Original Research Article

POTENTIALITY OF BIOFERTILIZERS AND SEAWEED EXTRACT ON GROWTH & YIELD OF SWEET CORN (*Zea mays* L.)

Abstract:

The study aimed to understand and study the effect of commercial seaweed extract and other biofertilizers on the yield attributes and economics of cultivated sweet corn. The biofertilizers were applied as seed inoculants and seaweed extract was applied as foliar spray. Totally nine combination treatments were evaluated for their performance on the growth and yield of sweet corn and revealed that green cob yield (10.58 t/ha and plant height 145.99 cm at harvest) was found to be significantly higher in treatment combination Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract and was on par with Azospirillum @20 gm/kg +5.0% Seaweed extract (9.61 t/ha, plant height 143.01 cm). Cobs/plant, grains rows/cob, grains /cob and grains/row were also found highest in the treatment Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract. Similarly with respect to stover yield and higher harvest index (34.50%) was noticed in PSB @20 gm/kg +10% Seaweed extract which was followed by Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract (34.40%). The benefit cost ratio was highest in the treatment Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% (2.77) and lowest B:C ratio (1.2) was obtained in the PSB @20 gm/kg + water spray. These findings indicate that seaweed extract can generally be used as a safe potential multifunctional biofertilizer in the agricultural field. The use of seaweed and biofertilizer could potentially help mitigate the adverse effects of main nutrient deficiencies, diminishing the use of chemical fertilizers.

Key words: Biofertilizers, Sweet corn, Seaweed extract, Plant height, Dry weight, Potential, yield.

Introduction:

All plants need certain minerals nutrients to survive in environment. These minerals occur naturally in the soil and are taken up from the soil by the roots of the plants. Most soil usually has enough of these minerals to keep plants healthy. However, plants are gradually absorbed some nutrients or nutrients are washed out of the soil, and need to be replaced to maintain optimal growth and development of the plants. Most common mineral nutrients that need replacing are N, P, K. Fertilizers are manufactured by mixtures of products that contain N, P, K and other necessary nutrients. The fertilizers are necessary to add in the soil

because the nutrients in the soil get used up due to repeated cultivation of the plant. The crop yield also starts decreasing so, in order of revive the fertility of the soil, fertilizers are necessary (Ali *et al.,* 2008). The excessive uses of chemical fertilizers (man - made or synthetic composition) in agriculture are costly with adverse effects on physico-chemical properties of soils, plant, animal and human life.

Chemical fertilizers are more resistant in the environment which in some cases is harmful to the environment- especially, on soil fertility and are actually causing huge amount of soil and land degradation (Liu *et al.,* 2009) because most of the microorganism. decrease following the use of chemical fertilizers in increasing level (Katsunori, 2003). Organic fertilizers are derived from natural products, which were once living organisms. Organic fertilizers are generally slow-acting because they have to decompose and to become plant nutrients; however, this also means their benefits are longer lasting. The term of biofertilizer represent everything from manures to plant extracts. Biofertilizers consist of N fixers (Rhizobium, Azotobacter, blue green algae, Azolla), Phosphate solubilizing bacteria (PSB) and fungi (Mycorrhizae) which increase the supply or availability of macro (primary & secondary nutrient) and/or micro nutrients (growth stimulus) to the target crop. Seaweeds are one of the most important marine sources of the world. The seaweed extract is available as fertilizer in different forms such as SLF (Seaweed Liquid Fertilizers), LF (Liquid Fertilizers) and powder form of seaweed manure have been used as a biofertilizer. In market, seaweed extracts available for several years as fertilizer additives and beneficial results from their use have been reported (Booth, 1969). Also, other important phytochemicals were identified in seaweed extracts including phenols, betaines, lipids, proteins, sugar alcohols, alginates and laminarins (Shukla *et al.,* 2018).

Maize (*Zea mays* L.) is one of the most important cereal grains grown worldwide in a wider range of environments because of its greater adaptability. As the leading cereal crop in the world, corn (*Zea mays* L.) plays a significant role in human foods. Usually grown for fresh or canned food industry sweet corn (*Zea mays saccharata* Sturt.). The core objective of the research is to increase production in order to close the massive gap between availability and demand. The objective of this study is to see how different concentrations of the seaweed and bio fertilizers affect sweet corn yield attributes and economics.

Materials and Methods:

The experiment was carried out during *Rabi,* 2021 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The soil of the experimental field constituting a part of central Gangetic alluvium and is neutral and deep. The experiment was laid out in Randomized Block Design. There were nine treatments (T_1: Azospirillum @20 gm/kg +10% Seaweed extract; T_2:Azospirillum @20 gm/kg +5.0% Seaweed extract; T_3:Azospirillum @20 gm/kg + Water spray; T_4:PSB @20 gm/kg +10% Seaweed extract; T_5:PSB @20 gm/kg +5.0% Seaweed extract; T_6:PSB @20 gm/kg + Water spray; T_7:Azospirillum @10 gm/kg + PSB @10 gm/kg +10% Seaweed extract; T_8:Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract; T_9:Azospirillum @10 gm/kg + PSB @10 gm/kg +Water spray) and each were replicated thrice with The medium maturing single cross sweet corn hybrid (Syngenta, India, Ltd.).

Fertilizers were applied as side placement, for which 4-5 cm deep furrows were made along the seed rows with a hand hoe. The nutrient sources were Urea, SSP and Murate of Potash (MOP) to fulfill the requirement of N, P_2O_5, and K_2O. The recommended dose of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O/ha was applied according to the treatment details through Urea and MOP. Whole of phosphorus and potash was applied as basal at the time of sowing but nitrogen is applied in 3 split doses ½ dose of N as basal, ¼ dose as top dressing at 30 DAS and last ¼ dose as top dressing at 60 DAS. All the biofertilizers were seed inoculated at the time of sowing and seaweed extract were sprayed on the crop at two different concentrations at 20, 40, 60 and days after sowing (DAS). Yield attributing parameters were recorded on plant height (cm), dry weight (g/plant), cob yield, stover yield and harvest index after the harvest of the crop and data was analysed statistically (Gomez, and Gomez, 1984) and further crop economics were also calculated.

Results and Discussion:

The plant height which was recorded at 20, 40, 60, 80 DAS and at harvest stage were presented in Table 1. There was no significant difference with respect to plant height at 20 DAS. At 40 DAS, there was a significant increase in plant height Azospirillum + PSB @20 gm/kg + 0.5 % sea weed extract recorded significant higher plant height (23.25 cm) followed by Azospirillum@20 gm/kg + 0.5 % sea weed extract,PSB @20 gm/kg + 10 % sea weed extract and PSB @20 gm/kg + Water spray (20.97, 20.57 and 15.96 cm). At 60 DAS, significantly higher plant height (44.39 cm) was observed in Azospirillum + PSB @20 gm/kg + 0.5 % sea weed extract which was at par with Azospirillum@20 gm/kg +

0.5 % sea weed extract (43.37 cm). Similar trend was observed at 80 DAS and at harvesting stage Azospirillum + PSB @20 gm/kg + 0.5 % sea weed extract was found to be highest. Similar results were reported by Prasanth *et al.* (2019) and Rathinapriya *et al.* (2020) who reported that optimum sowing time, suitable growth period and favourable climatic conditions especially temperature might haveresulted in maximum plant height.

There was no significant difference of dry weight at 20 DAS and At 40 DAS, highest dry weight (9.40 g/plant) was observed in Azospirillum + PSB @20 gm/kg + 0.5 % sea weed extract and least dry weight (7.36 g/plant) was recorded in PSB @20 gm/kg + Water spray. At 60 and 80 DAS, significantly higher dry weight was obtained in Azospirillum + PSB @20 gm/kg + 0.5 % sea weed extract with 15.17 and 66.91 g/plant respectively followed by Azospirillum @20 gm/kg +5.0% Seaweed extract (14.42 g/plant) and Azospirillum @10 gm/kg + Azospirillum @10 gm/kg + PSB @10 gm/kg +10% Seaweed extract (13.81 g/plant) at 60 DAS. At harvest stage, dry weight (200.62 g/plant) is recorded significantly higher in Azospirillum + PSB @20 gm/kg + 0.5 % sea weed extract (Table 2). Higher dry matter accumulation was due combined effect of higher plant height as reported by Marngar and Dawson (2017), Zothanmawii *et al.* (2018).

Number of cobs per plant recorded non-significant difference among the treatments. Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract recorded maximum number of cobs (1.25/plant) and minimum was recorded in PSB @20 gm/kg + Water spray (1.02/plant), respectively. Higher grain rows (15.35/cob) was recorded in Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract which was on par with Azospirillum @20 gm/kg +5.0% Seaweed extract (14.96/cob). Higher grain rows (809.48/cob) was recorded in Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract which was on par with Azospirillum @20 gm/kg +5.0% Seaweed extract (755.56/cob). The highest cob length (17.06 cm)were recorded in Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract While the lowest cob length (13.79 cm) were observed in PSB @20 gm/kg + Water spray (Table 3). These results are in agreement with the findings of Wasim Khan *et al.* (2017), Basavaraja *et al.* (2018) and Zothanmawii *et al.* (2018). Increased seaweed extract application and biofertilizers tend increased the cob length. The enhanced yield component may be due to increased LAI, leading to higher photosynthetic rate and accumulation of more assimilates which in turn increased the sink size.

The data on cob yield (t/ha) shows that there was a significant effect on treatment combination of Biofertilizers and Seaweed extract over green cob yield in Table 4. However, green cob yield (10.58 t/ha) was found to be significantly higher in treatment combination Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract which was statistically at par with Azospirillum @20 gm/kg +5.0% Seaweed extract (9.61 t/ha), respectively. Higher green cob yield with combination of this treatments Biofertilizers and Seaweed extract reflected in better growth and development of the crop. These results are in close conformity with the findings of Pal *et al.*(2015), Jinjala *et al.* (2016) and Thavaprakaash *et al.* (2018).

The data shows that there was a significant difference among the treatments over Stover yield. Stover yield was significantly higher (21.43 t/ha) in Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract which was followed by Azospirillum @20 gm/kg +5.0% Seaweed extract (20.35 t/ha), respectively. The present findings are well in agreement with that of Wasim Khan and Vikram Singh (2017), Zothanmawii *et al.* (2018) and Prasanth *et al.* (2019). Higher harvest index (34.50%) was noticed in PSB @20 gm/kg +10% Seaweed extract which was followed by Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract (34.40%) and Azospirillum @10 gm/kg + PSB @10 gm/kg +10% Seaweed extract (33.72%), respectively and results were in conformity with findings of Sundaresh and Basavaraja (2017).

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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Table 1. Effect of Biofertilizers and Seaweed extract on growth and yield on plant height of Sweet corn

Treatments	Plant height (cm)				
	20 DAS	40 DAS	60 DAS	80 DAS	At harvest
T1: Azospirillum @20 gm/kg +10% Seaweed extract	6.65	20.11	42.80	66.79	135.87
T2: Azospirillum @20 gm/kg +5.0% Seaweed extract	7.12	20.97	43.37	69.26	143.01
T3: Azospirillum @20 gm/kg +Water spray	6.98	17.85	38.41	63.35	126.53
T4: PSB @20 gm/kg +10% Seaweed extract	6.92	20.57	42.07	68.72	134.89
T5: PSB @20 gm/kg +5.0 Seaweed extract	6.86	18.89	39.59	66.33	139.38
T6: PSB @20 gm/kg + Water spray	6.50	15.96	37.83	62.45	124.89
T7: Azospirillum @10 gm/kg + PSB @10 gm/kg +10% Seaweed extract	6.96	20.13	42.62	68.10	142.74
T8: Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract	7.42	23.25	44.39	70.22	145.99
T9: Azospirillum @10 gm/kg + PSB @10 gm/kg + Water spray	6.64	17.78	40.39	64.03	125.56
F - Test	**NS**	**S**	**S**	**S**	**S**
SEm±	**0.53**	**0.92**	**1.07**	**1.40**	**1.77**
CD (P=0.05)	**-**	**2.75**	**3.21**	**4.19**	**5.31**

Table 2 Effect of Biofertilizers and Seaweed extract on growth and yield on plant dry weight of Sweet corn

Treatments	Dry Weight (g/plant)				
	20 DAS	40 DAS	60 DAS	80 DAS	At harvest
T1: Azospirillum @20 gm/kg +10% Seaweed extract	0.71	8.05	12.36	51.77	192.31
T2: Azospirillum @20 gm/kg +5.0% Seaweed extract	0.77	9.17	14.42	64.74	197.38
T3: Azospirillum @20 gm/kg +Water spray	0.66	7.75	10.31	50.15	176.56
T4: PSB @20 gm/kg +10% Seaweed extract	0.74	8.98	13.51	55.78	185.67
T5: PSB @20 gm/kg +5.0 Seaweed extract	0.70	8.54	12.95	59.47	194.43
T6: PSB @20 gm/kg + Water spray	0.63	7.36	9.35	47.96	174.45
T7: Azospirillum @10 gm/kg + PSB @10 gm/kg +10% Seaweed extract	0.73	8.72	13.81	59.55	194.80
T8: Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract	0.88	9.40	15.17	66.91	200.62
T9: Azospirillum @10 gm/kg + PSB @10 gm/kg + Water spray	0.72	8.09	10.09	51.44	175.03
F - Test	**NS**	**S**	**S**	**S**	**S**
SEm±	**0.05**	**0.20**	**0.42**	**2.98**	**3.52**
CD (P=0.05)	**-**	**0.59**	**1.27**	**8.94**	**10.55**

Table 3. Effect of Biofertilizers and Seaweed extract on growth and yield attributes of sweet corn

Treatments	Cobs/plant	Grains/cob	Grain rows/cob	Grains/row	Cob length(cm)
T1: Azospirillum @20 gm/kg +10% Seaweed extract	1.13	535.00	14.76	20.79	15.92
T2: Azospirillum @20 gm/kg +5.0% Seaweed extract	1.23	755.56	14.96	21.88	16.76
T3: Azospirillum @20 gm/kg +Water spray	1.06	528.54	12.36	19.45	14.85
T4: PSB @20 gm/kg +10% Seaweed extract	1.13	722.28	13.81	20.66	15.29
T5: PSB @20 gm/kg +5.0 Seaweed extract	1.06	688.75	14.62	20.70	14.46
T6: PSB @20 gm/kg + Water spray	1.02	318.44	12.04	18.66	13.79
T7: Azospirillum @10 gm/kg + PSB @10 gm/kg +10% Seaweed extract	1.22	552.66	13.06	20.71	14.68
T8: Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract	1.25	809.48	15.35	22.36	17.06
T9: Azospirillum @10 gm/kg + PSB @10 gm/kg + Water spray	1.13	344.63	13.82	19.06	14.79
F-Test	**NS**	**S**	**S**	**S**	**S**
SEm±	**0.07**	**31.95**	**0.52**	**0.46**	**0.60**
CD (P=0.05)	**-**	**95.79**	**1.55**	**1.39**	**1.79**

Table 4. Effect of Biofertilizers and Seaweed extract on growth and yield of sweet corn

Treatments	Green cob yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
T1: Azospirillum @20 gm/kg +10% Seaweed extract	8.98	17.52	33.86
T2: Azospirillum @20 gm/kg +5.0% Seaweed extract	9.61	20.35	32.88
T3: Azospirillum @20 gm/kg +Water spray	6.61	15.77	32.56
T4: PSB @20 gm/kg +10% Seaweed extract	8.59	16.33	34.50
T5: PSB @20 gm/kg +5.0 Seaweed extract	8.49	18.96	30.91
T6: PSB @20 gm/kg + Water spray	5.82	13.75	29.70
T7: Azospirillum @10 gm/kg + PSB @10 gm/kg +10% Seaweed extract	8.04	15.90	33.72
T8: Azospirillum @10 gm/kg + PSB @10 gm/kg +5.0% Seaweed extract	10.58	21.43	34.40
T9: Azospirillum @10 gm/kg + PSB @10 gm/kg + Water spray	7.30	15.87	32.11
F-Test	**S**	**S**	**S**
SEm±	**0.37**	**0.58**	**0.94**
CD (P=0.05)	**1.12**	**1.74**	**2.82**