Korean J. Ecol., 21(2):133~137, 1998

Allelopathic Effects of Extracts from *Ficus bengalensis* L.

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Ficus bengalensis L.의 알레로파시 효과

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ABSTRACT

Well grown trees of *Ficus bengalensis* produce one or more potential inhibitors of seed germination and seedling growth. The aqueous extract of Ficus leaf and bark enhanced the shoot length and root length of *Vigina radiata*, when plants were exposed to 5% and 6% concentration of aqueous leaf extract of *F. bengalensis*. Bark extract of *F. bengalensis* inhibited the shoot length and root length of the plant at high concentration. Both the bark and leaf extract inhibited the seed germination. The postemergence and preemergence treatment of bark and leaf extract of *F. bengalensis* reduced the shoot biomass. The result suggest that *F. bengalensis* may have potential allelochemicals which may be developed as natural herbicides.

Key words: Allelochemicals, *Ficus bengalensis*, Postemergence, Preemergence, *Vigna radiata*.

INTRODUCTION

Certain plants produce chemical substances which are released into the environment may either inhibit or enhance the growth and metabolism of the surrounding organisms. These secondary metabolites are believed to function as biochemical defences or allelochemicals (Bell 1981; Heisey 1990a). They include herbicide (Heisey 1990b; Eyini *et al.* 1996), insecticide (Osborn *et al.* 1988), antifeedence (Robbins *et al.* 1987) antimicrobial activity (Kemp and Burden 1986), allelopathic effect (Rice 1984) and other activity (Sutherst *et al.* 1982)

The allelopathic effects of plants are generally due to the selective action (Heisey, 1990a). The earlier growing stage have treated with the *Pinus rigida* extracts, the more inhibitory effects have obtained clearly in both laboratory and field bioassay(Rho and Kil 1986). The herbicidal effect of *Ailanthus altissima* extract on seedling of some plants has been studied by Heisey and Delwich (1983).

In the present study we have tried to study the allelochemical charateristics of *Ficus bengalensis* to de-

termine the potential of the active compound(s) for the development as herbicide.

MATERIALS AND METHODS

Allelochemical activity of *Ficus bengalensis* L. was quantified with bioassay on seeds of *Vigna radiata* L. Aqueous extracts were prepared by steeping 1g of powdered F. bengalensis bark and leaf was dissolved separately in 100 ml distilled water and kept for 24 hr at 4℃±2℃ with occasional stirring, followed by filtration through Whatman No.2 or No.4 paper. These extracts were considered to have a concentration of 10g tissue/l and were diluted with distilled water and made into different concentrations such as 5%, 10% and 20%.

The bioassay consisted of 10 seeds of *V. radiata* placed on Whatman No.1 paper in 6cm × 1.5cm petri dishes. Bioassays were moistened with *F. bengalensis* bark and leaf extracts (2ml/petri dish) separately. Distilled water was used for control. The petri dishes were incubated in darkness at 28℃±1℃. The experiment design was a randomized block with three replicates for each treatment (both leaf and bark) extract and control. *V. radiata* growth was measured after three days.

Leaf and bark extract were prepared for postemergence and preemergence treatments. 10 to 20g of dried leaf and bark powder of *F. bengalensis* were dissolved in 100ml with distilled water to give 5%, 10%, 15 %and 20% concentrations respectively. Triton X-100 surfactant was added (0.1%) to the aqueous extracts(Eyini and Jayakumar 1993).

Postemergence sprays were applied eight days after planting and 4~6 days after most seedlings had emerged. Postemergence treatment was thoroughly watered before to spraying and was not watered again until 4 days, later to allow time for foliar absorption. Postemergence treatment was subsequently watered for above as needed. Shoot length and biomass of seedling were determined ten days after spray(Eyini and Jayakumar 1993).

Preemergence treatment was done immediately after seed sowing. Preemergence treatments were given with 1.3 ml of water immediately before spraying, to initiate germination and 0.5 ml more immediately after spraying to carry the toxin into the soil(Eyini and Jayakumar 1993). Preemergence treatments were not watered again until three days after spraying and there after were watered from above as needed. Emerged shoots were harvested ten days after spraying to measure the shoot length and dried at 55℃ and weighted for biomass studies.

RESULTS AND DISCUSSION

Both bark and leaf extracts of F. bengalensis inhibited the germination of *V. radiata* seeds (Table 1).

Germination percent of *V. radiata* was heavily decreased in accordance with increased extract concentration (5, 10, 20%) and that was significant statisticantly at 5% level.

The bark extract in lower concentration (5%, 10%) enhanced the shoot and root length of *V. radiata* seedlings. In higher concentration (20%) shoot and root length were inhibited as 0.89% and 67.26% to the control, respectively. But the leaf extract of *F. bengalensis* promoted the shoot and root length was directly proportional to the increase in concentration of extract used to treat the seeds (Table 2).

Heisey (1990a) have registered a unique pattern of weed exclusion by *Ailanthus* tissue (bark and root) extracts. The inhibition of shoot length and root

Table 1. Effect of aqueous extract of bark and of *F. bengalensis* L. on the germination of *V. radiata* L. Values are mean ±SE of 3 samples

Aqueous extract concentration(%)	Germination(%)[a]	
	Bark extract	Leaf extract
0 (control)	80±5[a]	80±7[a]
5	70±6[ab]	65±8[b]
10	55±10[c]	55±5[c]
20	50±4[c]	50±5[c]

[a] Means in each column followed by the same letter are not significantly different according to Duncan's multiple-range test($p<0.05$).

Table 2. Effect of aqueous extract of bark and leaf of *F. bengalensis* L. on the seedling growth of *V. radiata* L. Values are mean ±SE of 3 samples

Concentration(%)	Treatment[a]			
	Bark extract		Leaf extract	
	Shoot length(cm)	Root length(cm)	Shoot length(cm)	Root length(cm)
0 (control)	7.82±0.5[a]	6.17±0.5[a]	7.82±0.8[a]	6.17±0.3[a]
5	8.56±0.7[a]	6.8 ±0.7[a]	8.6 ±0.9[a]	6.9 ±0.4[a]
10	12.35±1.1[bc]	8.7 ±0.3[b]	9.8 ±0.7[c]	7.0 ±0.5[a]
20	0.07±0.6[c]	4.15±0.4[bc]	12.2 ±1.0[ac]	8.55±1.0[b]

[a] Means in each column followed by the same letter are not significantly different according to Duncan's multiple-range test($p<0.05$).

Table 3. Shoot length and shoot biomass of *V. radiata* L. 10 days after postemergence spray with *F. bengalensis* L. bark and leaf extracts. Values are mean ±SE of 3 samples

Concentration(%)	Postemergence[a]			
	Bark extract		Leaf extract	
	Shoot length(cm)	Shoot biomass(mg)	Shoot length(cm)	Shoot biomass(mg)
0 (control)	20.14±1.5[a]	10.28±1.00[a]	20.14±1.8[a]	10.28±1.0[a]
5	17.5 ±1.6[b]	10.00±1.1[a]	19.70±0.9[a]	10.00±0.9[a]
10	17.00±1.5[b]	8.71±0.7[c]	19.56±1.7[a]	9.80±0.8[a]
15	13.71±1.00[c]	7.42±0.5[bc]	19.00±1.3[a]	9.50±0.5[a]
20	13.00±0.90[c]	7.00±0.4[bc]	18.00±1.9[b]	9.00±0.4[b]

[a] Means in each column followed by the same letter are not significantly different according to Duncan's multiple-range test ($p<0.05$).

length may be due to the presence of water soluble inhibitors in the bark. The inhibitors present in leaves are either not water soluble or they are bond in such a way that they are released only be decomposition in the soil. That is why the *Vigna* seedlings showed increase in shoot and root length treated with *F. bengalensis* leaf extract. Our inverstigation closely agrees with the previous report (Friedman *et al.*, 1982).

Postemergence treatment with the aqueous extract of *F. bengalensis* bark showed a gradual decrease in shoot length and shoot biomass in V. radiata seedlings as the concentrations of *F. bengalensis* increased. The similar was also followed for the aqueous leaf extract (Table 3).

Postemergence of *Ficus* bark and leaf extracts to the *Vigna* seedlings significantly reduced the growth, shoot biomass of all test seedlings. The fact that

Table 4. Shoot length and shoot biomass of *V. radiata* L. 10 days after preemergence spray with *F. bengalensis* L. bark and leaf extracts. Values are mean ±SE of 3 samples

Concentration(%)	Preemergence[a]			
	Bark extract		Leaf extract	
	Shoot length(cm)	Shoot biomass(mg)	Shoot length(cm)	Shoot biomass(mg)
0(control)	20.14±1.4[a]	10.28±1.0[a]	20.14±1.9[a]	10.28±1.0[a]
5	17.72±1.1[b]	8.00±0.8[b]	18.72±1.7[b]	8.50±0.9[b]
10	21.52±1.9[a]	11.00±1.0[a]	18.27±1.5[b]	8.20±0.8[b]
15	18.87±1.0[b]	9.00±1.0[b]	18.00±1.3[b]	8.00±0.7[c]
20	16.03±1.5[c]	8.00±0.9[c]	17.50±1.6[c]	7.50±0.9[c]

[a] Means in each column followed by the same letter are not significantly different according to Duncan's multiple-range test ($p<0.05$).

Ficus extract sprayed on Vigna seedling caused strong postemergence effects indicate the active compounds are water soluble.

Preemergence treatment with aqueous extract of *F. bengalensis* bark showed an inhibitory effect in shoot length and shoot biomass of *V. radiata* seedlings in 5%, 15%, 20% concentrations. There was an increase in shoot length and shoot biomass in 10% concentration. But the preemergence treatment with aqueous extract of *F. bengalensis* leaf showed a gradual decrease in shoot length and shoot biomass as the concentration increased (Table 4). Similar observations were made by Heisey (1990b)and Eyini *et al.* (1996).

The reduction in growth and shoot biomass in *Vigna* seedlings with the preemergence applications of *Ficus* bark and leaf is caused by the active compounds which are water soluble and mobile in the soil. The Ficus extract sprayed to the soil surface caused strong preemergence effects to the *Vigna* seedlings.

This preliminary observation indicate that *Ficus* allelochemicals may have potential for development as natural herbicides. Further it is essential to isolate the allelochemicals from *Ficus* will be much useful for further studies.

적 요

인도산 뽕나무과 식물인 *Ficus bengalensis* 나무에서 *Vigna radiata*의 종자발아와 유식물생장을 억제하는 물질을 방출한다는 사실을 밝혀냈다. 이 나무의 잎과 수피를 수용추출한 용액으로 실험해 본 결과 5%와 10% 수용액에서는 *Vigna radiata* 식물의 지상부와 지하부 신장을 촉진하였다. 그런데 수피의 수용추출액의 농도가 높으면(20%) 실험식물의 생장이 억제되었다. 더구나 *Vigna radiata*의 종자가 개갑되기 전후에 Ficus 나무의 수피와 잎의 추출액을 처리한 경우는 농도에 따라 정도의 차이는 있으나 *Vigna radiata*의 생물량이 현저하게 감소됨을 알아냈다. 그래서 *F. bengalensis* 나무는 알레로화학물질을 함유하고 있고 이것은 천연제초제개발에 연구재료로 쓰일수 있을 것이라고 생각된다.

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(Received February 28, 1998)