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EFFECTS OF LEAF EXTRACT OF *Christella dentata* (FORSSK) ON PEA SEED GERMINATION AND GROWTH

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ABSTRACT

In natural and agricultural systems, allelopathy describes the beneficial or harmful impacts of one plant on another by releasing the chemicals from its constituents through various processes. The goal of this study was to evaluate *Christella dentata* (Forssk) Brownsey and Jermy, allelopathic effect with regard to changes in germination, amplification of seedling growth, and biochemical actions in pea seeds (*Pisum sativum* L.). The leaf extracts of *C. dentata* were produced in different concentrations (12.5, 25, 50, 100, 150, and 200 mg ml^{-1}). Seeds were then subjected to the aforementioned treatments for a whole night with regular water serving as the control. In pea total sugar, protein and amino acid as well as the seed's germination and growth, were all enhanced by the leaf extracts (50 mg ml^{-1} and 100 mg ml^{-1}). All of the indicators showed a more or less stationary nature in greater concentrations following T_4 (100 mg ml^{-1}). There was a discernible difference between all treatments when seedling characteristics are considered; in this study, seed treatment consistently performs better than control. With the exception of fresh and dry weight, treatment T_4 (100 mg ml^{-1}) was performing the best in the biochemical results. Leaf extract's increased activity can help seedlings grow sooner in areas with limited water. Thus, in a timetable for the growth of seeds or crops, the previously indicated therapy might be regarded as an energising treatment.

(Key words: Allelopathy, pea, *Christella dentate*, leaf extract, germination, seedling maturity)

INTRODUCTION

The establishment of increased seedling numbers is an optimizing field method to the search for efficient and sustainable agricultural techniques. Effective germination and early growth provide the groundwork for strong crop development during the establishment phase, which is a crucial time in a plant's life cycle (Reed *et al.,* 2022). Based on this, investigating allelopathic interactions more especially, utilizing *Christella dentata* (Forssk) Brownsey and Jermy a ferns' allelopathic potential becomes a viable strategy for increasing seedling density and fostering field establishment.

Allelopathy is the result of a biochemical interaction between plants that can either stimulate or impede growth. Allelopathic properties have attracted interest as a sustainable and environmentally beneficial way to increase field establishment (Motmainna *et al.,* 2023). With their variety of secondary metabolites, ferns are among the most intriguing potential allelopathic sources to affect seed germination and seedling growth. It is crucial to develop fields with the ideal quantity of seedlings, and this cannot be emphasised enough. Improved weed competition, optimal resource use, and eventually increased crop yields are all benefits of efficient establishment (MacLaren *et al*., 2020). But conventional techniques might not be able to provide the necessary amplification of seedlings. Therefore, investigating other strategies like allelopathic interactions becomes essential for sustainable agriculture (Choudhary *et al.,* 2023). Field establishment tactics could undergo a revolution if these chemicals are utilised for crop development. Given their capacity to affect several stages of seed germination and seedling growth, ferns are rationally considered allelopathic sources for seedling amplification (Ashokbhai, 2016). According to Drost (2023), ferns can have an allelopathic effect on seedling vigour by influencing root and shoot growth, as well as boosting seed dormancy breaking. Maximising field establishment might be greatly enhanced by comprehending and adjusting these allelopathic relationships (Wang *et al.,* 2023).

The current study aimed to assess the impact of a significant responsive botanical for improving seed strength through seedling vigour and set up, which can indicate its final effect in productivity, particularly on quality seed progress. *C. dentata* are an interesting choice for controlling seedling numbers because they are a diverse group of species with variable potentials for allelopathy. Phenolics, flavonoids, and terpenoids are among the allelopathic substances that ferns emit; these substances have been shown to have a variety of impacts on nearby plants (Lam, 2014). It is therefore regarded as a priming treatment item for pea (*Pisum sativum* L.) seed invigoration.

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MATERIALS AND METHODS

The mature *C. dentata* leaves were gathered from the campus of Bejoy Narayan Mahavidyalaya, and the extraction process was completed in the Botany laboratory. To get 10 ml in the end, 5 g of fresh leaf extract was extracted in distilled water. The extract was centrifuged for 15 minutes at 5000 rpm, and the supernatant (500 mg ml^{-1}) was collected. Six distinct concentrations of the treatments were made from this extract: 12.5 mg ml^{-1} (T_1), 25 mg ml^{-1} (T_2), 50 mg ml^{-1} (T_3), 100 mg ml^{-1} (T_4), 150 mg ml^{-1} (T_5), and 200 mg ml^{-1} (T_6).

After being surface sterilised for two minutes with 0.1% $HgCl_2$, pea seeds (cv. PSM-3), were repeatedly cleaned with distilled water. The seeds were then subjected to the aforementioned treatments for a whole night, with regular water serving as the control. After this, the seeds were assessed using the Glass Plate method in five replicated aseptic conditions, taking into account the parameters of the seedlings at the fourteenth day, such as the vigour index, fresh weight, dry weight (100°C for 24 hours), and germination % in the first count (Mandal *et al*., 2023; Mandal and Bala, 2023; Purane *et al*., 2020). The biochemical characteristics of seedlings that were 14 days old (the day of the final count of peas) which were regarded as the last day for using food reserves were measured. These biochemical characteristics included total soluble sugar (Nielsen, 2010), soluble protein (Lowry *et al.,* 1951), and total amino acidd content (Moore and Stein, 1948). A completely ranomised design (CRD) was used for the statistical computations. Using MS Excel, the result was obtained at the 5% level of significance.

RESULTS AND DISCUSSION

The results of Table 1 showed that, at the day of germination initiation, the higher concentrations of leaf extracts of *C. dentata* amplified the germination percentage of pea seed, connecting it to active participation in the germination system; however, after treatment T_4 (100 mg ml^{-1}), it was abruptly reduced. With the exception of treatment T_6 (200 mg ml^{-1}) and control, the rate was obviously decreased in the later days, but it still maintained an insignificant average germination value in the conclusion. The first count at germination observation can also be interpreted as seed vigour, which greatly aided in the establishment of seedlings in the field.

The corresponding seedling characteristics in Table 2 showed that, up to treatment T_4 in final day of count (14 days), the length of the root and shoot increased with increasing concentration of leaf extracts of *C. dentata*; these results were not statistically significant thereafter. The root-to-shoot ratio on final day i.e. on day 14 showed that the root was growing quickly in conjunction with the leaf extract. Longer seedlings, however, amply demonstrated the superior "vigour index," where the treatments T_3 (50 mg ml^{-1}), T_4 (100 mg ml^{-1}) and T_5 (150 mg ml^{-1}) concentrations of leaf extract had the most impact while the treatments T_4 and T_5 stages showed negligible difference. A similar pattern was also seen in fresh and dry weight, which suggests that increased dry matter accumulation in healthy seedlings is the reason for the higher concentration of leaf extracts of *C. dentata* positive effects on the seedling fresh and dry weights. On the other hand, it was noteworthy that the accumulation of dry matter increased steadily and significantly with higher concentration, which was also the case for the last three treatments of other seedling parameters.

Table 1. Effect of *C. dentata* leaf extract on pea seeds germination

Treatments	**Seed germination (%)**			
	3rd Day	**4th Day**	**5th Day**	**Total**
Control	66.6	12.0	8.0	86.6
T_1	76.0	8.0	5.3	89.3
T_2	82.6	6.6	2.6	91.8
T_3	84.0	6.6	2.6	93.2
T_4	82.6	9.3	2.6	94.5
T_5	77.3	6.6	66.6	90.5
T_6	68.0	10.6	8.0	86.6
SEm(±)	**0.65**	**0.32**	**0.08**	**0.52**
CD (0.05)	**1.85**	**0.91**	**0.22**	**1.48**

Table 2. Effect of *C. dentata* leaf extract on seedling parameters of pea

Treatments	Root length (cm)	Shoot length (cm)	Root : Shoot ratio	Vigour index	Fresh weight (g)	Dry weight (g)
Control	6.56	5.41	1:0.82	84.9	0.98	0.05
T1	6.65	5.91	1:0.89	89.7	1.1	0.05
T2	7.23	6.30	1:0.87	91.7	1.23	0.06
T3	7.45	6.36	1:0.85	93.7	1.25	0.07
T4	7.62	6.82	1:0.89	94.1	1.31	0.07
T5	7.43	6.42	1:0.86	90.2	1.32	0.07
T6	7.18	6.32	1:0.88	84.4	1.35	0.08
Sem(±)	**0.09**	**0.05**	**-**	**0.52**	**0.005**	**0.001**
CD (0.05)	**0.26**	**0.13**	**-**	**1.49**	**0.014**	**0.003**

Table 3. Effect of *C. dentata* leaf extract on the activity of biomolecules of pea

Treatments	Total soluble sugar ($\mu g\ mg^{-1}$)	Soluble protein ($\mu g\ mg^{-1}$)	Amino acid ($\mu g\ mg^{-1}$)
Control	0.24	0.06	0.30
T_1	0.27	0.10	0.49
T_2	0.38	0.12	0.61
T_3	0.49	0.16	0.74
T_4	0.61	0.21	0.90
T_5	0.60	0.19	0.84
T_6	0.58	0.19	0.81
SEm(±)	**0.02**	**0.01**	**0.01**
CD (0.05)	**0.052**	**0.03**	**0.025**

The total soluble sugar increased as the concentration of *C. dentata* leaf extract increased, yet the final three concentrations i.e. 100 mg ml^{-1} (T_4), 150 mg ml^{-1} (T_5), and 200 mg ml^{-1} (T_6) showed no discernible trends (Table 3). The activity of the hypogeous cotyledon in exalbuminous seeds, where it evolved for both storage and photosynthesis (Rakesh, 2022), may be the reason for the last three treatments indication of a faster rate of carbohydrate synthesis than the others. The same pattern, or a greater inclination, was noted with higher quantities of root extract up to treatment T_4 (100 mg ml^{-1}), as was also seen in the quantity of protein and amino acids. This might be because, under the last three concentrations of leaf extract, the increased synthesis of protein and amino acids required for cellular activity intimately associated to the growth of the seedlings at their final day of count (14 days) is occurring.

A case of allelopathy can be seen in the way that varying *C. dentata* leaf extract concentrations promote the germination of seeds. With the exception of fresh and dry weight, the higher concentration was the best, but after treatment T_4 (100 mg ml^{-1}), or 100 mg ml^{-1}, their activity was either stationary or decreased. In short-duration crops, the early germination of seeds and the creation of new surface root initials, or lateral roots, from the primary root are particularly essential since the primary root's length and the buildup of dry matter may allow it to reach and utilise certain soil nutrient patches (Laliberte *et al*., 2015). The stationary state following T_4 treatment is most likely the result of more lateral roots forming. However, Mao *et al*. (2020) found that the most effective biochemical marker, and that the fast sequence of cell division for the advancement of morphological features, especially root, is closely linked to several biochemical markers. Treatment T_4 (100 mg ml^{-1}) is therefore thought to be the best option for obtaining the greatest number of amplified seedlings during field establishment.

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