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Full Length Research Paper

Herbicidal effects of effluent from processed cassava on growth performances of *Chromolaena odorata* weeds population

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An experiment was conducted to investigate the effect of effluent i.e. seepings from processed cassava on growth performance of potted seedlings of *Chromlaena odorata* (L). Serial dilutions of effluents processed cassava i.e. 100%, 75%, 50%, 25%, and 0% (water only) control were made and used to water potted *Chromolaena* plants for 10 weeks and growth performance i.e. plant height, stem girth, number of leaves, length of central mid rib, leaf area were taken fortnightly interval. Measurement of the weeds stem, root and leaves dry weight was taken at the end of the experiments. The cyanogenic residue from the soil was also analyzed. All growth performance parameters except plant height showed significant reduction ($p<0.05$) in all dilutions except that of 25% concentration where there was no significant difference. Amount of cyanogenic residue in the soil after the experiment was negligible (within recommended safe level) or 5 mg/kg (USDA) and lower when compared with initial levels in the effluents. Hence cassava effluent is recommended as pre and post emergent herbicide (at seedling stage) for controlling chromolaena infestation on small scale farmland.

Key words: Cassava effluents, cyanogenic residue.

INTRODUCTION

Weed infestation in field crops has such a serious magnitude that it require systematic and planned weed control project throughout Nigeria. Several workers have reported crop losses as large as 70-85% due to competition by weeds (Parker and Fryer, 1975). Weeds cause economic losses both in terms of shortfalls form potential production created by their presence and in terms of the costs of the input used in their control (Auld, 1969).

The family asteraceae has ten species among the seventy-six world's worst weeds (Baker, 1965) in which *Chromolaena odorata* is one. The weed is an early colonizer of fallows naturally regenerating after slash-and-burn agriculture locally called Thum. The plant was probably accidentally introduced into Enugu from Sri Lanka (Ceylon) with seed of *Gmelina arborea*, Roxb at about 1936 (Holm et al., 1977). It has spread to various parts of the southern states especially in the last two decades. In these areas, it is becoming a serious weed of plantation and arable agriculture.

Manual weeding i.e. by hand and simple tool, may consume as much as 70% or more of the farmer's time and energy during the cropping season (Cook, 1957; Wrigley, 1969). Chemical weed control on the other hand has the potential to reduce labour requirements, there-by reducing the cost of crop production (Khan et al., 1985; Mohammed and Nour, 1986). However, use of chemical may have negative side effect on both crop growth and the environment. Also, heavy herbicidal requirements and hilly terrain pose major impediments for use of chemical control. The only alternative left is biological control. This has been studied and used with some success in Trinidad, in Hawaii, and in Australia (Auld, 1970). It has been reported that biological control is the only viable method of control for *C. odorata* (L) due to the large

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areas involved and the expense of repetition of chemical or mechanical control.

Cassava (*Manihot esculenta)* (Crantz) though favoured for its starchy, tuberous roots as valuable source of cheap calories especially in development countries where calories deficiency and malnutrition are wide-spread has the disadvantage of containing toxic cyanogenic compounds (Cock, 1985; Cooke and Craz de la 1982; Rossling, 1988). The content of cyanogenic glucosides (mostly linamarin and, to a lesser extent lotaustralin) (Nestle, 1973) may be reduced with varying degrees of effectiveness during processing into different food forms. The toxic effect of the cyanogenic glucosides on human being and livestock consuming unprocessed cassava is well documented (Fassett, 1963; Nwoko et al., 1966). A cursory look at a cassava processing depot reveals that the cassava effluent released due to processing may have toxic effect on the weed flora. Vegetation hardly grows in such depots/site. The fact that cyanide hydrolyses to hydrogen cyanide which readily volatilizes without leaving any residue is an indication that cassava effluent can be effective as a non persistent herbicide.

Research on weed control has been concentrated mainly on blanket weed eradication, and relatively little has been done with respect to the developmental physiology of weeds. It is important to reduce the cost (economic, environmental) of weed control in order to maintain sustainable agriculture. This paper reports an attempt to investigate the use of the cassava effluents as a potential herbicide which has hydrogen cyanide (HCN) as its active ingredient. It is aimed at finding the herbicidal effects of the cassava influents of the performance of *C. odorata*.

MATERIALS AND METHODS

Experimental site

The research work was carried out on the open roof top green house of the Department of Crop Protection and Environmental Biology (CPEB), Faculty of Agriculture, University of Ibadan, Nigeria. The test plant used was *c. odorata* (L). The seeds of this plant were collected from Offa and International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria for the first and second trials respectively. Good garden soil was collected from the back of the Department of Crop Protection and Environmental Biology (CPEB), Faculty of Agriculture University of Ibadan, Nigeria. The soil was thoroughly mixed and filled into 10 litre size experimental pots and left there for two weeks and watered every morning to allow for emergence of dormant weed seeds; Yadav and Tripathi, 1982). By the second week, the pots were cleared of all emerged weed seedlings and the surface disturbed in preparation for transplanting of the seeding of test weed species (Roberts, 1962).

Experimental design

The experiment was a completely randomized design. Five treatments were randomly allocated to pots in each of the 16 replicates per treatment making 80 stands in all. The treatments were different concentration of cassava effluents namely; 0%, 25%, 75% and 100%. The pots were arranged in 20 rows and 4 columns and the space occupied was 11 m x 67 m with 30 cm interstand distances within the rows and between the columns. In each pot, 20 seeds of *Chromolaena* were sown. Serial dilutions of cassava effluents as described above were prepared and applied everyday as treatments starting from the day the weed seeds were sown. Tap water was applied as control treatment every morning. At 3 weeks after planting the plants were thinned to 10 plants per pot.

Germination of *Chromolaena odorata* (L) seeds

The seed of *C. odorata* were grown in petri-dishes lined with Whatman No. 1 filter paper moistened with tap water. The seeds were kept in incubator at 15°C/13°C temperature, alternating at 12h/12h as recommended by Erasmus and Van Staden (1985).

Data collection

At two weeks after planting, number of germinated plant was recorded from each pot receiving different treatments. As from 4 weeks after planting, vegetative growth parameters of *C. odorata* were recorded. Number of surviving seedlings in each treatment was taken by direct counting. The leaf area was determined using the method of Assif (1997). The length of central mid-rib was taken by measuring the distance between the tips of leaves to the tip of their petiole. The length of the central mid-rib of each leaf was correlated with corresponding actual leaf area using linear regression. The regression equation $Y= a + bx$ was used to estimate the leaf area.

Fresh and total dry matter production of *Chromolaena* weeds was determined after 10 weeks of the experiment. The plants were uprooted and washed thoroughly with clean water, each plant was cut into root and shoot systems. The plants were dried under natural conditions at the open roof top garden for 2 h. The fresh weight was taken and the plants were then packed in paper envelopes and over dried for 36 h at 70°C. The dry weight of root and shoot system of each plant were taken differently. The means from the replicates of each treatment were calculated for the different growth parameters.

Statistical analyses

Analyses of variance (ANOVA) was used to compare the means and the means separated at ($P< 0.05$) using the Least Significant Method (LSD).

Physical and chemical analyses of the soil

After proper mixing of soil, samples (80 g each per replicate) were grinded in a mortal in the laboratory and passed through 2 mm mesh in readiness for analysis. The samples were analysed according to the method of (IITA, 1992). Physical and chemical analysis was carried out on the soil before and after the experiment.

Chemical analysis of cassava effluents

Samples of cassava effluents were collected and analyzed. Analyses was done at the Department of Human Nutrition, University of Ibadan, Nigeria to determine the amount of active ingredient in them and the mean was calculated for each of the two trials to be 46 and 44 mg/l, respectively.

RESULTS

Soil characteristics

The physical and chemical properties of the soil samples used for both 1st and 2nd trials of the experiment were similar (Table 1). There were no significant differences between the soils samples used at the two trials. The mixing of the experimental soils with different concentrations of cassava effluents did not significantly affect the physico-chemical properties of the experimental soils (Table 2). However, there were minor differences in the concentration of most metallic ions (cations) which decreased as the concentration of effluents were reduced.

Table 1. physico chemical properties of the soil used before the two experiments were conducted.

Characteristics	First Trial	Result Second Trial
PH	7.00	7.00
%N	0.31	0.31
%0.C	3.63	0.31
P(ug/g)	18.36	18.35
Ca meg/ 100g	25.89	25.88
Mg meg/100g	3.16	3.14
K mg/ 100g	0.54	0.52
Mn meg/100g	0.5	0.5
Fe PPM	42.63	42.63
Cu PPM	1.01	1.01
Zu PPM	91.01	91.03
Acidity	0.67	0.66
CEC	31.79	31.79
%Sand	71.10	71.20
%Clay	10.80	10.80
%Loamy	18.00	18.20

Effect of cassava effluents on growth of *C. odorata* seed germination

The highest percentage seed germination took place at 0% cassava waste water treatment while the lowest was achieved at 75% and 100% cassava waste concentration. Seed germination was significantly lower at 50, 75 and 100% concentrations than the control (0%) concentration (Figure 1).

Morphological growth

The different concentrations of cassava effluents significantly inhibited the growth of *C. odorata* when compared with the control. The difference between 25% concentration and 0% concentration were not significant as the difference between 0% and other concentrations. Seedling mortalily increases with increase in concentrations. The maintenance of constantly high densities in the control culture ultimately induced intra-specific effects in the following parameters; leaf areas, number of leaves, fresh and dry weights.

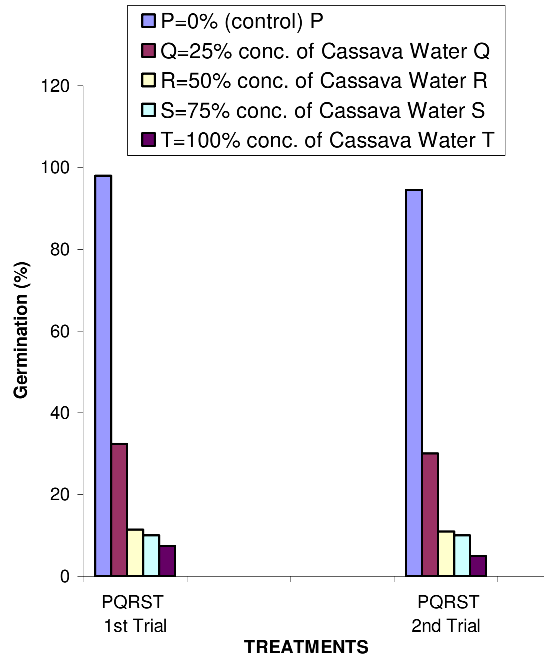

Figure 1. The effects of different concentrations of cassava effluents on germination.

Leaf area response to cassava effluents was similar to that found for length of central mid-rib (Table 2). The regression equation for the relationship between leaf area and length of central midrib is $Y = 4.55X - 10.15$, where Y = leaf area in cm^2, X= length of central midrib of each leaf, $R = 0.98$.

Leaf area increased with age within each treatment. Number of surviving seedling significantly reduced in all the treatment used when compared with the control but the level of significance was highest in 75% and 100% concentration (Figures 2 and 3). Final shoot and root dry weights were affected by the treatments. They decreased significantly with increase in cassava effluent concentration (Table 3). A similar trend was obtained with regards to length of the central mid-rib (Table 2). At both trials effects of 100% concentrations was not significantly different from effects of 75% for all the growth parameters accessed.

DISCUSSION

The results for all the parameter during the first trial which was carried out in the rainy season, when compared with

Table 2. Effect of cassava effluents on length of the median mid rib.

Treatment	Week 4		Week 6		Week 8		Week 10	
	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
0%	3.8170	3.6350	6.2630	5.8760	8.8120	8.7950	9.1540	9.0000
25%	2.0590	1.9980	3.3210	3.2270	4.6360	4 .7508	4.8250	4.7755
50%	0.9200	0.8280	1.5010	1.3000	2.1490	1.9061	2.0550	1.9660
75%	0.1440	0.0700	0.2820	0.0763	0.2070	0.1176	0.2120	0.1214
100%	0.1410	0.0640	0.2710	0.0756	0.0970	0.1549	0.1590	0.1211
LSD%	1.1123	1.0517	1.8817	1.6998	2.6325	2.1618	2.6631	2.6228

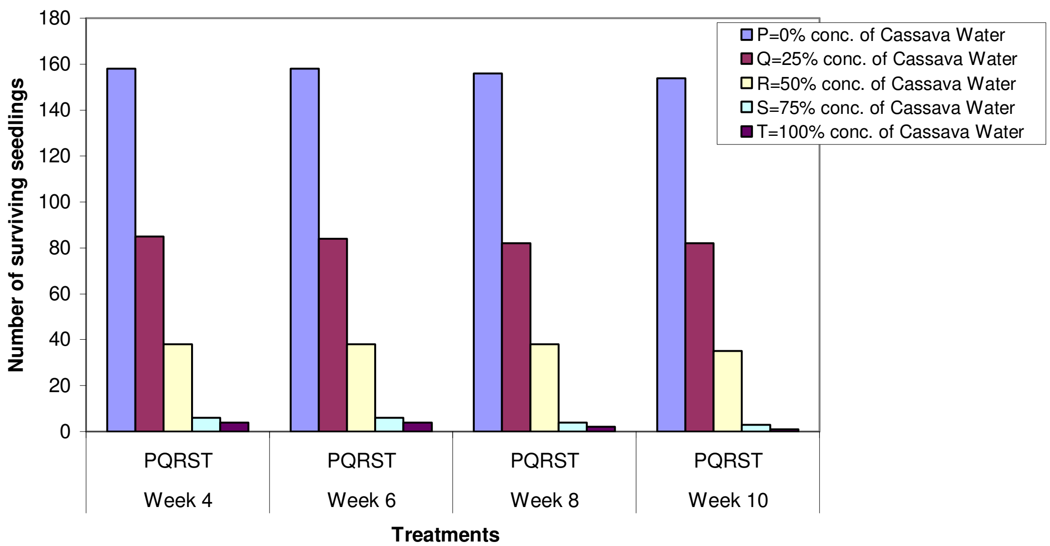

Figure 2. Effects of cassava effluents dilutions on number of surviving seedlings out of 160 seeds planted during Trial 1.

Table 3. Effect of cassava effluents on shoot and root dry weights.

Treatment	Trial 1	Trial 2	Trial 1	Trial 2
0%	5.00	4.40	1.2	1.03
25%	2.45	2.31	0.65	0.49
50%	1.48	1.20	0.40	0.35
75%	0.93	0.84	0.25	0.22
100%	0.929	0.801	0.2	0.118
LSD%	2.088	2.4120	0.6	0.71

the second trial carried out during the dry season showed that growth inhibition by cassava effluents was more effective during the dry season. These findings were comparable with those of (Hawton and Drennan, 1980) who pointed out that the aggressiveness (including resistance to herbicides) of weed in cropping land varies with the prevailing climatic and edaphic factors. The exponential increases with time of all growth parameters in the control (i.e. tap water without cassava effluents) in the early stage agrees with the findings of Fawole et al. (1979) who confirmed that *Chromolaena* grows very fast and attain a height of several centimeters within a few weeks. In its natural habitat, the performance is probably likely to be much faster than recorded in these pot trials. Reduction that started at the early stage showed that *Chromolaena* is susceptible to herbicidal effects of cassava effluents at different stages of growth namely; seedling stage, matured stage (i.e. shortly before flowering) and germination stage.

The general reduction in the germination percentage, seedling survival and other parameters measured, suggest that hydrogen cyanide as found in cassava effluents exerted deleterious effects on *C. odorata.* Concentration of effluents as low as 25 and 50% will effectively inhibit the germination and growth of *C. odorata.* The higher the concentration of cassava effluents, the higher the degree of inhibition. It is highly probable that this by product of cassava processing enterprises can be utilized as a biocide in the control of weeds.

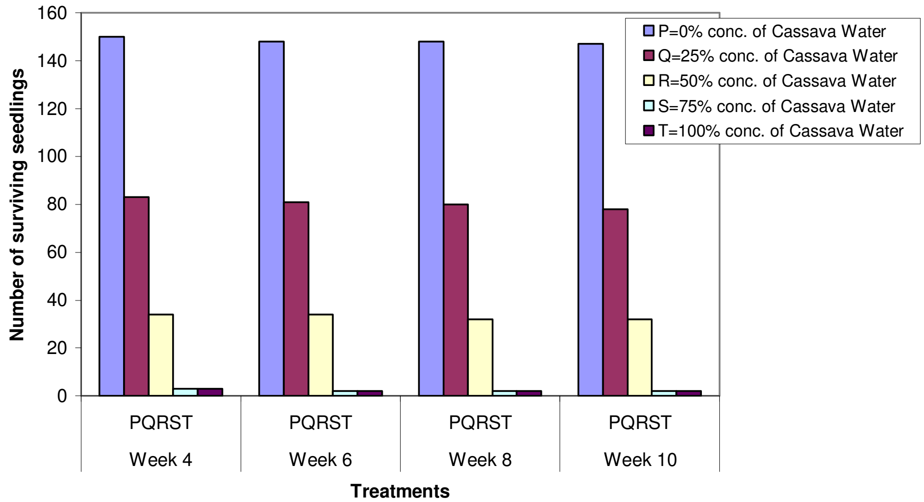

Figure 3. Effects of cassava effluents dilutions on number of surviving seedlings out of 160 seeds planted during Trial 2.

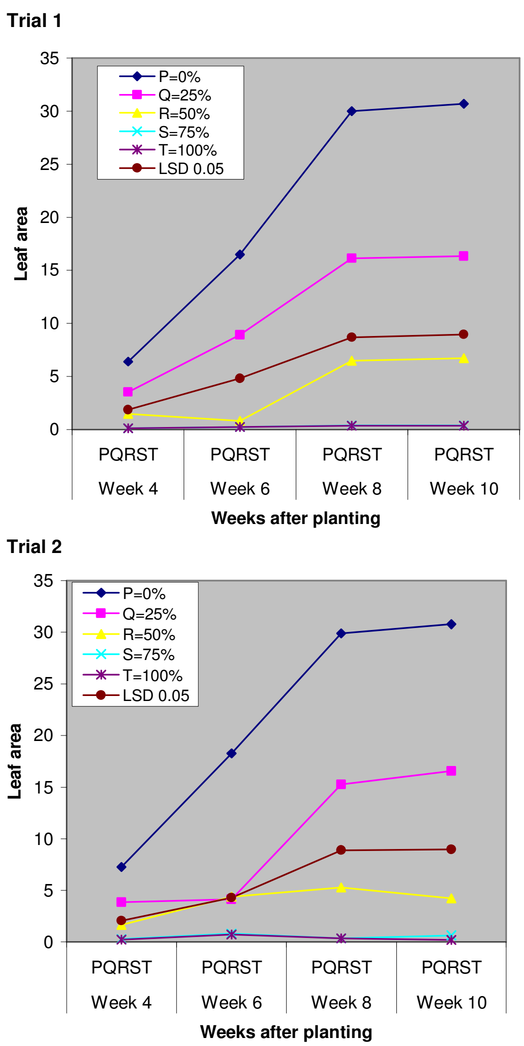

Figure 4. Effects of cassava effluents on leaf area during Trials 1 and 2.

The results of the analyses of soil treated with different concentrations of cassava effluents (i.e. soil taken for analyses after the experiment) showed negligible HCN residues (i.e. as low as 0.04 mg/kg) agrees with those of Delange et al. (1982) about the formation of free (HCN) which is associated with carbonydrin hydroxy-nitrites that have been stabilized by glycosylation. There is therefore a strong indication that cassava effluents water as a biocide may be environmental friendly since it is highly biodegradable (Figure 4).

Results of this study suggest that cassava effluents act as pre or post-emergence herbicide for the control of *C. odorata* in Southern Nigeria. *Chromolaena* plant is best controlled with 100 and 75% concentrations of cassava effluents at which it is capable of suppressing the weed not only at seedling stage but also of inhibiting its germination. The public should be educated about the usage of cassava effluents to suppress weed growth. Further research into the mode of activity of this biocide and its large scale utilization is also recommended.

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