lower electrical conductivity (0.277 d Sm^{-1}). EC values differed with the treatments owing to their differential influence of membrane integrity. The lower EC values recorded with these seeds treated with seaweed extract and the beneficial effect of prevention of lipid auto oxidation by antioxidants.

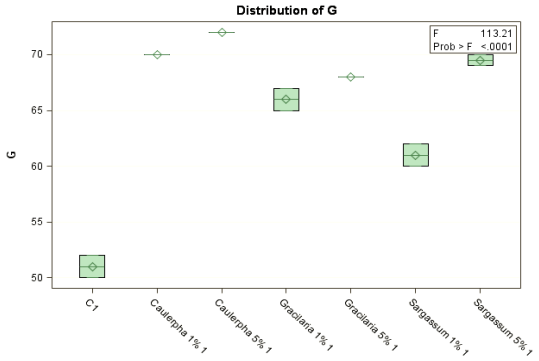
Abnormal seedling percentage

Abnormal seedling percentage differed significantly due to seaweed extracts. However, these abnormal seedlings percentage increased in control seeds (14) compared to other seaweed extracts *S. myricocystum* (7), *G. edulis* (8) and *C. racemosa* (5). Significantly lower abnormal seedling percentage (3%) was observed in seeds treated with *C. racemosa* 5% extract (Plate 1b).

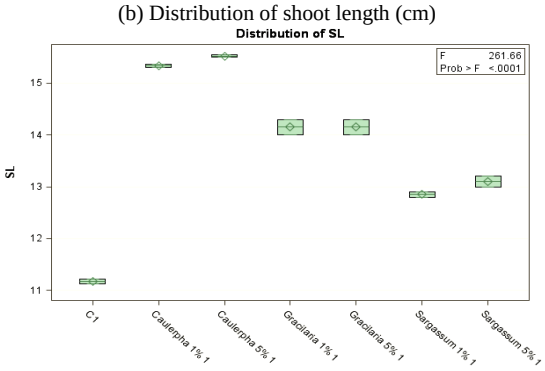
DISCUSSION

The beneficial effect of seaweed has attempted in many crops (Venkataraman et al., 1993) in blackgram and green gram;Gandhiappan and Perumal (2001) in sesame

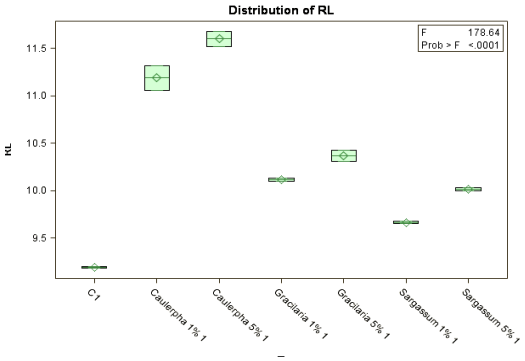
(a) Distribution og Germination %



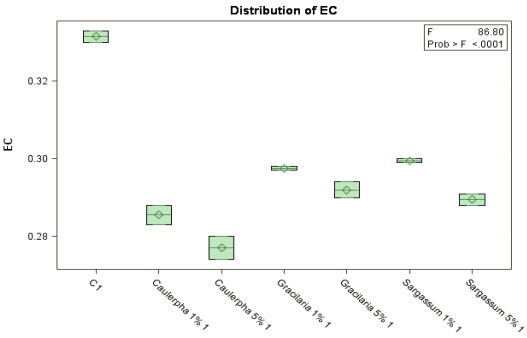
(b) Distribution of shoot length (cm)



(c) Distribution of root length (cm)



(d) Distribution of Electircal conductivity (dSm^{-1})



(e) Distribution of Dehydrogenase (OD value)

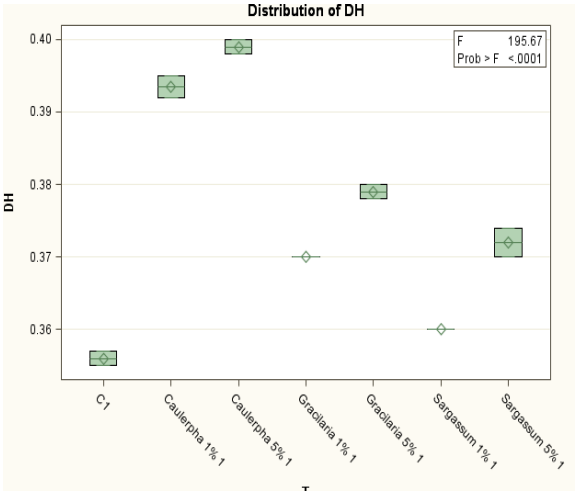


Figure 1. Effect of seaweed extract on low vigour sunflower seeds.

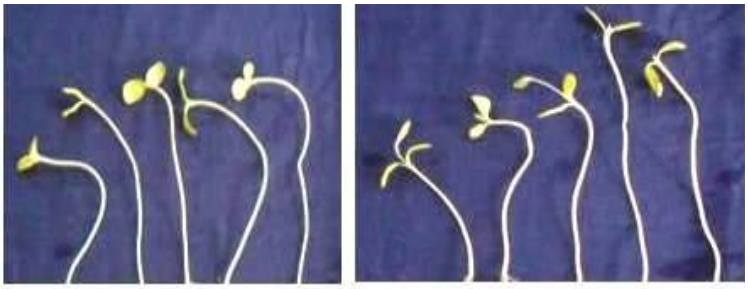
and Veeragurunathan et al., 2011 in capsicum). Being a cheap and abundant source of nutrients, minerals and natural antioxidants seaweeds will be beneficial in improving seedling emergence and vigour.

In the present study, among the seaweeds *C. racemosa* 5% extract shown to increase the seedling emergence and vigour over control. This enhanced growth effect is thought to be due to various organic compounds present in the seaweed extract. More specifically it is thought to be due to presence of phyto hormones mainly cytokinins in the seaweed extracts (Wrightman and Thimann, 1980; Steveni et al., 1992;

(a) Seed germination and seedling vigour

Control Treated seeds

Earliness in leaf formation



Control Treated seeds

(b) Abnormal seedlings

Control Treated seeds

Plate 1. *C. racemosa* (5%) seaweed extract on low vigour sunflower. (a) Seed germination and seedling vigour,(b) Abnormal seedlings.

Rayorath et al., 2008). They had observed that root growth – promoting effects of cytokinin in *Maxicrop triple* and *Ascophyllum nodosum* and these extracts improved root and shoot growth over control seeds. Early seed emergence and increased seedling vigour have a large effect on seedling establishment.

High enzyme activities were observed in seaweed treated seeds compared to water soaking and control and also lower abnormal seedling and EC values. The effect of seaweed extract particularly *Caulerpa* followed by *Gracilaria* and *Sargassum* would have contributed for antioxidant role in quenching of free radicals minimising peroxidant changes. The seaweeds *Caulerpa* have natural sources of vitamins A, C and E (Ratana – arporn and Chiropart,2006; Sivasankari et al., 1999; Matanjun et al., 2009; Sarojini et al., 2011). The promotional impact

Table 1. Correlations between various vigor parameters of treated sunflower seedling.

Parameter	G %	RL (cm)	SL (cm)	EC	DH	Abnormal (%)
G %	1.000					
RL (cm)	0.892**	1.000				
SL (cm)	0.851**	0.911**	1.000			
EC	-0.947**	-0.801**	-0.811**	1.000		
DH	0.843**	0.709*	0.864**	-0.805**	1.000	
Abnormal (%)	-0.903**	-0.948**	-0.974**	0.888**	-0.824*	1.000

*Significant at 5% (P = 0.05) level; **Significant at 1% level (P =0.01) - : Negatively correlated, G % - Germination %, RL – Root Length (cm), SL – Shoot length (cm), EC – Electrical Conductivity (dSm^{-1}), DH – Dehydrogenase activity(OD), Abnormal (%) – Abnormal seedlings %.

was more pronounced in the case of alcohol aqueous method. This may be due to growth promoting ingredients soluble either in alcohol or water getting completely isolated in the seaweed extracts (Sylvia et al., 2005; Vethanayagi et al., 2009; Jeba et al., 2010).

Correlation studies also shown that percentage of germination increase was positively correlated with shoot, root and dehydroenase activity and negatively correlated with electrical conductivity and abnormal seedling percentage (Table 1). It could be concluded that low vigour sunflower seeds treated with 5% *C. racemosa* seaweed extract obtained through rotary evaporator can be recommended for mid - storage seed treatment for improving seed vigour and viability.

Conflict of Interest

The authors have not declared any conflict of interest.

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