**Influence of Gliricidia Extract on Cowpea Seed Germination and Seedling Growth Performance Under Greenhouse Conditions**

**Abstract**

*Gliricidia sepium* is highly regarded as a good soil improver as green manure. A Greenhouse experiment was conducted in a completely randomized design using sand medium for three weeks with the aim to determine the effect of Gliricidia extract from leaves at different concentrations (0, 5%, 10%, 15% and 20%) for irrigation purposes on *Vigna unguiculate* (cowpea) seed germination and seedling performance. The study showed significant (P<0.05) different amongst the different concentration of *Gliricidia extract* for cowpea seed germination percentage and seedling growth performance. The Gliricidia extract had stimulatory effect on the cowpea seeds germination and seedling performances at lower Gliricidia concentrations (< 10%) while inhibitory effect was observed at higher Gliricidia concentrations (> 15%). Similarly, all seedling development indicators, including seedling vigor index (SVI) and percentage phytotoxicity (PP), decreased considerably (P<0.05) with higher extract concentrations (>15) compared to lower concentrations (<10%). It was clear that Gliricidia extract had a negative and inhibiting influence on percentage seed germination and seedling growth parameters at higher concentration whilst it has positive and stimulatory impact on seed germination and growth parameter at lower concentrations.

**Keywords:** *Gliricidia Sepium*,Percentage Germination**,** Seedlings Growth, Greenhouse, *Vigna unguiculata*

**Introduction**

Cowpea (*Vigna unguiculata*) is a good source of protein and an important crop in Sub-Saharan Africa. However, a lack of improved cultivars, poor management techniques, and sparse input utilization result in relatively modest growth rates (Kyei-Boahen et al., 2017). It is an important grain legume grown in semi-arid Sub-Saharan Africa. It is a significant source of protein and an affordable source of high-quality protein for African rural and urban residents (Ajeigbe et al., 2012; Dube & Fanadzo, 2013). Cowpea leaves have a protein content ranging from 27 to 43%, while dry grain has a protein concentration ranging from 21 to 33%. (Ahenkora et al., 1998; Ddamulira et al., 2015; Abudulai et al., 2016). Cowpea is a valuable source of cattle fodder in West African savannas, making dual-purpose cultivars particularly appealing to farmers (Singh et al., 2003; Kamara et al., 2012).

*Gliricidia sepium* is a fast-growing, adaptive tree that may disperse seeds up to 40 meters from the parent tree by exploding pods. As green manure, a soil conditioner, and an erosion preventer, this species has been widely introduced in tropical and subtropical areas (Elevitch & Francis, 2006). The legume *Gliricidia sepium* may fix nitrogen. The half-life of Gliricidia leaves is about 20 days, and it produces a lot of litter. The plant is therefore regarded as a good soil-improving green manure, and due to its deep roots and quick development, it also acts as a windbreak (Heuzé and Tran 2015). It can restore depleted soil and thrives on steep slopes. Due to its ability to create light shade and lower soil temperatures, *Gliricidia sepium* is frequently employed as a nursing tree or as shade for perennials such as coffee, tea, and cocoa (Orwa et al., 2009).

The stages of seed germination and crop growth are essential for ensuring reproduction and agricultural productivity (Gassama et al., 2015). Determining the impact of *Gliricidia sepium* extract on agricultural activities is crucial since there is a growing need for green manure to boost crop yield to feed an expanding global population. Given these viewpoints, the objective of the current study was to determine the effect of various *Gliricidia sepium* extract concentrations on cowpea seed germination and seedling growth in a greenhouse environment.

**Materials and Method**

**Experimental procedures**

Fresh leaves of *Gliricidia sepium* were harvested from the mature plant at the School of Agriculture and Food Sciences, Njala University. The leaves were reduced in size by being pounded with a mortal and a pistil and then squeezed to obtain the essence. The different concentrations 0% (control), 5%, 10%, 15% and 20% of Gliricidia were extracted. Cowpea seeds were sown on a sand substrate and the different concentrations of Gliricidia extracts were used to moistened sands at the department of crop science greenhouse.

**Seed Preparation and Imbibition Treatment**

To clean and get rid of microorganisms, cowpea seeds were repeatedly rinsed in double-sterilized water. In 3kg of sterile sand-filled plastic germination trays, 100 treated healthy cowpea seeds were planted as recommended by Gassama et al., (2015). 500 mL of *gliricidia sepium* extract in various concentrations was used to moisten the sand before the seeds were sown. A completely Randomized Design (CRD) with three replications were used in a three-factorial experiment. 200 mL of various doses of extract and distilled water were used to water the seedlings when the sand was set to dry. The following percentages of the extracts were used as the treatments: 0% (control), 5%, 10%, 15% and 20%. The International Seed Testing Association's guidelines were followed when conducting the germination test (ISTA Rules 1999).

**Data Collection**

The following parameters were measured: germination percentage, seedling fresh weight, seedling vigor index, percentage phytotoxicity, seedling leaf length, seedling leaf breadth, seedling dry weight and seedling length.

$Seedling Vigor Index \left(SVI\right)=Germination (\%) x Seedling Length (cm)$ as suggested by (Abdul-Baki & Anderson, 1973).

$Percentage Phytotoxicity=\frac{Radical length of control-Radical lenth of test}{Radical lenght of control}x100$ as suggested by (Chou and Lin 1976).

**Statistical Analysis**

The data were analyzed using SAS statistical software (9.4 version), which also included an analysis of variance (ANOVA). Using the least significant difference (LSD) at P <0.05, treatment averages were compared.

**Results**

**Phytochemical Analysis of *Gliricidia sepium***

The presence of the phytochemicals listed in Table 1 was determined by a preliminary phytochemical analysis of ethanolic, acetonic, and aqueous extracts of *Gliricidia sepium* leaves. Alkaloids, flavonoids, cardiac glycosides, steroids, tannins, carbohydrates, and proteins were abundant in ethanol and aqueous extracts, but acetone leaf extract contained significantly fewer phytochemicals (Dubal R.S et al., 2020).

**Table 1: Qualitative analysis of phytochemicals in leaf extract of G. sepium.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Phytochemicals** | **Ethanolic Extract** | **Acetonic Extract** | **Aqueous Extract** |
| Alkaloids | +++ | + | ++ |
| Flavonoids | ++ | - | + |
| Glycosides | ++ | + | ++ |
| Steroids | ++ | - | + |
| Tannins | ++ | - | +++ |
| Phenols | +++ | + | ++ |
| Carbohydrates | ++ | + | +++ |
| Proteins | +++ | + | +++ |
| Fat and oil | - | + | - |

(Dubal R.S et al., 2020)

**Percentage Seed Germination**

Data pertaining to different concentrations of *Gliricidia sepium* on *Vigna unguiculate* (cowpea) seed germination percentage was significantly (P<0.05) different (Fig:1). Percentage germination increased with increase in *Gliricidia sepium* up to 10% for cowpea seed and thereafter decreased gradually. Maximum germination percentage of 97% was recorded at 10% concentration of *Gliricidia sepium* whilst the lowest germination percentage 79% was recorded at 20% concentration. Lower concentrations had promoting effect on seed germination while higher concentration had reducing effect. The outcome demonstrates that as Gliricidia extract concentration increased, the percentage of seed germination dropped. Similar findings were reported by Oyun (2006), who found that maize seed germination was decreased at higher Gliricidia concentrations. The outcome demonstrates that cowpea seed germination was adversely affected by large amounts of Gliricidia extract. The presence of allelochemicals such as tannins, wax, flavonoids, and phenolic acids may be the cause of the test species' inhibitory effect on seed germination (Oyun, 2006).

**Fig 1:** Effect of different concentrations of *Gliricidia sepium* on percentage germination of *Vigna unguiculate* (cowpea) seeds.

**Seedling Growth Performance**

Different concentration of Gliricidia extract on cowpea's seedling leaf length, seedling leaf breadth, seedling fresh weight, seedling dry weight and seedling length was significantly (P<0.05) different (Table 2). Result in table 2 indicated that, all parameters increased with increase in different concentration of gliricidia extract at 10% and a further increase in the concentration from 15-20% a decreased was observed. This result was also consistent with Oyun's (2006) observation that gliricidia and acacia leaf leachates inhibited the growth of maize seedlings. The low amount of oxygen in dissolved form due to high concentration of dissolved solids in the extract reduces the energy supply through anaerobic respiration causing retardation of growth and development of seedling (Saxena *et al.,* 1986). It was clear that the growth of cowpea seedlings was hindered by the toxic effect of various concentrations of Gliricidia leaf extract.

**Table 2. Effect of different concentrations of Gliricidia sepium seedling performances cowpea**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Concentrations (%) | Seedling Leaf Length(cm) | Seedling Leaf Breadth(cm) | Seedling Fresh Weight(g) | Seedling Dry Weight(g) | Seedling Length(cm) |
| 0 | 3.34a | 3.07a | 18.38b | 2.34b | 33.20a |
| 5 | 3.41a | 3.43a | 20.33a | 2.61a | 32.88a |
| 10 | 3.77a | 3.63a | 20.45a | 2.67a | 35.31a |
| 15 | 2.9b | 2.96b | 17.85b | 2.27b | 28.78b |
| 20 | 2.6b | 2.56b | 15.35c | 1.74c | 26.45b |

\*Means with the same letters are not significantly different (P >0.05)

**Seedling Phytotoxicity Percentage**

Data revealed that as cowpea seedlings were watered with different concentrations of Gliricidia extract, significant (p<0.05) different in phytotoxicity were seen (Fig: 2). Cowpea seed germination was more hazardous when Gliricidia extract concentrations were higher, which slowed the growth of the seedlings. Additionally, a larger concentration of Gliricidia extract was found to have higher phytotoxicity. At a concentration of 20%, the mean value of phytotoxicity was the highest with 34.26% while at lower concentration, they phytotoxicity was low. Higher concentration decreases the activities of dehydrogenase (Murkumar and Chavan 1987) and acid phosphatase (De Leo and Sacher 1970) which are important enzymes during early germination process and are also involved in the mobilization of nutrient reserves (Flinn and Smith 1967).

Fig 2: Effect of different concentrations of *Gliricidia sepium* on percentage phytotoxicity of *Vigna unguiculate* (cowpea) seeds.

**Seedling Vigor Index**

Seedling vigor index for cowpea seeds as influenced by different concentration of Gliricidia extract, was significantly (p<0.05) different (Fig 3). It was observed that steady increase in various concentration levels of Gliricidia extract from 0% to 10% increase in seedling vigor index was recorded. Further increase in the Gliricidia extract concentration from 15 to 20% saw significant reduction in seedling vigor index for cowpea seeds. However, seed irrigated with 10% concentration of Gliricidia extract had the most vigorous seedlings (3425.07), whereas 20% of the Gliricidia extract had the least vigorous seedlings (2089.55). The result shows that, gliricidia extract had more inhibiting effect on seedlings at higher concentrations. Hence, the concentration that gave the highest seedling vigor index is thought to be more vigorous (Abdul-Baki & Anderson, 1973).

Fig 3: Effect of different concentrations of *Gliricidia sepium* on seedling vigor index of *Vigna unguiculate* (cowpea) seeds

**Discussions**

The recent discoveries support the earlier study by Bora et al (1999). They discovered that the content of leaf extracts had a direct correlation with the inhibition of some crops' germination. Jadhar and Gayanar (1992) also noticed that as the concentration of leaf extract increased, the percentage of germination, plumule count, and radicle length of rice and cowpea all reduced. Response indices in the current investigation showed that seedling growth parameter inhibition was more pronounced than seed germination. The presence of allelochemicals such as tannins, wax, flavonoids, and phenolic acids may be the cause of the test species' inhibitory effect on cowpea seed germination and seedling growth (Oyun, 2006). Additionally, the toxicity could result from a combination of effects rather than just one (Fag and Stewart, 1994). Phenolic acids are harmful to plant growth and germination processes (Einhelling, 1995).

In their research, Rajangam and Arumgam (1999) discovered that the usage of Excoecaria agallocha leaf z-aqueous extracts hindered rice seed germination as well as plumule and radicle elongation. On the other hand, according to Joes and Gillespie (1998), the juglone emitted by black walnuts inhibited corn and soybean leaves and roots from respiring and transpiring as well as photosynthesis and stomatal conductance. Therefore, in this investigation, the lower growth characteristics of cowpea seedlings with an increasing concentration of leachates were undoubtedly caused by the leachates' inhibitory influence on physiological processes that contribute to growth (Oyun, 2006). Although it was not explicitly evaluated, it was found that the leaf leachates' inhibitory effect on seed germination was due to their ability to prevent water absorption, which is a prerequisite to physiological processes that should take place in the seed before germination is activated (Oyun, 2006). Similar to how it was found in the study, the effect of leaf extract on seedling growth was probably due to an obstruction of the growing cowpea's ability to absorb nutrients, which decreased growth parameters at higher concentrations in a proportion that was related to the concentrations of the extract.

**Conclusion**

Gliricidia sepium extracts at concentrations of 15% and 25% inhibited cowpea seed germination and seedling growth. The ingredient reduces water absorption as well as nutritional intake in growing cowpea seedlings when the seeds were still germinating. Thus, the current investigations findings indicate that a higher concentration of gliricidia sepium extract inhibit cowpea seed germination and seedling growth while lower concentration stimulate seed germination and seedling growth.

**Author Contribution Statement**

Mr. UMG planned and designed this research and provided the resources and materials needed for the research. I instructed Mr. IK to implement the research and collect the data under my supervision while all data analysis and report writing was done by Mr. UMG.

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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