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NATURAL FARMING FOR CLIMATE RESILIENCE IN CORIANDER: RESPONSE OF BEEJAMRITAM UNDER SALINITY STRESS

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ABSTRACT

A field experiment was conducted using local variety of coriander during November 2024 at farmer’s field in Lingala village in a Randomized Block Design (RBD) with four replications and six treatments. Treatments included control, Beejamritam, NaCl at 10 mM and 20 mM, and combinations of NaCl with Beejamritam. The study assessed the impact of Beejamritam and varying concentrations of NaCl in coriander seed germination and other growth parameters. The results revealed that the highest germination percentage in the seeds treated with Beejamritam alone, followed by (97.50%). Seeds treated with 20 mM NaCl recorded significantly lower germination percentages of 36.25%. The highest germination index (GI) was observed in seeds treated with Beejamritam alone (14.26), while the lowest GI was recorded in the 20 mM NaCl treatment (5.05). Similarly, shoot length (SL) was greatest for Beejamritam-treated seeds (16.80 cm) and smallest in the 20 mM NaCl treatment (14.70 cm). The root length (RL) showed the highest value of 10.25 cm in Beejamritam-treated seeds, whereas it was lowest (4.50 cm) under 20 mM NaCl. The root-to-shoot ratio (R:S) reached a maximum of 0.62 in seeds treated with Beejamritam, while the minimum ratio was 0.31 in the 20 mM NaCl treatment. The seedling vigor index (SVI) was notably highest for Beejamritam-treated seeds at 2636.01, whereas seeds treated with 20 mM NaCl recorded the lowest SVI of 688.41. These results underscore the potential of Beejamritam to improve germination and growth under saline stress conditions. The combination treatments of Beejamritam and NaCl showed improved germination percentages and other growth parameters, compared to NaCl treatments alone. The findings indicate that Beejamritam has the potential to mitigate the adverse effects of salinity stress on seed germination and other growth parameters, suggesting its utility in enhancing crop establishment under saline conditions.
Keywords **:** Beejamritam, germination percentage, treatments and saline condition.

Introduction

Coriander (*Coriandrum sativum L.*), commonly known as "Dhania," is an important spice crop valued for its culinary and medicinal uses, owing to its essential oil content, particularly linalool, which imparts its distinctive aroma and flavor. The crop, belonging to the family Apiaceae, is extensively used in cuisines across Asia, the Middle East, and other regions, and its seeds and leaves are integral to various food and industrial applications. India, being the “Home of Spices,” plays a significant role in coriander production. In India the major growing states are Rajasthan, Gujarat, Madhya Pradesh, Tamil Nadu and Uttar Pradesh. Rajasthan contributes about 43 per cent of coriander production in country. In India, it is grown on an about 5, 83,000- hectare area with 7, 58,000 tones production and 0.76 tons per hectare productivity. In Uttar Pradesh it is grown on an about 3, 97,000 hectares area with 2, 88,000 tons production and 0.48 tons productivity. (NHB, 2019) However, coriander cultivation faces challenges such as salinity stress, which adversely impacts seed germination and crop growth. Liquid organic formulations Bijamrita used in natural farming. This is prepared by fermentation process from locally available ingredients in the farm. This is the rich sources of beneficial micro flora which support, stimulate the plant growth, help in getting better vegetative growth and also good quality yield (Devakumar *et al*., 2014). In this context, Beejamritam, a traditional organic seed treatment prepared using cow dung, cow urine, lime, and jaggery, has shown potential to enhance seed germination and mitigate stress by improving microbial activity around seeds. Salinity stress, simulated using NaCl in this experiment, reduces germination by creating osmotic stress and ion toxicity, but the use of Beejamritam offers a sustainable approach to counter these effects. The present study aimed to evaluate the response of coriander seeds to different NaCl concentrations and Beejamritam, individually and in combination, to explore its potential in improving germination and other growth parameters under saline conditions.

Objectives

- To evaluate the effect of different concentrations of NaCl and Beejamritam, individually and in combination, on the germination percentage of coriander (*Coriandrum sativum* L.), with the aim of understanding the potential of Beejamritam in mitigating salinity stress and improving seed germination under saline conditions.
- To evaluate the effect of different concentrations of NaCl and Beejamritam, individually and in combination, on the growth parameter of coriander.

Materials and Methods

A field experiment was conducted during November 2024 at a farmer's field in Lingala village, Andhra Pradesh. The experiment was laid out in a Randomized Block Design (RBD) with six treatments and four replications to ensure statistical validity. The treatments included a total of six combinations *i.e* T_1-Control (untreated seeds), T_2-Beejamritam (seed treatment with Beejamritam), T_3-10 mM NaCl (seeds soaked in 10 mM NaCl solution), T_4-20 mM NaCl (seeds soaked in 20 mM NaCl solution), T_5-10 mM NaCl + Beejamritam (seeds treated with 10 mM NaCl followed by Beejamritam), T_6-20 mM NaCl + Beejamritam (seeds treated with 20 mM NaCl followed by Beejamritam). Beejamritam was prepared using traditional natural farming techniques, which included fresh cow dung (500 g), cow urine (500 ml), lime water (50 g), and a small amount of soil from the field. These ingredients were mixed with water and fermented for 24 hours before use. NaCl solutions were prepared by dissolving NaCl in water to achieve concentrations of 10 mM and 20 mM. The coriander seeds were soaked in respective solutions for 12 hours, depending on the treatment, and air-dried to remove excess moisture. Seeds were then sown in well-prepared plots at a spacing of 15 cm × 10 cm. Standard agronomic practices were followed uniformly across all plots to ensure proper crop management. The primary parameter recorded was germination percentage, calculated based on the number of seeds that successfully germinated out of the total sown. Observations were taken 7 days after sowing (DAS). The growth parameters were also recorded. The data were statistically analyzed using ANOVA to assess the significance of treatment effects on seed germination. The mean values were compared using the RBD at a 5% probability level to draw conclusions about the effectiveness of Beejamritam and its combinations with NaCl under varying salinity stress levels.

Result and Discussion

Germination percentage

The results of the study demonstrated in Table. 1 and Figure.1, where, significant variations in the germination percentage of coriander seeds under different treatments was observed. There is a significant difference between the treatments. The highest germination percentage was observed in the seeds treated with Beejamritam alone showed high germination percentage of 97.50%, highlighting the optimal conditions for seed germination without external stressors, indicating the positive influence of Beejamritam in promoting seed germination through its beneficial microbial and nutrient-enhancing properties. Whereas control (untreated seeds) exhibited statitistically at par with germination percentage of 96.20%. Conversely, treatments involving NaCl alone had a pronounced negative effect on seed germination *i.e* T_4-36.25% followed by T_3-48.65%. These results underscore the detrimental impact of salinity stress on seed viability, as NaCl disrupts water uptake and creates osmotic stress, which adversely affects the germination process.

Germination index

The results revealed substantial variations in the germination index across different treatments and drawn in Table.1 and Figure. 2. A statistically significant difference was observed between treatments. Seeds treated with Beejamritam (T_2) alone achieved the highest germination index of 14.26, which was statistically at par with control (T_1)-13.99. On the other hand, treatment involving 20Mm NaCl (T_4) exhibited a marked reduction in the germination index, with recording only 5.05, followed by 10Mm NaCl (T_3) at 6.81. These findings highlight the detrimental impact of salinity stress on germination index.

Germination involves an increase in overall metabolic processes, leading to the development of a seedling from the embryo (Subramaniyan and Malliga, 2016). During germination, seeds absorb water, triggering the activation of enzymes like lipases, proteinases, phosphatases, and hydrolases, which facilitate the breakdown of stored nutrients (Bewley and Black, 1985). Concentration of salt reduces the water potential in the medium which hinders water absorption by germinating seeds and thus reduces germination (Maas and Nieman, 1978). It appears that a decrease in germination is related to salinity induced disturbance of metabolic process leading to increase in phenolic compounds (Ayaz *et al*., 2000). It is assumed that germination rate and the fi nal seed germination decrease with the decrease of the water movement into the seeds during imbibitions (Hadas, 1977). Salinity stress can affect seed germination through osmotic effects (Welbaum *et al*., 1990). Salt induced inhibition of seed germination could be attributed to osmotic stress or to specifi c ion toxicity (Huang and Redmann, 1995). Earlier experiment showed that seeds treated with beejmritam reduced days for germination and increased seed germination percentage in garden pea (Pawar *et al*., 2015). The result of Beejamrita treatment showed significant effect on germination percent, increase in morphological parameters such as epicotyls length, hypocotyls length, and number of radical, and increase in biochemical contents of *Zea mays* L. seed (Subramaniyan and Malliga, 2016).

Shoot length

The results demonstrated notable differences in the **shoot length** across various treatments, with statistically significant variations observed and depicted in Table.1 and Figure. 3. T_2 alone exhibited the greatest shoot length of 16.80 cm, which was statistically on par with the T_1- 16.20 cm, T_5- 15.85 cm, T_6- 15.20 cm, T_3- 15.10 cm and T_4- 14.70 cm.

Root length

A significant difference in the root length was noticed and showed in Table.1 and Figure. 4. Among treatments T_2- 10.25 cm showed highest root length followed by T_1- 8.05 cm, while lowest root length noticed in T_4-4.50 cm followed by T_3-6.19 cm.

Root to shoot ratio

From the data recorded, for root to shoot ratio a significant variation was recorded in the treatments and it was presented in Table 1 and Figure. 5. Highest root to shoot ratio was observed in T_2-0.62 which was statistically at par with T_1-0.50, while lowest ratio observed in T_4-0.31 which was statistically on par with T_6-0.39, T_3- 0.40, T_5- 0.41.

Root and shoot lengths are critical indicators of a plant's response to salt stress, as roots directly interact with the soil to absorb water, while shoots transport it to the rest of the plant. Therefore, these parameters serve as essential markers for assessing how plants adapt to saline conditions (Jamil and Rha, 2004)

Seedling vigor Index

According to analysis of variation significant difference was found among treatments. T_2-2636.01 showed highest seedling vigor index followed by T_1-2337.17, while lowest was observed in T_4-688.41 followed by 1033.14 (Table.1 and Figure. 6).

Interestingly, the combination treatments of NaCl with Beejamritam showed a notable improvement in germination percentages and other growth parameters compared to NaCl treatments alone. These findings suggest that Beejamritam mitigates the adverse effects of salinity stress by enhancing the seed’s tolerance to osmotic and ionic stresses, likely through its bio-enhancing properties that promote microbial activity and nutrient availability. This highlights the potential of Beejamritam as a natural solution for improving seed germination and crop establishment in saline conditions. The better performance of Beejamritam treatment can be attributed to its components and the microorganisms associated with it. Swaminathan (2005) reported that naturally occurring beneficial microorganisms, including bacteria, yeasts, actinomycetes, photosynthetic bacteria, and certain fungi, are present in cow dung, a key component of Beejamritam. Natrajan, (2007) and Sreenivasa (2010) reported that Beejamritam contains macro- and micronutrients, various vitamins, essential amino acids, growth-promoting factors such as Indole Acetic Acid (IAA) and gibberellic acid (GA), along with beneficial microorganisms. Seed germination and seedling development are highly coordinated processes in plant physiology that require elevated metabolic activity (Karuppaswamy and Perumal, 2013).

Conclusion

The study demonstrates the potential of Beejamritam as an effective natural amendment to mitigate the adverse effects of salinity stress on seed germination and early seedling growth. The combination treatments of NaCl with Beejamritam significantly improved germination percentages and growth parameters compared to NaCl treatments alone. This improvement can be attributed to the nutrient-enriching and microbial-promoting properties of Beejamritam, which enhance plant tolerance to osmotic and ionic stresses. The presence of beneficial microorganisms, growth-promoting compounds such as IAA and GA, and essential nutrients in Beejamritam underscores its role as a sustainable solution for improving seed vigor and crop establishment under saline conditions. These findings highlight the potential for integrating Beejamritam into agricultural practices to enhance resilience and productivity in stress-prone environments.

Table 1 : Effect of Beejamritam, NaCl and their combination on germination and growth parameters of coriander.

	GP	GI	SL	RL	R:S	SVI
T1	96.20	13.99	16.20	8.05	0.50	2337.17
T2	97.50	14.26	16.80	10.25	0.62	2636.01
T3	48.65	6.81	15.10	6.19	0.40	1033.14
T4	36.25	5.05	14.70	4.50	0.31	688.41
T5	70.40	10.25	15.85	6.30	0.41	1562.35
T6	61.63	8.28	15.20	5.94	0.39	1297.60
C.D	10.21	1.44	2.72	1.30	0.12	343.02
SE(m)	2.45	0.48	0.65	0.31	0.03	82.31
SE(d)	3.47	0.67	0.92	0.44	0.04	116.41
C.V.	7.16	9.75	8.35	9.11	13.61	10.34

GP-Germination Percentage GI-Germination Index SL-Shoot Length
RL-Root Length R:S-Root to Shoot ratio SVI-Seedling vigour index

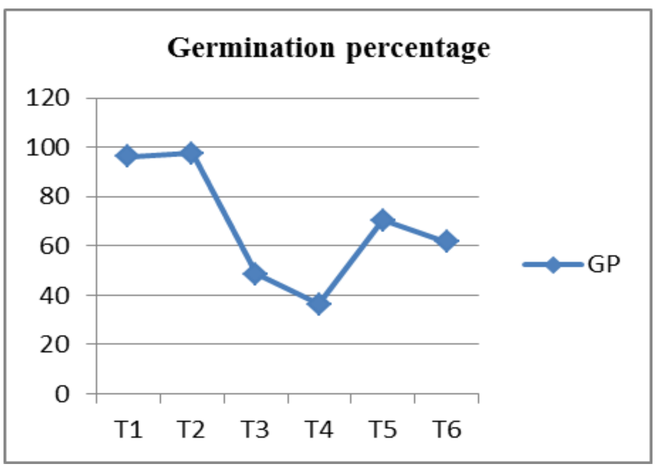

Fig. 1 : Effect of treatments on Germination percentage

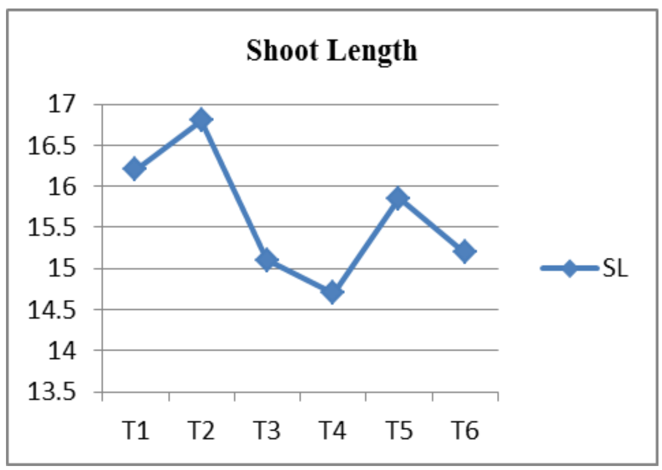

Fig. 3: Effect of treatments on Shoot length

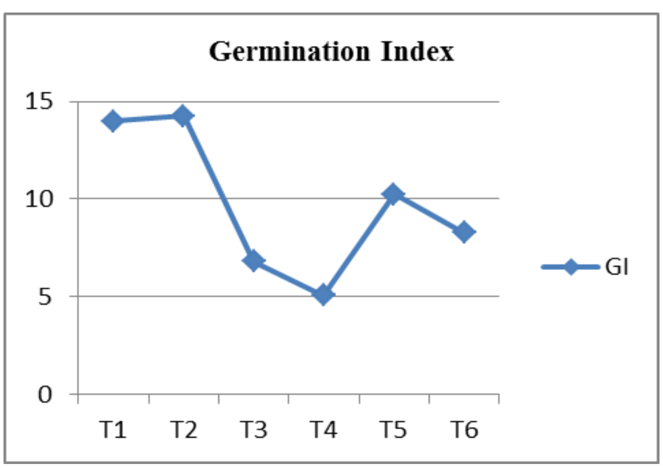

Fig. 2 : Effect of treatments on Germination index

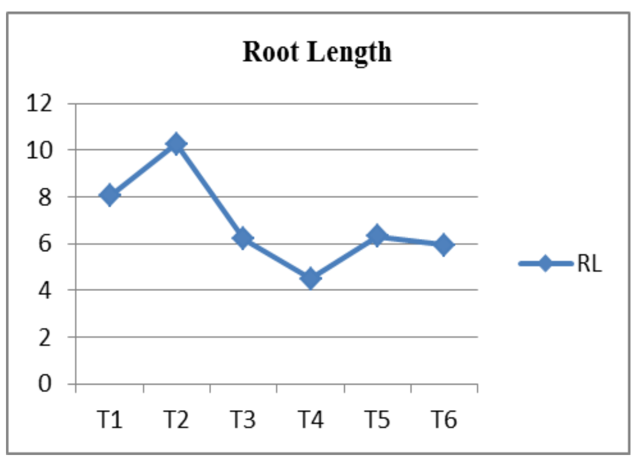

Fig. 4 : Effect of treatments on root length

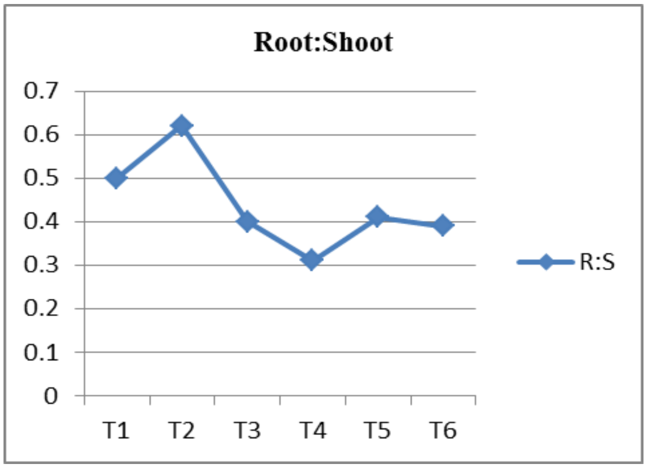

Fig. 5 : Effect of treatments on Root to Shoot ratio

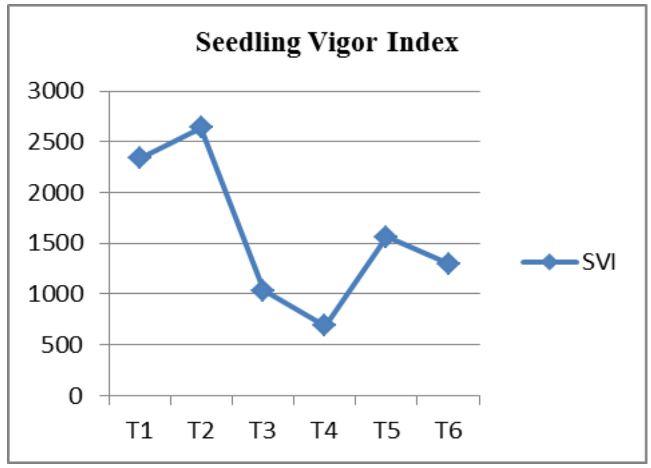

Fig. 6 : Effect of treatments on Seedling vigor index

T_1 T_2 T_3 T_4 T5 T_6

Photo 1 : Effect of different treatments on germination

Photo 2 : Effect of Beejamritam, NaCl and their combination on coriander

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