

## Effect of Seaweed Saps on Growth and Yield of Maize

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**Abstract:** A field experiment was conducted during Kharif, 2012-13 to study the effect seaweed saps on growth and yield of maize in red sandy loam soils of Telangana state. The foliar spray was applied thrice at different concentration of 5, 10, 15% v/v of seaweed extracts namely Kappaphycus and gracilaria. The grain yield of maize (DHM 117) was significantly higher with application of 10% Gracilaria sap spraying thrice + RDF (9306 kg/ha) application than compared to maize crop applied with 7.5% Kappaphycus sap + 50% recommended dose of fertilizer. The chlorophyll index at 60 DAS was significantly higher in 15% Gracilaria sap spraying thrice + RDF applied crop. The percent increase in grain yield of maize with application of 10% Gracilaria sap thrice was 22.9% than compared to 7.5 Kappaphycus sap +50% recommended dose of fertilizers application. While, it is 8.5% higher than compared to water sprayed with recommended dose of fertilizers applied crop.

**Keywords:** Seaweed saps, Kappaphycus, Gracilaria, Recommended dose of fertilizer, Maize.

### INTRODUCTION

Maize (*Zea mays* L) is an important cereal in many developing and developed countries of the world. The developing countries use it in general as food. While the developed world uses it widely as a major source of carbohydrate in animal feed and as industrial raw material for wet and dry milling. Keeping in view the potential of the crop, Maize seems to be a vital and alternate crop to bridge the noted productivity gap. There has been considerable interest in several of the developing countries to step up their maize production so as to meet their food, feed and industrial needs.

In the present scenario of sustainability for food security, besides the agronomic manipulation, great deals of interest have been shown in regulating the plant growth and development through bio-physiological manipulations. One such approach is the use of dried or fresh sea weeds and liquid extracts as bio stimulants which enable the plant to develop their morphological and physiological behavior in such a way that they can have best use

of existing as well as applied inputs. Liquid extracts derived from marine algal have been used over the past 40 years on various crops to promote growth and development which is mainly attributed to the presence major and minor nutrients, amino acids, vitamins and cytokinins (Zodape, 2011). Hence, the present experiment was conducted to evaluate the efficiency of sea weed sap extracts on Maize growth and yield.

### MATERIALS AND METHODS

An experiment was conducted during Kharif 2012-13 at Agricultural Research Station, Karimnagar situated at 79°15' East longitude and 18°30' North latitude with an elevation of 259.15 m above mean level. The experimental site was red sandy loam soils having neutral pH (6.64), medium in organic carbon (0.65%) and high available nitrogen (613.88 kg /ha), high in available phosphorus (62.84 kg/ha) and high in available potassium (436 kg/ha). The experiment was laid out in randomized block design with three replications and ten treatments.

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The details of the treatments are mentioned below.

T1 : 2.5% Kappaphycus sap + RDF

T2 : 5% Kappaphycus sap + RDF

T3 : 10% Kappaphycus sap + RDF

T4 : 15% Kappaphycus sap + RDF

T5 : 2.5% Gracilaria sap + RDF

T6 : 5% Gracilaria sap + RDF

T7 : 10% Gracilaria sap + RDF

T8 : 15% Gracilaria sap + RDF

T9 : RDF + Water spray

T10 : 7.5% Kappaphycus sap + 50% RDF.

It is covered under Northern Telangana agro climatic zone of Telangana state which falls under semi arid climate with dry hot summer and cold winters. The actual rainfall received during Kharif 2012-13 from June to October 2012 was 721.2 mm in 51 rainy days. The maximum temperature ranged from 31.9 to 35.7°C, while, the minimum temperature ranged from 23.2 to 26.4°C during the crop season. The crop was sown on 26-06-2012 with the plot size of 6 rows of 4 m width with crop spacing at 75 × 20 cm. The recommend dose of fertilizer (RDF) for maize was 200:60:50 Kg NPK/ha was applied, with entire phosphorus as basal, recommended dose of nitrogen in four equal splits *i.e.*, basal, 23, 42 and 55 DAS and recommended dose of potassium as basal (50%) and at flowering (50%). Three sprays of Kappaphycus and gracilaria extracts were applied at per-tasseling stage to flowering stage at 43, 57 and 66 DAS. The spray fluid was mixed with adjuvant sandovit @ 1 ml/litre water. The total spray volume of 500 litres/ha was applied in each application. The fertilizer, topdressing and spraying of sea weed extracts were not coincided. The other management practices were adopted as per recommended package of practices. The crop was harvested on 19-10-2012.

Data were taken through random sampling at 60 DAS to measure dry matter accumulation, leaf no./plant and leaf area of flag leaf by length × width method there by LAI was computed as the ratio of the leaf area to the area of ground cover. The

chlorophyll index was measured by chlorophyll meter. Data on yield attributes were taken randomly before harvesting. Plot yields were recorded on plot basis.

## RESULTS AND DISCUSSION

### Effect of Sea Weed Sap on Flowering of Maize

The data on the flowering of maize *i.e.* Day to 50% tasseling and silking showed that the flowering did not differ much among different concentrations of sprayings of Kappaphycus sap and Gracilaria sea weed sap and water spray (Table 1)

### Effect of Sea Weed Sap on Growth Parameters of Maize

The different growth parameters *i.e.* plant height, ear height at harvest, leaf no./plant, leaf area of flag leaf, dry matter/m<sup>2</sup>, leaf area index at 60 DAS and stem girth at 7<sup>th</sup> node at harvest for different treatments under test indicated no statistical difference among different doses of spraying applications of sea weed sap of Kappaphycus and Gracilaria and water spraying treatment except chlorophyll index at 60DAS differed significantly with different treatments under test.

The chlorophyll index at 60 DAS was significantly influenced by different spraying concentrations of sea weed sap. The 15% Gracilaria sap application has recorded significantly higher

**Table 1**  
**Effect of sea weed sap on flowering of maize (DHM 117) crop**

Treatments	Days to 50% tasseling	Days to 50% silking
T1 : 2.5% K sap + RDF	51	53
T2 : 5% K sap + RDF	51	54
T3 : 10% K sap + RDF	50	53
T4 : 15% K sap + RDF	51	53
T5 : 2.5% G sap + RDF	50	53
T6 : 5% G sap + RDF	50	54
T7 : 10% G sap + RDF	50	53
T8 : 15% G sap + RDF	50	53
T9 :RDF + Water spray	50	53
T10 : 7.5% K sap + 50% RDF	51	54

chlorophyll index (51.4) and was found to be on par with 10% Gracilaria sap (50.4), 15% Kappaphycus sap (49.4), 10% Kappaphycus sap (48.8), Water spray (48.2) and 5% Gracilaria sap (46.8) applications treatments. The possible increase in chlorophyll content in sea weed treated crop may be due to increase in magnesium content which is a constituent of chlorophyll (Patolia, 2006). Significantly lowest chlorophyll index was resulted with crop applied with 7.5% Kappaphycus sap + 50% RDF (39.6) and was inturn on par with 2.5% Kappaphycus sap + RDF (40.8) or 2.5% Gracilaria sap + RDF (43.7).

However when compared between different growth treatments, the plant height recorded higher at 5% Kappaphycus sap (241.8 cm) followed by 15% Gracilaria sap application (237.8 cm). The ear height was higher at 10% Gracilaria sap application (109.6 cm) followed by 15% Gracilaria sap application (104.5 cm). The mean leaf no. also increased with increase in concentration of Kappaphycus or Gracilaria sap. The mean leaf area of flag leaf at 60 DAS recorded higher at 15% Gracilaria sap application (589.1 cm<sup>2</sup>) followed by 10% Gracilaria sap application (575.4 cm<sup>2</sup>), while the leaf area of flag leaf was lowest with 7.5% Kappaphycus sap + 50% RDF (520.1 cm<sup>2</sup>). While stem girth recorded higher at 15% Gracilaria sap application (7.5 cm)

followed by 10% Gracilaria sap (7.4 cm). The dry matter/m<sup>2</sup> showed higher accumulation with application of 10% Gracilaria sap (1143 g/m<sup>2</sup>) followed by 10% Kappaphycus sap application (1123 g/m<sup>2</sup>). The leaf area index was higher at 15% Gracilaria sap application (5.89) followed by 15% Kappaphycus sap application (5.74). Further, the application of 7.5% Kappaphycus sap + 50% RDF has recorded less height (plant and ear), leaf area index and dry matter, lowest stem girth, lowest leaf area of flag leaf than compared to all other treatments (Table 2).

Our findings coincide with those of earlier studies carried out on marigold (Aldworth and Van Staden, 1987; Russo *et al.*, 1994) where there was an increase in vegetative growth by the application of seaweed extract. Similar results were also observed in *Cajanus cajan* (L.) Millsp. (Mohan *et al.*, 1994) and *Vigna sinensis* L. (Sivasankari *et al.*, 2006). The increased growth of these crops may be due to the presence of some growth promoting substances present in the seaweed extract (Mooney and Van Staden, 1986; Blunden, 1991). In addition, the growth enhancing potential of the seaweed extract might be attributed to the presence of macro and micronutrients.

**Table 2**  
Effect of sea weed sap on growth parameters of maize (DHM 117) crop.

Treatments	Plant height (cm) at harvest	Ear height (cm) at harvest	Mean Leaf no./ plant at 60 DAS	Mean Leaf area of flag leaf at 60 DAS (cm <sup>2</sup> )	Chloro phyll index (%) at 60 DAS	Mean stem girth at 7 <sup>th</sup> node at harvest	Dry matter g/m <sup>2</sup> at 60 DAS	Leaf area index
T1 : 2.5% K sap+ RDF	225.3	98.4	14.0	530.9	40.8	6.7	969	4.96
T2 : 5% K sap + RDF	241.8	102.3	14.0	552.5	44.2	6.9	1101	5.16
T3 : 10% K sap + RDF	235.5	101.0	15.0	573.8	48.8	7.1	1123	5.74
T4 : 15% K sap + RDF	235.8	100.3	15.0	572.7	49.4	6.6	1103	5.73
T5 : 2.5% G sap+ RDF	229.7	97.4	14.0	535.3	43.7	6.7	974	5.00
T6 : 5% G sap + RDF	235.3	99.0	15.0	556.1	46.8	6.9	1107	5.56
T7 : 10% G sap + RDF	235.3	109.6	15.0	575.4	50.4	7.4	1143	5.75
T8 : 15% G sap + RDF	237.8	104.5	15.0	589.1	51.4	7.5	1105	5.89
T9 :RDF+ Water spray	236.5	101.2	15.0	569.7	48.2	6.6	1041	5.70
T10: 7.5% Ksap + 50 % RDF	223.0	96.3	14.0	520.1	39.6	6.3	901	4.85
C.D (0.05)	NS	NS	NS	NS	6.9	NS	NS	-
S.Em+	7.9	2.6	0.4	27.3	2.3	0.3	11.7	-
C.V(%)	5.9	4.4	4.9	8.4	8.7	6.3	12.7	-

### Effect of Sea Weed Sap on Yield Attributes of Maize

The yield attributes *i.e.* cob length, cob girth, kernel rows, no.of kernels/row of cob, single cob weight and 1000 seed weight did not differ significantly and statistically among different treatments of spraying application of sea weed sap and water spraying except grain weight/cob resulted in significant difference between different sea sap spraying applications.

The cob length was higher in treatment were maize was applied with 5% Gracilaria sap (18.2 cm) and 10% Kappaphycus sap (18.2 cm) during critical stages of crop growth. While, cob girth recorded higher in maize applied with 10% Gracilaria sap (17.5 cm) followed by maize applied with 5% Gracilaria sap (17.3 cm). Further, kernel rows and number were also resulted higher with application of 10% Gracilaria sap during crop growth. The single cob weight indicated numerically higher in maize applied with 10% Gracilaria sap (234 g) followed by maize applied with 5% Gracilaria sap (227.3 g). The 1000 grain weight recorded higher in maize sprayed with 10% Gracilaria sap (367 g) followed by treatments of maize with 15% Gracilaria sap (360 g) and 5% Kappaphycus sap (360 g) (Table 3).

The grain weight/cob recorded significantly higher with maize crop applied with 10% Gracilaria

sap (182.3 g) and was found to be on par with maize crop applied with 15% Gracilaria sap (180.3 g), 5% Kappaphycus sap (176 g), 10% Kappaphycus sap (171.7 g), 5% Gracilaria sap (167.3 g) and 15% Kappaphycus sap (162 g). The beneficial effect might be due to presence of microelements and plant growth regulators especially cytokinins present in sap (Zodape *et. al.*, 2011). While, the grain weight / cob resulted significantly lowest in maize crop applied with 7.5% Kappaphycus sap + 50% RDF (142.7 g) and was found to record lowest grain weight with 2.5% Kappaphycus sap + RDF (150 g) and RDF + water spray (157 g) and 2.5% Gracilaria sap + RDF (159.3 g).

### Effect of Sea Weed Sap on Yield of Maize

The Maize Cob and Grain yield differed significantly among different concentrations of sea weed sap sprayings and water spray (Table 4).

### Cob Yield

The cob yield recorded significantly higher in maize crop applied with 10% G sap (11444 kg/ha) and was found to be on par with application of 15% Gracilaria sap (11205 kg/ha), 10% Kappaphycus sap (11183 kg/ha). 15% Kappaphycus sap (10994 kg/ha). 5% Gracilaria sap (10780 kg/ha), 5% Kappaphycus sap (10652 kg/ha) and water spray

**Table 3**  
Effect of sea weed sap on yield attributes of maize crop (DHM 117)

Treatments	Cob length (cm)	Cob girth (cm)	Kernel rows	No. of kernels/row	Single cob weight (g)	Grain weight (g)/cob	1000 seed wt (g)
T1 : 2.5% K sap + RDF	17.2	16.1	13.5	28.3	203.7	150.0	343
T2 : 5% K sap + RDF	17.7	16.2	14.3	32.6	224.3	176.0	360
T3 : 10% K sap + RDF	18.2	16.9	14.4	33.4	218.0	171.7	357
T4 : 15% K sap + RDF	17.5	17.1	14.7	30.0	213.0	162.0	313
T5 : 2.5% G sap + RDF	17.9	16.7	13.5	28.4	206.3	159.3	327
T6 : 5% G sap + RDF	18.2	17.3	14.0	33.8	227.3	167.3	355
T7 : 10% G sap + RDF	17.7	17.5	14.8	35.6	234.0	182.3	367
T8 : 15% G sap + RDF	17.6	16.8	13.9	31.0	210.3	180.3	360
T9 :RDF + Water spray	16.9	17.1	14.0	34.3	212.3	157.0	360
T10 : 7.5% K sap + 50% RDF	15.2	15.7	13.4	27.8	185.0	142.7	333
C.D (0.05)	NS	NS	NS	NS	NS	22.7	NS
S.Em+	0.7	0.4	0.4	1.8	10.1	7.6	12
C.V(%)	6.6	4.1	4.5	9.5	8.2	8.0	6.0

treatment (10608 kg/ha). While the cob yield in maize crop applied with 7.5% Kappaphycus sap + 50% RDF recorded significantly lowest than compared to all the other treatments under test. The cob yield with 10% Gracilaria sap application thrice on maize crop resulted in 19.7% higher cob yield than compared to 7.5 % Kappaphycus sap + 50% RDF. While, the percentage increase in cob yield was 7.3% over the crop with water spray (Table 4).

### Grain Yield

The data on grain yield indicated that maize crop applied with 10% Gracilaria sap spraying thrice resulted in significantly higher grain yield (9306 kg/ha) and was found to be on par with application of 10% Kappaphycus sap (9058 kg/ha); 15% Gracilaria sap (9047 kg/ha); 15% Kappaphycus sap (8817 kg/ha), 5% Gracilaria sap (8598 kg/ha) and crop with water spray (8515 kg/ha). The maize crop applied with 7.5% Kappaphycus sap + 50% recommended dose of fertilizer recorded significantly lowest grain yield (7271 kg/ha) and was on par with maize crop sprayed with 2.5% Kappaphycus sap (7892 kg/ha). The percent increase in grain yield of maize with application of 10% Gracilaria sap thrice was 22.9% than compared to 7.5 Kappaphycus sap +50% recommended dose of fertilizers application. While, it is 8.5% higher over water sprayed crop.

**Table 4**  
Effect of sea weed sap on Cob and Grain yield of maize (DHM 117) crop.

Treatments	Cob yield (kg/ha)	Grain yield (kg/ha)
T2 : 5% K sap + RDF	10652	8351
T3 : 10% K sap + RDF	11183	9058
T4 : 15% K sap + RDF	10994	8817
T5 : 2.5% G sap + RDF	10122	8094
T6 : 5% G sap + RDF	10780	8598
T7 : 10% G sap + RDF	11444	9306
T8 : 15% G sap + RDF	11205	9047
T9 :RDF + Water spray	10608	8515
T10 : 7.5% K sap + 50 % RDF	9193	7271
C.D (0.05)	844	843
S.Em+	282	282
C.V(%)	4.6	5.7

Significantly higher cob and grain yield with application of 5/10/15% Gracilaria sap or 10/15% Kappaphycus sap may be attributed to increase in growth parameters and yield attributes particularly increase in chlorophyll content as evident with chlorophyll index and increase in weight of grain per cob. Zodape *et. al.*, 2011 also reported the promotive effects of sea weed extract due to mining of nutrients besides plant bio physiological activities. Another reason for higher yields in these treatments may also be attributed to the initial soil fertility status which was found to be medium in organic carbon and available NPK was found to be higher in status which must have inturn contributed to higher yields in these treatments including water spray treatment. Further sea weed extracts stimulate various aspects of growth and development resulting in overall good health of the plants. The effect of sea weed extracts on root development and mineral absorption, shoot growth and photosynthesis and ultimately crop yield was significant as the extract is the rich source of several primary nutrients like K,P, secondary nutrients like Ca, Mg, trace elements like Zn, Cu, Fe, Mn (Biswajit *et. al.*, 2013) .

### CONCLUSION

In red sandy loam soils with higher NPK status and medium in organic carbon, the cob and grain yield of maize (DHM 117) was significantly higher with application of 10% Gracilaria sap spraying thrice + RDF (9306 kg/ha) application and was found to be on par with application of 10% Kappaphycus sap (9058 kg/ha); 15% Gracilaria sap (9047 kg/ha); 15% Kappaphycus sap (8817 kg/ha), 5% Gracilaria sap (8598 kg/ha) and crop with water spray (8515 kg/ha). The maize crop applied with 7.5% Kappaphycus sap + 50% recommended dose of fertilizer recorded significantly lowest grain yield (7271 kg/ha) and was on par with maize crop sprayed with 2.5% Kappaphycus sap (7892 kg/ha). The percent increase in grain yield of maize with application of 10% Gracilaria sap thrice was 22.9% than compared to 7.5 Kappaphycus sap +50% recommended dose of fertilizers application. While, it is 8.5% higher than compared to water sprayed with recommended dose of fertilizers applied crop.

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