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Allelopathic Effects of some Crop Residues on the Germination and Growth of Cowpea (*Vigna unguiculata* L. Walp.)

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ABSTRACT

The allelopathic effect of aqueous extracts from sorghum and rice husk on germination and growth of cowpea was investigated. The results showed that the extracts brought about considerable inhibition in the germination of cowpea seeds and in the growth of its radicle and plumule. The germination percentage in the extract-treated seeds decreased with the increase in the concentration of the extracts thus indicating that the degrees of inhibition were concentration dependent. It was apparent that sorghum extracts had more inhibitory effects on cowpea seeds than those from the rice husks. In sorghum extract- treated seeds, radicle growth was observed clearly at 48hrs of the experiment whereas radicle growth was recorded at 24hrs experimental time in the rice husks extracts. Also in sorghum extracts, plumule growth occurred at 72hrs of the experiment whereas plumule growth was recorded at 48hrs experimental time in the rice husks extracts treated seeds.

Key words: Allelopathy, allelochemicals, rice husk, sorghum, inhibition.

INTRODUCTION

Allelopathy is the ability of plant to inhibit the germination of other plants through the production of allelochemcals (Rice 1984, Inderjirt 1966) which may be present in any parts of the plants, i.e. leaves, roots, fruits, stems, rhizomes and seeds, from where they are released to the soil through volatilization, root exudation, leaching and decomposition of plant residues (Rice 1984, Chou 1990).

A number of authors, such as Rice (1984), Rasmussen and Rice (1971) and Nelson (1996) had documented the interference effects of some plants on other crops, prominent of which is the inhibition of germination (Williamson *et al* 1992, Patil, (1992), Djurdjevic *et al* 2004), reduction in the growth lengths of plumule and radicle (Tobe and Omasa 2000), retardation of seedling growth (Bhatt and Todoria 1990) and poor seedling survival (Smitt 1990). Previous assertions had suggested that allelochemicals inhibit seed germination by blocking of nutrient reserve and cell division thereby caused significant reduction in the growth of plumule and radicle of many crops (Ogbe *et al* 1994, Tobe and Omasa (2000).

Previous studies conducted in Taiwan revealed that Rice (*Oryza sativa*) planted twice in a year in monoculture system reduced the second crop yield by about 25% in area of poor water drainage (Chou 1980). Also Chou and Chou (1979) found aqueous extract of paddy soil collected bio assayed to be phototoxic. In pot experiment, Chuo (1983) also found rice seedlings growing poorly in the decomposed straw and soil mixture. In Nigeria, allelopathic studies so far reported were based on the allelopathic potentials of weeds on agricultural crops. These include the studies the studies of Ogbe *et al* (1994) and Gill *et al* (1993) on *Chromoleana odorata*, Kayode (1998, 2004a and b, 2006) respectively on *Euphobia heterophylla*, *Calotropis procera*, *Aspillia africana*, *Chromoleana odorata* respectively. No study was reported on the allelopathic potentials of any crop residues in the country. Thus, the study been reported here examined the allelopathic effects of aqueous extracts from residues of sorghum stem and rice husks on cowpea which is an important cereal food crop widely cultivated in Nigeria.

MATERIALS AND METHODS

Freshly removed rice husks were obtained from a rice mill in Ikere Ekiti, a town situated at about

25km from University Ado Ekiti Nigeria while matured sorghum plants were harvested from the experimental farm of the Department of Plant Science situated within the University of Ado-Ekiti campus. The rice husks and sorghum were cut into pieces and air dried for three weeks after which they were pounded using pistil and mortal.

Portion of 5g, 10g, 15g, 20g and 25g were measured out form rice husks and sorghum residues. Each portion was soaked in 200ml of distilled water in 500ml conical flasks. The mixtures were shaken intermittently and left over for 24hrs.The extracts were filtered using Whatman No 1 filter paper and the filtrates were used afresh, some portions were kept inside the refrigerator for further usage. Two layers of Whatman No 1 filter papers were put in each Petri dish of 9cm diameter and five maize seeds, obtained from the Department of Plant Science, University of Ado-Ekiti, Nigeria were placed in each Petri dish. The Petri dishes were moistened daily with the five different filtrates using syringe (5ml) and needle. Extracts from each treatment were replicated ten times.

Control experiment was also set up, also replicated ten times, with Petri dishes moistened with distilled water and replicated ten times. All the Petri dishes were kept in the growth chamber at room temperature. The seeds were considered germinated upon radicle emergence. The germination, radicle and plumule growth elongation measurements were recorded at 24hrs interval for six days. The results obtained from the extracts treated seeds were compared statistically to those obtained from the control experiments.

RESULTS AND DISCUSSIONS

The allelopathic effects of aqueous water extracts derived from sorghum stem and rice husks in the germination of cowpea are shown in the Tables 1 and 2 respectively. It was obvious that the aqueous extracts from both extracts inhibited the germination of cowpea seeds. The degree of inhibition was concentration dependant as the proportion of the inhibition increased with the increase in the concentrations of the extracts.

The effects of the aqueous water extracts from sorghum stem and rice husks on the radicle lengths of cowpea were shown in Tables 3 and 4 respectively. The results showed that the radicle growth was retarded by both extracts but the effects were more pronounced in the sorghum extract treated seeds. Also the degree of retardation increased with the increase in the concentrations of the extracts. Statistical analyses at 5% levels (t-test) revealed that, apart from comparison between 5 and 25g extract concentrations, there were no significant differences in the growth length of radicles in the varying extract concentrations as well as those of the control in both extracts.

The aqueous extracts of the two extracts also retarded the plumule lengths of cowpea (Tables 5 and 6). The degree of retardation also increased with the increase in the concentrations of the extracts. The effects were also prominent in the sorghum extracts treated seeds than the rice husks extract treated seeds. While the plumule, with the exemption of the 5g extract concentration, germinated at 72hour period in the sorghum extract treated seeds, the plumule germinated at the 48hour period of the experiment in the rice husks extract treated seeds. Statistical analyses (t-test, 5% level) revealed that apart from the comparison of the growth lengths of plumule from the 25g sorghum extract concentration with those of the control, there were no significant differences in the growth lengths of the plumule in the varying extract concentrations and the control in both extracts.

Previous study by Nimbal *et al* (1996) had asserted that sorghum contained sorgoleone, an allelochemical substance. It was also reported that sorghum shoot produced higher amount of cynogenic glucoside whose phenolic products inhibit plant growth (Einhellig and Rasmussen 1989). The allelochemicals in mature sorghum, according to Cheema (1988) included benzoic acid, *p*-hydroxybenzoic acid, vannillic acid, *m*-comedic acid, *p*-coumaric acid, gallic acid, caffeic acid, ferulic acid and chlorogenic acid. Phenolic compounds such as *p*-hydroxybenzoic, vanillic, ferulic, *p*-coumeric and *o*-hydroxyphenylacetic acids are contained in the rice residues (Chou and Lin 1976). Previous assertion by Enhellig and Souza, (1992) had revealed that these phenolic derivatives are extremely phytotoxic. Hence they must have been responsible for the inhibition of seed germination and the retardation of seedling growths of radicle and plumule of the cowpea used in this study.

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Table 1. Effects of the aqueous extracts from sorghum stem on the germination of cowpea seeds.

Extracts (g/200ml)	Cowpea Germination(%)/ Experiment Time (Hrs)*					
	24	48	72	96	120	144
5	2 (50)	42 (-)	26 (48)	4 (-)	6 (-)	-
10	0 (100)	16 (56)	43 (14)	6 (-)	4 (-)	-
15	0 (100)	12 (67)	56 (-)	8 (-)	2 (-)	-
20	0 (100)	10 (72)	54 (-)	8 (-)	2 (-)	-
25	0 (100)	6 (83)	48 (4)	4 (-)	2 (-)	-

Control	4 -	36	50	-	-

* Figures in brackets represent the % decrease over control

Table 2. Effects of the aqueous extracts from rice husks on the germination of cowpea seeds.

Extracts (g/200ml)	Cowpea Germination (%) / Experimental Time (Hrs)*					
	24	48	72	96	120	144
5	6 (25)	28 (27)	40 (20)	12 (-)	6 (-)	-
10	4 (50)	22 (39)	38 (24)	4 (-)	10 (-)	-
15	4 (50)	10 (37)	48 (24)	4 (-)	8 (-)	-
20	2 (75)	10 (72)	48 (4)	4 (-)	2 (-)	-
25	2 (75)	8 (78)	46 (4)	8 (-)	2 (-)	-
Control	8	36	50	-	-	-

- Figures in brackets represent the % decrease over control

Table 3. Effects of the aqueous extracts from sorghum stem on the radicle length (cm) of cowpea seeds.

Extracts (g/200ml)	Radicle length (cm.)/ Experimental Time (Hrs)					
	24	48	72	96	120	144
5	0	2.40	7.54	13.64	16.10	17.46
10	0	0.46	6.48	10.74	12.60	14.60

15	0	0.40	5.00	6.92	7.40	12.48
20	0	0.20	3.78	6.72	7.00	11.72
25	0	0.14	2.62	5.00	5.34	8.04
Control	0	2.82	12.62	23.68	17.90	25.86

Table 4. Effects of the aqueous extracts from rice husks on the radicle length (cm) of cowpea seeds.

Extracts (g/200ml)	Radicle length (cm.) / Experimental Time (Hrs)					
	24	48	72	96	120	144
5	0.24	2.00	8.50	16.98	24.50	25.24
10	0.12	1.98	7.98	15.49	18.14	19.05
15	0.10	1.62	7.30	14.04	17.32	18.56
20	0.00	0.62	4.81	12.28	14.70	15.46
25	0.00	0.60	4.60	11.46	14.25	14.78
Control	0.30	4.86	12.76	23.20	28.24	30.30

Table 5. Effects of the aqueous extract from sorghum stem on the plumule length (cm) of cowpea

seeds.

Extract (g/200ml	Plumule length (cm,) / Experimental Time (Hrs) 24	48	72	96	120	144
5	0	0.08	2.46	5.02	7.12	10.32
10	0	0	1.12	3.22	4.52	8.32
15	0	0	0.54	2.99	3.24	6.40
20	0	0	0.26	2.08	4.56	4.70
25	0	0	0.10	1.12	4.10	4.18
Control	0	0.14	5.20	10.26	12.64	25.86

Table 6. Effects of the aqueous extracts from rice husk on the plumule length (cm) of cowpea seeds.

Extracts (g/200ml)	Plumule length (cm.)/ Experimental Time (Hrs) 24	48	72	96	120	144
5	0	0.10	2.16	7.20	16.26	17.28
10	0	0.07	1.94	7.00	15.68	13.80

15	0	0.05	1.68	6.81	14.76	12.34
20	0	0.04	0.96	4.54	12.86	9.84
25	0	0	0.74	4.28	8.46	9.12
Control	0	0.54	6.98	12.10	20.07	34.02