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Effect of Foliar Spray of Seaweed Extract and Humic Acid on Growth and Yield of Cluster Beans [C*yamopsis tetragonoloba* (L.) Taub.] var. Pusa Navbahar

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ABSTRACT

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.], known commonly as "Guar," is a vital legume crop grown mostly under rainfed conditions in arid and semi-arid regions of India during the *Kharif* and summer season. Numerous horticultural strategies may be used to improve the growth and productivity of guar including sea weed extract and humic acid. A field experiment was conducted to determine the influence of seaweed extract and humic acid on growth, yield and post-harvest characteristics of cluster bean. Seaweed extract and humic acid were administered in the field as foliar spray at 0.1, 0.2 and 0.3 per cent concentrations in a randomized block design (RBD) consisting of seven treatments and three replicates. The results indicated that the higher concentration of 0.3 per cent seaweed extract and humic acid produced significantly higher plant height, leaf number, pod number per plant and total yield per hectare as compared to the lower concentrations and control. The post-harvest study revealed that foliar treatment of 0.3 per cent humic acid and seaweed extract resulted in a lower percentage of physiological weight loss and increased the shelf life of pods compared to untreated.

Key words: Cluster bean, Growth, Humic acid, Physiological loss in weight, Sea weed extract, Yield.

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] is generally referred to as "Guar" and is mainly grown in arid and semi-arid parts of India under rainfed conditions. Guar is a widely farmed crop in India, particularly Rajasthan, Haryana, Punjab, Gujarat, Uttar Pradesh, Tamil Nadu and Madhya Pradesh. Numerous horticultural strategies may be used to improve the development and productivity of guar. As a rainfed and industrial crop, it is critical to increasing output and quality while mitigating the negative consequences of rainfed systems. In cluster beans, bio-stimulants such as seaweed extract and humic acid might have such an impact. With these considerations in mind, experiment this was designed and conducted at the Department of Horticulture, Central University of Tamil Nadu, Thiruvarur, Tamil Nadu. The purpose of this experiment was to determine the influence of various concentrations of seaweed extract and humic acid on the growth, yield and post-harvest characteristics of cluster bean var. Pusa Navbahar.

The experiment was conducted during 2020-21at the hamlet of Kottucherry, Karaikal district. Kottucherry is located around 6 kilometers south of Karaikal at 10.9599 North latitude, 79.8269 East longitude, at 4 meters above mean sea level. The experimental site is located inside the coastal agro-climatic zone and the predominant climatic condition is dry, sub-humid. The experiment included seven treatments: 0.1 per cent seaweed extract (T_1), 0.2 per cent seaweed extract (T_2), 0.3 per cent seaweed extract (T_3), 0.1 per cent humic acid (T_4), 0.2 per cent humic acid (T_5) and 0.3 per cent humic acid (T_6) and control (T_7). The variety used was Pusa Navbahar, which is a vegetable type. The experiment used a randomized block design with three replications per condition. Individual plants were sprayed three times with seaweed extract and humic acid at 15, 30 and 45 days after seeding (DAS). The following growth parameters were observed at 30 and 45 days of plant growth: plant height (cm), leaf number, dry matter production (g plant^{-1}) and yield parameters: number of pods per plant, pod length (cm), 100 pod weight (g), pod yield per plant (g), pod yield (t/ha), number of pickings, physiological loss in weight (PLW) of pods, the shelf life of pods (days) and benefit: cost ratio. For assessing the PLW, in each treatment, a known weight of the original sample (100 g of harvested pods) was extracted and kept separately in a well-ventilated ambient environment. Each sample was weighed every two days for a total of six days. The observations gathered in this

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technique were utilized to calculate physiological weight loss (PLW). The data for all parameters were analyzed statistically using the Panse and Sukhatme techniques (1985).

Effects of humic acid and seaweed extract on growth factors

As a result of the use of seaweed extract and humic acid, the plant height of the cluster bean has been measured and presented in Table 1. At both phases of plant development, data on plant height varied considerably between treatments. On the 30th and 45th day, a foliar spray of seaweed extract at a concentration of 0.3% (T3) resulted in the maximum plant height, followed by a foliar spray of humic acid at a concentration of 0.3%. Control recorded the smallest plant height. The number of leaves were significantly different across treatments on both the 30th and 45th day of observation. On both the days of observations, humic acid @ 0.3 per cent produced considerably more leaves, followed by seaweed extract @ 0.3 per cent. In general, control plants had the fewest leaves per plant (Table 1). Seaweed extract and humic acid had a substantial effect on dry matter production statistics (Fig 1). On the 60th and 90th day of observation, humic acid at a concentration of 0.3 per cent (T6) generated the maximum dry matter per plant. The control group had the lowest dry matter on the 60th and 90th day.

Effect of seaweed extract and humic acid on yield and post harvest characters

The foliar spray of seaweed extract and humic acid had a substantial effect on the pods produced per plant, as shown in Table 2. Among the treatments, humic acid at a concentration of 0.3 per cent had the most pods per plant (62.44), which was highly significant compared to the other treatments. The control plant produced the fewest pods per plant (57.75). For 100 pod weight (g) of cluster bean, the impact of seaweed extract and humic acid is statistically significant. Among the various treatments, humic acid at 0.3 per cent resulted in the highest weight of 100 pods (306.97 g), which was significantly substantial compared to the other treatments. The seaweed extract and humic acid substantially affected the overall pod production per hectare at varying doses. The data on pod yield per hectare is presented in Table 2. T_3 treatment at 0.3 per cent had the highest total yield per hectare (12.99 t/ha), followed by T_2 and T_1 (12.61 and 12.33 t/ha, respectively). The control had the lowest total output (12.03 t/ha). Seaweed extract and humic acid affected the results of physiological weight reduction. At 2, 4 and 6 days after storage, the treatments differed considerably in physiological weight loss. The least physiological weight loss was seen in seaweed extract at a concentration of 0.3 per cent (4.2 per cent), followed by

Table 1: Effect of seaweed extract and humic acid on plant height (cm) and number of leaves per plant of cluster bean var. Pusa Navbahar.

Treatments	Plant height (cm)		Number of leaves per plant	
	30 days	45 days	30 days	45 days
T_1 - Seaweed extract @0.1%	33.17	101.37	12.67	30.00
T_2 - Seaweed extract @0.2%	36.00	100.90	13.00	32.67
T_3 - Seaweed extract @0.3%	42.67	107.77	14.67	33.00
T_4 - Humic acid @0.1%	35.83	103.37	13.00	30.00
T_5 - Humic acid @0.2%	34.17	106.70	13.33	31.67
T_6 - Humic acid @0.3%	39.00	115.60	15.00	33.67
T_7 - Control	31.00	99.37	12.33	29.00
SEm	1.485	2.695	0.457	0.649
SEd	2.101	3.811	0.647	0.917
CD (0.05)	4.628	8.395	1.424	2.021

Table 2: Effect of seaweed extract and humic acid on yield and post harvest characters of cluster bean var. Pusa Navbahar.

Treatments	Number of pods per plant	100 pod weight (g)	Total pod yield (t/ha)	PLW (%)			Shelf life of pods (days)
				2nd day	4th day	6th day	
T_1 - Seaweed extract @0.1%	59.60	281.78	12.33	1.377	3.38	5.30	4.96
T_2 - Seaweed extract @0.2%	60.84	291.58	12.61	1.347	2.67	4.53	5.33
T_3 - Seaweed extract @0.3%	62.33	306.83	12.99	1.103	2.19	4.28	5.82
T^4 - Humic acid @0.1%	60.27	276.07	12.39	1.470	3.55	5.49	4.99
T_5 - Humic acid @0.2%	60.54	291.55	12.73	1.313	2.77	4.57	5.43
T_6 - Humic acid @0.3%	62.44	306.97	12.98	1.143	2.42	4.32	5.87
T_7 - Control	57.75	258.55	12.03	1.927	3.75	5.68	4.83
SEm	0.755	7.31	0.133	0.108	0.35	0.156	0.205
SEd	1.067	10.34	0.188	0.238	0.78	0.343	0.453
CD (0.05)	2.351	22.79	0.413				

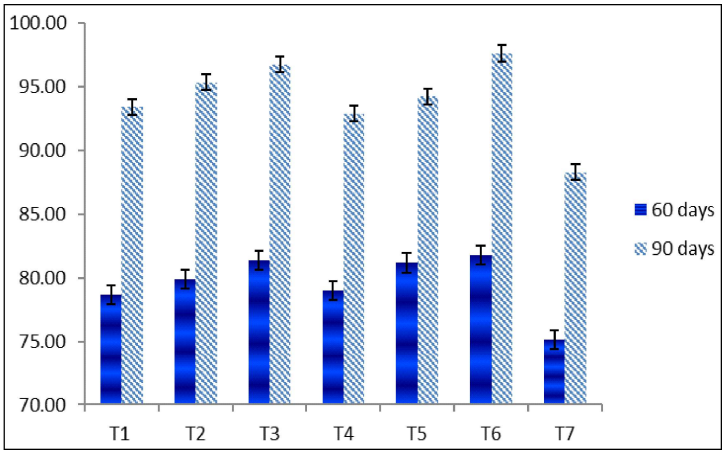

Fig 1: Effect of seaweed extract and humic acid on dry matter production (g^{-1} plant) of cluster bean var. Pusa Navbahar.

humic acid at a concentration of 0.3 per cent (4.3 per cent). All treatments resulted in no change in green hue after three days. The pod color progressively altered on the fourth day of storage. The shelf life of pods was most significant when 0.3 per cent humic acid was used (5.87 days), followed by 0.3 per cent seaweed extract (5.82 days). Among the treatments, pods treated with a greater concentration of humic acid and seaweed extract had a significantly longer shelf life than pods treated with lower concentrations or untreated pods (Table 2).

Effect on growth characters

This study established the effect of foliar application of seaweed extract and humic acid on cluster bean growth. The improved growth and development seen with these treatments might be attributed to the macronutrient content of seaweed extracts. Macronutrients such as nitrogen, phosphorus and potassium are critical for the plant's growth and development (Attememe, 2009). The improvement in growth characteristics might be attributed to auxin presence in the seaweed extract, which plays a vital role in cell division and expansion, resulting in increased shoot growth, leaf size and plant dry weight (Gollan and Wright, 2006). Humic acid has a role in physiological processes by promoting enzymes and the transfer of photosynthetic products and cell division and elongation (Fawzy *et al*., 2007), resulting in higher growth and, thus, greater leaf mineral content.

Humic compounds have been shown to have a direct and indirect effect on plant development. Directly, these substances are designed to induce plant growth by accelerating respiration processes, increasing cell permeability and stimulating hormonal growth responses (Vaughan, 1974). Indirectly, specific plant hormone-like compounds found in humic acid may promote the growth and development of chlorophyll and the proliferation of beneficial soil microorganisms (Liu *et al*., 1998). The application of humic acid to plants resulted in a considerable improvement in photosynthesis (Bettoni *et al*., 2014). Additionally, Nardi *et al*. (2002) observed that humic acid increased total protein content in plants and facilitated respiration and photosynthetic processes, resulting in improved growth promotion.

Effect on yield characters

In general, we observed a considerable increase in cluster bean production potential following foliar application of seaweed extract and humic acid at increasing dosages. The improvement in yield characteristics might result from humic acid and seaweed extract having a substantial influence on the shoot system, which increases plant yield and overall yield. These results might also be explained because the added humic acid is high in nutritious components and serves as a nutrient base for the bacteria, increasing their activity (Tisdale *et al*., 1997).

Due to the foliar application of humic acid throughout fruit development and harvest, pod size and weight increased. Humic acid increased pigment accumulation, resulting in brighter, more photosynthetically efficient leaves. This would have led to increased photosynthetic production and transfer from leaf to growing pods. Hancock (1999) made similar observations.

The beneficial impact of humic acid may be attributed to the humic components' existence of auxin and cytokinin. According to Kumar *et al*. (2002), spraying black pepper with different auxin and cytokinin chemicals increased berry size and production. They determined that the size increase is primarily due to auxin-induced quicker mitotic cell division and subsequent centripetal cytokinesis in growing berries. Similar physiological changes would have occurred in plants treated with humic acid, given that humic acid is known to contain auxin and cytokinin.

The increase in leaf quantity and size in plants treated with seaweed extract may be attributed to the presence of betaines. By controlling osmotic adjustment and promoting ion homeostasis, betaines serve a critical function in avoiding chlorophyll breakdown and safeguarding the thylakoid membrane. Stephenson (1974) observed similar results in maize using extracts of *Ascophyllum* and

Laminaria. The cytokinin found in Seaweed extract is critical for the mobilization of cytokinin from roots to reproductive organs, hence initiating flowering and yield. As Omar (2014) noted, a higher concentration of seaweed extract worked effectively in the post-harvest phase. Seaweed extracts are a promising and effective natural substance that may be used in place of conventional fungicides to prevent the development of post-harvest rot, hence improving product quality and storability.

CONCLUSION

The experimental findings on the influence of seaweed extract and humic acid on cluster bean var. Pusa Navbahar demonstrated that foliar spraying of 0.3 per cent seaweed extract and humic acid increased plant height, leaf count and dry matter production compared to control at 30 and 45 days after sowing (DAS). Foliar spraying with 0.3 per cent humic acid resulted in the maximum pods per plant. In seaweed extract, treatment at a concentration of 0.3 per cent resulted in the maximum pod production per plant, followed by humic acid at a concentration of 0.3 per cent. T_3 at 0.3 per cent seaweed extract produced the highest total pod yield per hectare (12.99 t/ha), followed by humic acid at 0.3 per cent (T_6) at 12.98 t/ha. The least physiological weight loss was seen in seaweed extract at a concentration of 0.3 per cent (4.2 per cent), followed by humic acid at a concentration of 0.3 per cent (4.3 per cent). The shelf life of pods was highest when 0.3 per cent humic acid was used (5.87 days), followed by 0.3 per cent seaweed extract (5.82 days).

Conflict of interest

On behalf of all the authors, I certify that there is no conflict of interest among the authors for this manuscript.

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