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Allelopathic Potential Effect of *Pennisetum Purpureum* on *Cyperus Iria*

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Abstract. *Pennisetum purpureum*, is spreading rapidly in many part of the world especially into tropical countries. The abundance of *P. purpureum* in Malaysia is a current weedy issue. The present study aimed at evaluating a potential allelopathic effect of *P. purpureum* on *Cyperus iria* involving leaf debris extract, amended soil and *P. purpureum* infested soil were conducted. The study showed that the shoot length, root length, fresh weight and dry weight was significant reduced in amended soil, leaf debris extract and *P. purpureum* soil-infested increasing concentration were observed. C. iria seed germination and early growth were 100% inhibited at concentration of 8% and 10% thereby indicated that the presence of certain phytotoxic in leaf debris water extract. Moreover, both germination and seedling growth of *C.iria* were significantly reduced >50% in *P. purpureum* infested-soil; whereas in soil incorporated with *P. purpureum* leaf stem debris germination and growth of *C. iria* were significantly reduced with increasing amount proportion, too. These phenomena indicating there might presence of some water-soluble, inhibitory principles in *P. purpureum*. A significant amount of the phenolics, the largest group of secondary metabolite usually implicated in allelopathy, was estimated exist in *P. purpureum* infested soil, debris amended soil and leaf debris extract, thereby showing their direct involvement in the observed growth inhibitions. Based on the observations, the present study reveals that *P.purpureum* exert an allelopathic influence on the growth and development of *C.iria* and can be further explored as a herbicide for future weed management strategies.

Keywords: Allelopathy, *Pennisetum Purpureum, Cyperus Iria,* Phenolic Compounds

1. Introduction

Elephant grass (*Pennisetum purpureum* Schum.) is a tropical C4 bunchgrass with high rates of growth and biomass production [15]. Elephant grass is native throughout humid, tropical mainland Africa and the island of Bioko. It is planted as hedgerows for erosion protection and forage production in the alley cropping system of agroforestry. The plant is also effective as a windbreak for agricultural crops. However, because of the aggressive spread of these species, it is a menace to plantation such as oil palm plantation which compete with the oil palm for nutrients, moisture and sunlight and eventually cause yield depression [3]. In Malaysia, the amount of herbicides sold to combat this species and other noxious weeds were RM220-230 million/years or 76-79% of the total pesticides use in Malaysia [1]. Thus, alternative strategies are under development which tend towards finding biological solutions to minimize the unsafe impacts of herbicides use in agriculture [16]. Allelopathy is an interference mechanism by which plants release chemicals which affect other plants; while it has often proposed as a mechanism for influencing plant population and communities through either encompass both positive (yield improvement without environmental cost) or negative interaction among plants [6]and involve numerous secondary plant chemical classes like phenolic, flavanoids, terpenoids and others have been responsible for plants allelopathic activity [7]. Finally, it can serve as natural products to secure the world's food supply for future generation that it is one of the most important considerations for scientists. However, there are little or no report about the allelopathic effects of

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P. purpureum has been conducted in the current scientific literature. Thus, the present study was aim at evaluating the potential allelopathic effects of *P. purpureum* to assess the growth of *C.iria* in bioassay (A) leaf debris extract (B) debris amended soil (C) *P.purpureum* infested soil; and (d) determine the potential phenolic compounds that may cause the susceptible effect by Fiolin-Ciocalteau reagent were also conducted. *C. iria* (also known as rice flat sedge and rice flat sedge) is a smooth, tufted sedge found worldwide, was chosen to test the allelopathic effects of elephant grass in these study.

2. Materials and Methods

The method of [2], [4] and [14] were adopted with minor modification in bioassay (BS) A, B and C. Aboveground tissues of *P. purpureum* leaf and stem (use for BS A and BS B), *C. iria* (tested seeds) and the *P. purpureum* infested and non-infested soil (BS C) were collected from our campus near the greenhouse (N 02°55.317′, E 101°47.310′). The aboveground tissues samples were washed thoroughly with tap water and air-dried at room-temperature (28±3°C) for 72 h. The air-dried leaf tissues (for BS A) were ground (2 cm size) using a commercial grinder. 10 grams of *P. purpureum* leaf debris powder were then extracted with 100ml of distilled water at 28°C for 48h in a shaker . The extracts are filter through 4 layers of cheese cloth to remove debris fiber, and centrifuged at 9,000 rpm for 15 min at 15°C. The supernatant was then vacuum-filter through one layer of cellulose paper (Whatman, 0.25µm). These 10% (w/v) extracts of leaf were further diluted to obtain 8,6,4,2% solutions. Ten milliliters of each of the different concentration extract were used to wet filter papers. 50 seeds of *C.iria* were used as receiver were sown separate onto petri dishes Distilled water, served as control in a similar manner. Plates were incubated in a growth chamber at 30°C under 12h/12h light/dark photoperiod daily. After 7 days, seed germination, seedling root/shoot length and fresh/dry weight were determined. The BS B are conducted to determine whether leaf and stem debris would have an effect on growth of bioassay species under field-like conditions. The soil type used was a sandy clay, (containing 46% sand, 39% clay and 15% silt) with 3.38% organic matter and pH 4.54 obtained from our soil department. The stem and leaves were incorporated into soil in three different proportions, i.e. 5, 25 and 50/500g (tissue/soil). In BS C, the collected soil (*P. purpureum* infested-soil and non-infested soil) as mention above were brought to laboratory, air-dried and sieved through a 2-mm sieve were place in polyethylene bag (PEG, 10 cm dia x 12cm height). For both these experiments, fifty seeds of *C. iria* were sown in each PEG bag, and PEG filled solely with soil represented the control treatment for BS B. PEG bags were watered adequately daily and maintained under greenhouse conditions. After 1-month , seedling height (from tip of root to tip of shoot), root/shoot length and fresh/dry weight of the *C. iria* were measured.

Total water-soluble phenolic compounds (TPC) in the leaf debris water extract, debris amended in soil and soil infested were determined as [4] and [10] using Folin-ciocalteau reagent with minor modification in BS D. Their amount were determined spectrophotometrically at 750nm against the standard of gallic acid.

All experiments were done in completely randomized design with four replications. The experimental data were subjected to analysis of variance. The means of fresh/dry weight and root/shoot length of the test species were compared by the LSD test at the 5% level of significance.

3. Result and Discussion

Growth of *C.iria* measured in terms of root length, total plant height, fresh/dry weight and root/shoot length was significantly reduced in the leaf debris extract, soils amended with leaf and stems residues of *P. purpureum* and soil-infested respectively (Table 1, 2 and 3). The germination, FW, DW, RL and SL of of *C.iria* reduced with increasing concentration of the water leaf-debris extract of *P.purpureum*, especially at higher concentration of 8 and 10% which totally inhibited germination (Table 1), the result was unexpected in our study because *C. iria* have been reported by [5] to have allelochemical properties. [12] explained that it could be due to different responses of different plants to different allelochemicals release by different weeds and the presence of inhibitory chemicals in higher concentrations in the leaves might be the reasons for differential behavior of the extracts and maximum reduction in seedling growth. Table 2 shows a similarly significant reduction result of FW, DW,RL, and SL of *C.iria* were higher in soil amended with higher rate of amendment. Nearly 59%, 84%, 92% and 94% reduction were observed in FW. RL, DW and SL compared to control at LSAS 3. Even at lower rate LSAS 1 the reduction all were >50% except for RL, 36%. Thereby these study suggested that amendment of *P. purpureum* LSAS in soil might contain certain water soluble phytotoxic chemicals release from the incorporated materials in soil water causing the reduced growth of *C. iria* [8]. Soil collected from *P. purpureum*-infested had significant reduction effect on seedling growth of *C. iria*, too with >50% reduction of FW, DW, RL, SL and PH (Table 3). [2] indicated that some weeds contain and release phytochemicals into the soil either through leachation from the fresh leaves or the fallen leaf debris or through root exudates which accumulate on soil in large quantities thereby stunted their growth [8] which was compliment in these BS C study finding.

[9] and [13] indicated that phenolic are the most common and widely distributed water-soluble allelochemicals. Thus, their presence was tested in *P. purpureum* extracts, amended soil and *P.purpureum* soil infested. As Table 4 showed that an appreciable amount of phenolic was found in water leaf-debris extract, followed by LSAS amended soil and the lesser is *P.purpureum* soil-infested. These can be explained by [11] that as the phenolic undergo various abiotic and biotic process in the soil, a variety of chemical transformation occur in the dynamic of soil system, such as microbial action, sorption to organic matter or clay particles, etc, thus cause the available amount varies greatly. However, our study resulted showed that phenolic amount of *P.purpureum* soil-infested is sufficient enough to bring about growth-retardatory effects in parallel to [11] documented that *Parthenium hysterophorus* residues amended soil is lesser compare to extracts, however amount of phenolic content in *P. hysterophorus* residues amended soil is sufficient enough to reduce growth of three Brassica species.

On the basis result in these study we can propose that *P. purpureum* has allelopathic potential therefore further study is needed to elucidate the exact allelochemical, which can be exploited for the development of use as a natural herbicide.

4. References

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Table 1: Effect of *P.purpureum* leaf debris extracts on early seedling growth of *C.iria*

Conc	FW	DW	RL	SL	G
0	$0.001±0.001^a$	$0.0002±0.0004^a$	$0.65±0.54^a$	$1.19±0.31^a$	70%
2	$0.0006±0.0007^b$	$0.0001±0.0003^a$	$0.392±0.21^b$	$0.87±0.54^b$	15%
4	$0.0002±0.0004^c$	$0±0^b$	$0.072±0.22^c$	$0.16±0.24^c$	8%
6	$0.00004±0.0002^c$	$0±0^b$	$0.01±0.036^c$	$0.04±0.09^d$	2%
8	$0±0^c$	$0±0^b$	$0±0^c$	$0±0^d$	0%
10	$0±0^c$	$0±0^b$	$0±0^c$	$0±0^d$	0%

Table 2: Growth performance of *C.iria* in *P.purpureum* leaf ± stem (LSAS)amended soil after 1-month.

Soil type	FW	DW	RL	SL	G
CS	$0.039±0.02^a$	$0.013±0.006^a$	$10.41±2.38^a$	$8.73±2.51^a$	85%
LSAS 1	$0.01±0.004^b$	$0.004±0.002^b$	$6.66±1.59^b$	$2.66±0.37^b$	36%
LSAS 2	$0.004±0.003^c$	$0.002±0.002^c$	$3.38±2.2^c$	$1.23±0.8^c$	21%
LSAS 3	$0.016±0.002^d$	$0.001±0.001^d$	$1.65±1.75^d$	$0.51±0.55^d$	11%

Table 3: Growth performance of *C.iria* in *P.purpureum* infested soil after 1-month.

Soil	FW	DW	RL	SL	PH	G
Control	0.033±0.013	0.007±0.004	9.01±2.41	6.33±1.67	9.13±2.27	75%
Soil Infested	0.002±0.005	0.001±0.001	3.03±3.25	1.15±1.47	1.55±1.82	26.5%

**FW* Fresh weight, *DW* Dry weight, *RL* Root length, *SL* Shoot length, *PH* Plant height

**CS* Unamended control soil; *LSAS 1*, 5g debris/500g-1 soil; *LSAS 2*, 25g debris/500g-1 soil; *LSAS 3*, 50g debris/500g-1 soil

*Data are mean (±S.D.)of four replicates; different superscripts in a column indicate significant difference at P<0.05.

Table 4: Total phenolics compound content in the leaf debris extract, leaf-stem debris amended soil and *P. purpureum* infested soil (mg phenolic compound/gram tissues)

Treatment	**Amount of phenolic**
Extract	$12.42±1.76^a$
LSDS	$2.78±1.27^b$
Soil-Infested	$0.69±0.36^b$

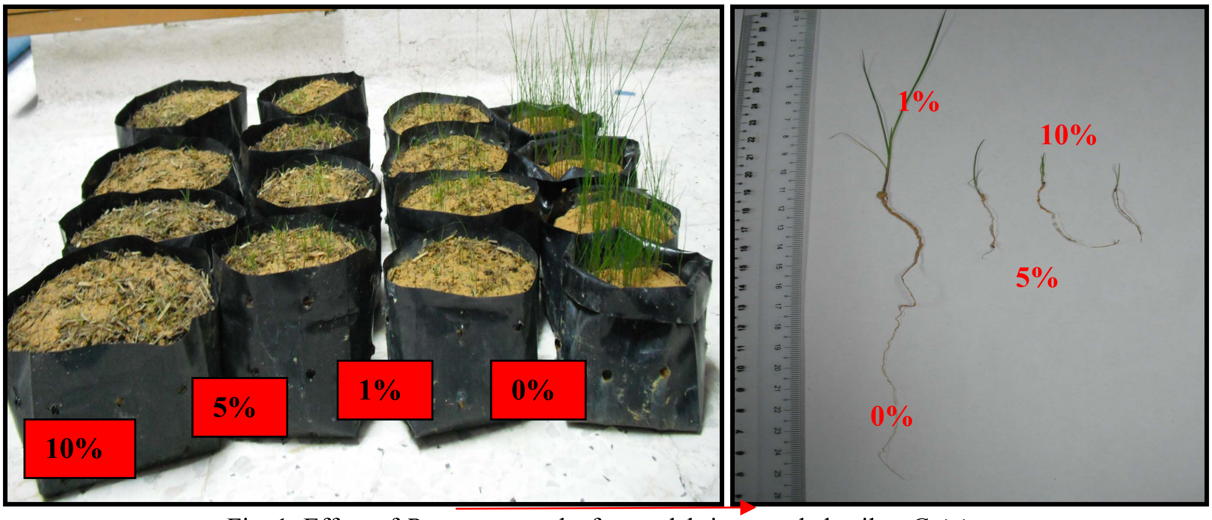

Fig. 1: Effect of *P. purpureum* leaf stem debris amended soilon *C. iria*.

Fig. 2: Effect of *P. purpureum* soil-infested on *C. iria*.

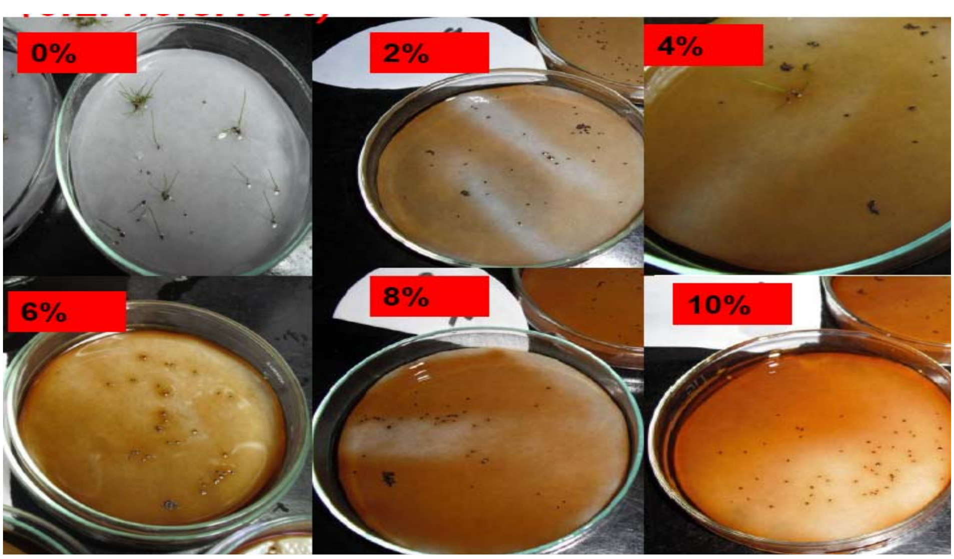

Fig. 3: Effect of *P. purpureum* leaf debris water extract on *C. iria*.