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Effect of Crop Geometry and Seaweed (*Kappaphycus & Gracilaria*) Extract on Growth and Yield of Baby corn (*Zea mays*)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during *Zaid,* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), organic carbon (0.74%), available N (273.57 kg/ha), available P (31.97 kg/ha), and available K (335 kg/ha). The treatments comprised of crop geometry and foliar application of Seaweed Extract (*Kappaphycus alvarezii & Gracialria*). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice. The results showed that *viz:* Plant height (166.30 cm), plant dry weight (115.82 g/plant) were recorded significantly higher in Spacing 45 x 25 cm along with foliar application of 10% (*K. sap* + *G.sap*) spray. Number of cobs per plant (1.39), cob length with husk (22.32 cm), cob length without husk (8.34 cm), cob girth with husk (7.78 cm), cob girth without husk (5.15 cm), cob weight with husk (67.48 g), cob weight without husk (24.92 g), cob yield with husk (15.50 t/ha), cob yield without husk (5.28 t/ha), green fodder yield (30.35 t/ha) were recorded significantly higher. Thus, crop geometry with foliar application of seaweed extract (*Kappaphycus alvarezii*) could be a promising option for yield enhancement in baby-corn.

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1. INTRODUCTION

Baby corn (also known as young corn, mini corn, or candle corn) is the ear of maize (*Zea mays* L.) plant harvested young, when the silks have either not emerged or just emerged, and no fertilization has taken place. It is one of the most important dual-purpose crops grown round the year in India [1]. Baby corn cultivation is a recent development providing for the profitable alternative of crop diversification, value addition of maize and ushering in establishment of the small food processing industrial units.

Optimum crop geometry is one of the important factors for higher productivity, by virtue of which there is efficient utilization of underground resources and also harvesting maximum solar radiation which in turn results in better photosynthesis [2]. An optimum plant population for maximum economic yield exists for all crop species and varies with cultivar and environment [3]. Yield increases with increasing plant density up to a maximum for a corn genotype grown under a set of particular environmental and management conditions and declines when plant density is further increased [4]. Maximum yield can be expected only when plant population allows individual plants to achieve their maximum inherent potential [5]. Thus, there is need to work out an optimum plant spacing by adjusting inter and intra row spacings in relation to other agronomic factors.

In recent years, Marine algae liquid extract from seaweed have recently been used in cattle feeds, seed treatment, pest control, and help in various growth and yield parameters. Seaweed act as bio-stimulants, which can make mineral-based fertilizers more effective [6]. Marine bioactive substances extracted from marine algae are used in agricultural and horticultural crops, and many beneficial effects may be achieved in terms of enhancement of yield and quality. Liquid extracts obtained from seaweeds have recently gained importance as foliar sprays for many crops including various cereals, pulses, vegetables, and species. In many countries, seaweed and beach cast are still used in both agriculture and horticulture, [7]. Seaweed (*Kappaphycus alvarezii and Gracillaria edulis*) extract has been found rich in nutrients including plant growth regulators *i.e., Indole-3-Acidic Acid*, kinetin, zeatine and gibberellins [8]. Therefore, present study was taken to investigate the Effect of Crop Geometry and Seaweed (*Kappaphycus & Gracilaria*) on growth and yield of baby corn (*Zea mays*).

2. MATERIALS AND METHODS

Germination of baby corn *var. G-5414* had recorded as 83.33%. A field trial was conducted during *Zaid,* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P), India which is located at 25^{o}39”42” N latitude, 81^{0}67”56” E longitude, and 98m altitude above the mean sea level (MSL). The soil was sandy loam in texture, low in organic carbon and medium in available nitrogen, phosphorus, and low in potassium. The treatments comprised of crop geometry and foliar application of Seaweed Extract (*Kappaphycus & Gracilaria*). There were 9 treatments, and each replicated thrice. Treatment was randomly arranged in each replication and divided into 27 plots. The treatments which are with 1- Spacing 30 x 20 cm + 5% *K.sap,* 2- Spacing 30 x 20 cm + 5% *G.sap,* 3- Spacing 30 x 20 cm + 10% (*K. sap* + *G.sap*), 4– Spacing 40 x 20 cm + 5% *K.sap,* 5 – Spacing 40 x 20 cm + 5% *G.sap*, 6– Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*), 7- Spacing 45 x 25 cm + 5% *K.sap,* 8 - Spacing 45 x 25 cm + 5% *G.sap,* 9 - Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*). The date of sowing was 26th February 2022 with the seed rate of 20kg/ha. Blanket application with Recommended Dose of Fertilizer 120:60:40 NPK kg/ha. Foliar application of seaweed (*Kappaphycus & Gracilaria*) extract on 20 and 40 days after sowing. The growth parameters of the plants were recorded at frequent intervals from germination up until harvest and finally, the yield parameters were recorded after harvest. The growth parameters such as plant height, plant dry weight. The yield parameters such as number of cobs per plant, cob length with husk, cob length without husk, cob girth with husk, cob girth without husk, cob weight with husk, cob weight without husk, cob yield with husk, cob yield without husk, green fodder yield.These parameters were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design [9].

3. RESULTS AND DISCUSSION

3.1 Effect on the Growth of Baby-corn

As can be seen in Table.1, growth parameters are summarized statistically. At 60 DAS,

significantly taller plant height (166.30 cm) was recorded with application of Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*) spray. However, spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*) statistically at par with Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*) spray. Minimum plant height (140.04 cm) recorded in Spacing 30 x 20 cm + 5% *G.sap.* At 60 DAS, significantly maximum dry weight (115.82 g) was recorded with application of Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*) spray. However, spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*) statistically at par with Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*) spray. Minimum plant dry weight (90.49 g) recorded in Spacing 30 x 20 cm + 5% *G.sap.* [10] reported that application of *Gracilaria* extracts 7.5% + RDF had given that higher Dry matter accumulation, grain yield, Stover yield respectively when compared to the control plot of water spray + RDF in the crop maize. Higher plant height and plant dry weight recorded with higher concentration of seaweed extract [11]. The increase in shoot characteristics due to the auxins content in the seaweed extracts which have an effective role in cell division and enlargement; this leads to increase the shoot growth, leaf area and plant dry weight [12]. Higher intra-row spacing recorded significantly higher total dry matter over closer spacing of 60 cm x 20 cm [13].

3.2 Effect on the Yield of Baby-corn

As can be seen in Table.2, yield parameters are summarized statistically. At the time of harvest, significantly maximum number of cobs per plant (1.39) recorded in Spacing 45 x 25 cm along with 10% (*K. sap* + *G.sap*) *spray.* However, spacing 45 x 25 cm + 5% *K.sap,* Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*), Spacing 40 x 20 cm + 5% *K.sap,* Spacing 30 x 20 cm + 10% (*K. sap* + *G.sap*), Spacing 45 x 25 cm + 5% *G.sap,* statitically at par with Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*). The minimum number of cobs per plant (1.03) recorded in Spacing 30 x 20 cm + 5% *G.sap.* At the time of harvest, significantly maximum Cob length with husk per plant (22.32 cm) recorded in Spacing 45 x 25 cm along with 10% (*K. sap* + *G.sap*) *spray.* However, spacing 45 x 25 cm + 5% *K.sap,* Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*) statitically at par with Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*). The minimum Cob length with husk per plant (14.81 cm) recorded in Spacing 30 x 20 cm + 5% *G.sap.* At the time of harvest, significantly maximum Cob length without husk per plant (8.34 cm) recorded in Spacing 45 x 25 cm along with 10% (*K. sap* + *G.sap*) *spray.* However, spacing 45 x 25 cm + 5% *K.sap,* Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*), Spacing 40 x 20 cm + 5% *K.sap,* Spacing 30 x 20 cm + 10% (*K. sap* + *G.sap*), statitically at par with Spacing 45 x 25 cm along with 10% (*K. sap* + *G.sap*) *spray.* The minimum Cob length without husk per plant (6.74 cm) recorded in Spacing 30 x 20 cm + 5% *G.sap.* At the time of harvest, significantly maximum Cob girth with husk per plant (7.78 cm) recorded in Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*). However, spacing 45 x 25 cm + 5% *K.sap,* Spacing 40 x 20 cm + 5% *K.sap,* Spacing 30 x 20 cm + 10% (*K. sap* + *G.sap*), Spacing 45 x 25 cm + 5% *G.sap,* Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*) statitically at par with Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*). The minimum Cob girth with husk per plant (6.10 cm) recorded in Spacing 30 x 20 cm + 5% *G.sap.* At the time of harvest, significantly maximum Cob girth without husk per plant (5.15 cm) recorded in Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*). However, spacing 45 x 25 cm + 5% *K.sap*, Spacing 40 x 20 cm + 5% *K.sap,* Spacing 30 x 20 cm + 10% (*K. sap* + *G.sap*), Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*) statitically at par with Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*). The minimum Cob girth without husk per plant (3.06 cm) recorded in Spacing 30 x 20 cm + 5% *G.sap.* At harvest, significantly maximum weight of cob with husk (67.48 g) recorded higher in Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*). However, spacing 40 x 20 cm + 5% *K.sap,* Spacing 45 x 25 cm + 5% *K.sap,* Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*) statitically at par with Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*). At harvest, significantly maximum weight of cob without husk (24.92 g) recorded higher in Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*). However, spacing 30 x 20 cm + 10% (*K. sap* + *G.sap*), Spacing 40 x 20 cm + 5% *K.sap,* Spacing 45 x 25 cm + 5% *K.sap,* Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*) statitically at par with Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*). At harvest, significantly maximum Cob yield with husk (15.50 t/ha) recorded higher in Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*). However, spacing 30 x 20 cm + 10% (*K. sap* + *G.sap*), Spacing 40 x 20 cm + 5% *K.sap* , Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*), Spacing 45 x 25 cm + 5% *K.sap* , statitically at par Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*). At harvest, significantly maximum Cob yield without husk (5.28 t/ha) recorded higher in Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*). However, spacing 40 x 20 cm + 5% *K.sap,* Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*), Spacing 45 x 25 cm + 5% *K.sap* ,statitically at par with Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*).

At the time of harvest, maximum green fodder yield (30.35 t/ha) recorded higher in Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap.*The minimum green fodder yield (22.89 t/ha) recorded in Spacing 30 x 20 cm + 5% *G.sap.* The results demonstrate that [14] reported that plant spacing of 45 x 25 cm resulted in highest green cob yield and biological equivalent yield than 60 x 19 cm whereas nutrient uptake was highest in 60 x 19 cm as compared to 45 x 25 cm. [15] studied that the highest grain yield was recorded with applications of 15% *Kappaphykus* + recommended dose of fertilizer which at par with 15% *Gracilaria* extracts + RDF resulting in an enhanced by 51 and 44% grain yield, respectively compared to the water applied plots in black gram. [16] observed that corn weight was significantly higher at wider intra-row spacing of 60 cm x 25 cm (7.7 g corn^{-1}) with a plant population of 66,666 ha^{-1} than narrow intra-row spacing of 60 cm x 20cm, with a population of 83,333 plants ha^{-1} at New Delhi. [17] noticed that with an increase in plant density there was increase in green fodder yield, discarded baby corn and barrenness was observed, whereas decrease was observed in cobs plant^{-1} and husk: baby corn ratio. [18] concluded that altering the plant spacing did not affect the days to tasseling for the plants. [19] reported in sweet corn that 53333 plants ha^{-1} gave 56.72 q ha^{-1} whereas 88888 plant population gave 80.12 q ha^{-1}. Similarly, the number of primers, non-primers, green ear, and kernel yield increased by increasing plant population but decreased the length and girth of the ear. [20] observed in popcorn varieties that the highest grain and straw yield was obtained when sowing was taken at 45 x 20 cm^2.

Table 1. Effect of Crop geometry and Seaweed (*Kappaphycus & Gracilaria*) Extract on Growth of Baby Corn

Treatment Combination	At 60 DAS	
	Plant height (cm)	Dry weight (g/plant)
1- Spacing 30 x 20 cm + 5% *K.sap*	142.82	94.59
2- Spacing 30 x 20 cm + 5% *G.sap*	140.04	90.49
3- Spacing 30 x 20 cm + 10% (*K. sap* + *G.sap*)	156.54	103.50
4- Spacing 40 x 20 cm + 5% *K.sap*	158.36	106.38
5- Spacing 40 x 20 cm + 5% *G.sap*	149.04	97.73
6- Spacing 40 x 20 cm + 10% (*K. sap* + *G.sap*)	164.00	114.56
7- Spacing 45 x 25 cm + 5% *K.sap*	162.91	110.10
8- Spacing 45 x 25 cm + 5% *G.sap*	153.23	101.91
9- Spacing 45 x 25 cm + 10% (*K. sap* + *G.sap*)	166.30	115.82
F test	S	S
SEm±	1.27	1.67
CD (P = 0.05)	3.76	4.95

Table 2. Effect of Crop geometry and Seaweed (*Kappaphycus & Gracilaria*) Extract on Yield of Baby Corn

Treatment	Number of Cobs per plant	Cob length (cm)		Cob girth (cm)		Cob weight (g)		Cob yield (t/ha)		Green fodder yield (t/ha)
		With husk	Without husk	With husk	Without husk	With husk	Without husk	With husk	Without husk	
1	1.16	16.95	6.84	6.44	3.69	53.03	20.39	10.77	3.51	24.28
2	1.03	14.81	6.74	6.10	3.06	48.95	18.60	8.99	3.21	22.89
3	1.25	19.07	7.86	7.33	4.65	60.52	23.08	14.08	4.27	29.22
4	1.32	19.62	7.48	7.48	4.98	64.69	23.58	14.34	4.47	28.59
5	1.19	17.12	7.36	6.57	4.26	55.00	20.89	12.13	3.74	25.98
6	1.36	21.40	8.18	7.78	5.15	67.48	24.92	15.34	5.05	30.11
7	1.30	20.81	8.07	7.50	4.87	66.26	24.22	14.68	4.82	29.55
8	1.24	18.32	7.73	7.00	4.13	56.50	22.09	12.30	3.80	27.39
9	1.39	22.32	8.34	7.75	5.13	66.43	24.37	15.50	5.28	30.35
F test	S	S	S	S	S	S	S	S	S	S
SEm (±)	0.06	0.73	0.32	0.32	0.30	1.55	0.88	0.75	0.33	0.98
CD (p=0.05)	0.17	2.16	0.96	0.95	0.88	4.59	2.62	2.24	0.99	2.91

4. CONCLUSION

Based on my research trail, the treatment combination of Spacing 45 x 25 cm along and foliar application of 10% (*K. sap* + *G.sap*) was found to be more productive and economically feasible. The spacing of 45 x 25 cm helps to reduce the plants nutrient competition and also, good root penetration. Marine algae extract helps in increasing yield with increasing adequate concentration. Due to the recommended crop geometry and combined seaweed extract plays a vital role in plant growth and yield.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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