

## Effects of *Nypa Palm (Nypa fruticans Wurmb)* Leaf and Root Extracts on Germination of *Tridax procumbens* and *Cyperus rotundus*

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### ABSTRACT

Weeds are plants that present significant challenges to agricultural production. The control of weeds through the use of synthetic herbicides, affect both the proper functioning of the ecosystem and the health of humans and other organisms. The allelopathic effects of aqueous extract of *Nypa fruticans* an invasive plant on the germination of *Tridax procumbens* and *Cyperus rotundus* was investigated. Leaf and root extracts of *Nypa fruticans* were prepared following the standard methods. The seeds were treated in 0%, 25%, 50%, 75%, and 100% concentrations and distilled water was used as control (0%). The aqueous leaf extract of *Nypa fruticans* showed significant inhibitory activity on germination potency of the seeds of *Tridax procumbens* and *Cyperus rotundus* in terms of Germination Index. There was concentration dependent decrease in germination rate across the test samples. The maximum and minimum inhibitory values were obtained in 100% and control (0%) extract concentrations respectively. The study revealed that both the leaf and root extracts of *Nypa fruticans* have significant impact at ( $p \leq 0.05$ ) on the germination of *Tridax procumbens* and *Cyperus rotundus*.

**Keywords:** Leaf Extract, Root extracts, Allelopathy, *Nypa fruticans*, *T. procumbens*, *C. rotundus*, Germination Index.

### Introduction

Weeds pose one of the most significant challenges to agricultural production worldwide. They impede crop growth and disrupt production, resulting in substantial losses by competing for light, nutrients, water, and space. Additionally, weeds can harbor other pests, including insects (Madden et al., 2021). The *Nypa* palm (*Nypa fruticans Wurmb*) is a unique monocot genus within the Palmae (Arecaceae) family. *Nypa fruticans* originates from the Indo-Pacific region and is found as part of mangrove ecosystems.

In Nigeria, it is often considered a "nuisance palm" due to its negative ecological impacts on waterways and marine life. *Nypa fruticans* are found particularly in brackish, sheltered tidal areas like river deltas where dicotyledonous mangrove species thrive. It tends to establish itself before the natural regeneration of *Rhizophora* species, filling any gaps left by native mangroves (Chukwuebuka et al., 2020).

The rapid spread of this palm has resulted in the decline of native mangrove species like *Rhizophora* and *Avicennia africana*, which are vital for providing poles, fuelwood, and tannins, as well as supporting rice cultivation and fish and oyster breeding (Etukudo et al., 2001). Its invasive nature has been linked to the presence of phytochemicals like phenolic compounds. Yusoff et al, 2015, mentioned that the extracts of *N. fruticans* contain phenolic and flavonoids compounds. *Nypa fruticans* contains flavonoids, tannins, phenol, hydroquinone, diterpenes, steroids and saponins (Ebana et al., 2015).

*Tridax procumbens*, commonly known as cotton button or Tridax daisy, is a flowering plant belonging to the Asteraceae family. This annual or short-lived perennial aster exhibits a notable ability to establish and spread rapidly. *T. procumbens* is recognized as an economically significant weed, with a serious threat to crops like cassava, cotton, wheat, and various irrigated plants.

Additionally, it is often found in waste areas, along roadsides, and in neglected lawns and gardens (Kunal et al., 2022).

*Cyperus rotundus* L., a member of the Cyperaceae family, is an erect, glabrous herbaceous plant with fibrous roots and slender, scaly creeping rhizomes. This plant thrives in cultivated fields, farmlands, neglected areas, wastelands, grasslands at forest edges, and along roadsides. It is particularly prevalent in disturbed locations and lawns, making it one of the most common weeds in secondary succession within abandoned and arid fields. Controlling *Cyperus rotundus* poses challenges due to its extensive underground tuber system and resistance to most herbicides. Its presence in agricultural fields significantly decreases crop yields (Bian-Xia et al., 2023).

Allelopathy is a biological process in which plants produce and release specific chemicals known as allelochemicals into their environment through methods such as volatilization, leaching, root secretion, and the decomposition of plant material (Radivojević et al., 2025;). These chemicals can directly or indirectly affect the growth and metabolism of neighboring plants, typically inhibiting their development (Siyu et al., 2025). Allelochemicals can be found in various parts of the plant, including roots, stems, leaves, flowers, pollen, and seeds; in some cases, toxic compounds may be concentrated in just one or two specific organs.

Crude extracts or plant residues can be applied directly as bioherbicides, while compounds isolated from allelopathic plants can serve as templates for developing natural herbicides (Poonpaiboonpipat, 2021). However, the composition, concentration, and allelopathic properties of these compounds can vary significantly among plant species, resulting in effects that are specific to the target species

Seed germination is a crucial stage in the plant life cycle, highly responsive to environmental signals and biochemical interactions. Allelochemicals such as phenolics, flavonoids, and alkaloids can disrupt various processes, including cell membrane integrity, which impairs water absorption, enzymatic activity (particularly of amylases and proteases crucial for mobilizing seed reserves), and hormonal balance especially gibberellins and abscisic acid.

Extracts of castor (*Ricinus communis*) showed significant reduction in radicle length, hypocotyl length and fresh biomass of the weed was also observed (Anwar, 2021).

The aim of the study was to evaluate the allelopathic effects of invasive *Nypa fructicans* leaf and root extracts on the germination of *Tridax procumbens* (Coat buttons or Triadax diasy) and *Cyperus rotundus* (Purple nutsedge or nutgrass).

## Materials and Methods

### Equipment /Apparatus

Water bath (Grant, England), hot air oven (Gallenpkam, England), Bench centrifuge (Clay adams, USA), beakers, digital weighing balance (Mettler PT 320-Wagen, Switzerland), funnel, measuring cylinder, pH meter (Hanna, HI 98106), magnetic stirrer (Lensor, USA), No 1 Whatman Filter paper, Rotary evaporator (Buchi Rotavapour Switzerland).

### Chemicals and Reagents

All chemicals and reagents used in this study were of analytical grade.

### Plant material collection and identification

Fresh leaves and roots of *Nypa fructican* were gathered from healthy host plants at Ekede river side in Ekede in Andoni Local Government Area, while healthy seeds of *Tridax procumbens* and *Cyperus rotundus* were gathered from a farm at the Agricultural Development Programme Area in Obio Akpor Local Government Area all in Rivers State.

The samples collected were identified and certified by Dr Wisdom Barade a taxonomist in the Department of Science Laboratory Technology, School of Applied Sciences, Kenule Beeson Saro-Wiwa Polytechnic, Bori, Rivers State, Nigeria and voucher numbers were given, *Nypa fructican* KSPT/2023/330. *Tridax procumbens* KSPT/2023/321.

The leaves and roots were washed in running tap water to remove the surface contaminants and dust and dried at room temperature. The plant materials were chopped into small pieces.

**Extract Preparation**

Extracts were prepared following the method of Ngondya et al., (2016) with some modifications: 100g of *Nypa fruticans* leaf and root powder were soaked separately in 1 L of distilled water for 72 hours. Afterward, the crude extracts were filtered using Whatman No. 1 filter paper. Both extracts were then diluted with distilled water in the following ratios: 0:100, 25:75, 50:50, 75:25, and 100:0 (extract: distilled water) to achieve concentrations of 0%, 25%, 50%, 75%, and 100%, with distilled water (0%) serving as the control. The diluted extracts were placed in properly labelled containers and stored in the refrigerator at 4°C. Laboratory experiments were conducted to examine the effect of *Nypa fructican* leaf and root extracts on the germination of the test plant species *Tridex procumbens* and *Cyperus rotundus*.

**Germination Experiment**

Petri plate experiment was conducted to observe seed germination. Seeds of *Tridex procumbens* and *Cyperus rotundus* were sterilized using a 0.2% sodium hypochlorite solution for 10 minutes and then rinsed with distilled water two times to prevent pathogen contamination. Two layers of filter paper were placed in 9 cm diameter petri plates, and ten seeds each of *Tridex procumbens* and *Cyperus rotundus* were positioned on the paper. These media were treated with 10 ml of aqueous extracts from the leaves and roots of *Nypa frutican* at various concentrations (0%, 25%, 50%, 75%, and 100%). Distilled water served as the control (0%) with three replicates for each treatment group established. The plates were maintained at room temperature under a controlled 12-hour light and 12-hour dark cycle. To keep the filter paper moist, 2 ml of the corresponding extract was added every 48 hours. The number of germinated seeds was counted from the second day until the conclusion of the experiment.

Germination percentage (%) was computed using the following formula.

$$\text{Germination \%} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds planted}} \times 10$$

**Statistical Analysis**

Data generated was analysed with the aid of Graph Pad Prism version 5.0. One-way analysis of variance (ANOVA) and Turkey’s post hoc test for comparism of means were used. Results were presented as mean± standard deviation and considered significant at p≤0.05.

**Results**

Table 1 shows the germination rate (%) of the seeds of *T. procumbens* and *C. rotundus* exposed to the root and leaf extract of *N. fructican*. The results show that germination rates of the seeds treated with the control (0%) for both *T. procumbens* (leaf, 96.67±5.77% and root, 93.33±5.77%) and *C. rotundus* (leaf, 93.33±5.77% and 90.00±0.00%) were appreciably higher than those of the groups treated with 25%-100% extracts. There were observed extract concentration dependent decreases in germination rate (%) of the seeds ranging from 76.67±5.77% - 20.00±0.00% for *T. procumbens* seeds treated with 25%-100% leaf extracts of *N. fructican*, while the root extract reduced the seeds germination rate from 26.67±5.77% to 0.00±0.00% respectively. There were observed extract concentration dependent decreases in germination rate % of the seeds ranging from 83.33±5.77% to 26.67±5.77% for *C. rotundus* seed treated with 25-100% of leaf extract of *N. fructican* while the root extract reduced the seed germination rate from 53.33 ±5.77%-10.00±0.00%.

**Table 1: Germination rate (%) of *Tridex procumbens* and *Cyperus rotundus* seeds exposed to leaf and root extracts of *Nypa fructican***

Extract conc (%)	<i>Tridex procumbens</i>		<i>Cyperus rotundus</i>	
	Leaf	Root	Leaf	Root
Control (0)	96.67±5.77 <sup>a</sup>	93.33±5.77 <sup>a</sup>	93.33±5.77 <sup>a</sup>	90.00±0.00 <sup>a</sup>
25	76.67±5.77 <sup>a</sup>	26.67±5.77 <sup>a</sup>	83.33±5.77 <sup>a</sup>	53.33±5.77 <sup>b</sup>
50	50.00±0.00 <sup>a</sup>	13.33±5.77 <sup>a</sup>	56.67 ± 5.77 <sup>b</sup>	20.00± 0.00 <sup>b</sup>
75	36.67±5.77 <sup>a</sup>	10.00 ± 0.00 <sup>a</sup>	46.67 ± 5.77 <sup>b</sup>	13.33± 5.77 <sup>a</sup>
100	20.00±0.00 <sup>a</sup>	0.00±0.00 <sup>a</sup>	26.67± 5.77 <sup>b</sup>	10.00 ± 0.00 <sup>b</sup>

**Key:** Values are mean ± standard deviation of triplicate determinations. Values with different superscript letters per row are statistically significant (P<0.05).

## Discussion

The results of this study showed the effect of both the leaf and root extract of *Nyssa fructifera* on the germination of *Tridax Procumbens* and *Cyperus rotundus*. The trend of inhibition of germination by the extracts was the same. However, there was a significant difference observed between the control and all the treated plants. This investigation has revealed that, the Control (0%) treatments of extracts showed high germination rates, indicating strong baseline viability and of the allelopathic effects of *Nyssa fructifera* extracts on germination, of *Tridax procumbens* and *Cyperus rotundus*.

For *Tridax procumbens*, leaf extracts caused a gradual decline from 76.67% for 25% extract concentration to 20.00% for 100% extract concentration. Root extracts had a more drastic effect, reducing germination to 0.00% at 100% extract concentration. This suggests that *T. procumbens* is highly sensitive to allelochemicals from root extracts, which may interfere with water uptake or enzymatic activation during germination. For *C. rotundus*, leaf extracts reduced germination from 83.33% for 25% extract concentration to 26.67% for 100% extract concentration. Root extracts caused a sharper decline, from 53.33% for 25% extract concentration to 10.00% for 100% extract concentration for *C. rotundus*.

Although *C. rotundus* is a notoriously resilient weed, these results indicate that *N. fructifera* root extracts can significantly impair its germination potential. Across both species, root extracts were more inhibitory than leaf extracts at all concentrations. This aligns with findings by Wang et al. (2024), who reported that seed germination is more sensitive to allelopathic compounds than seedling growth, especially when exposed to root extracts. This observed inhibition could be as a result of the presence of phytochemicals in the leaf and roots of *Nyssa fructifera*. These compounds may have fatal effects on seed germination by disrupting cell membrane function, affecting permeability and hormonal processes, causing changes in enzymatic activities and drastically affecting the overall embryo development (Lobuc et al., 2023). Syngkli & Rai (2024) found that aqueous extracts of *Ageratum conyzoides* significantly inhibited maize and lettuce germination, with stronger effects from root tissues.

According to Woghiren et al. (2022), similar inhibitory effects were observed with *Bidens pilosa* extracts on soybean and tomato seeds, supporting the idea that allelopathy can be a potent natural mechanism for plant competition and weed suppression. Zhao et al. (2018) investigated the allelopathic effects of volatile organic compounds from wheat on the seed germination of Chinese cabbage. They found that volatile organic compounds from wheat had a negative impact on Chinese cabbage seed germination, suggesting that allelopathy may play a role in regulating plant community dynamics in agricultural systems. This knowledge will improve the understanding of the allelopathic potentials of *Nyssa fructifera* which will allow for proper weed management.

## Conclusion

In conclusion, the extract of *Nyssa fructifera* leaf and root inhibited the germination of *Tridax procumbens* and *Cyperus rotundus* due to its phytotoxic effects. Thus, screening new allelopathic species and identifying active compounds with strong allelopathic activity could enhance current weed management strategies.

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