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Effects of Nigeria Dyestuff Effluent on Germination Latency, Growth, and Gross Growth of *Zea mays*

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The discharge of pollutants from the industry and mines, whether aquatic or terrestrial, represents an important chapter in environmental pollution. River Kaduna in the northern part of Nigeria is in a great environmental stress. One garment manufacturing industry has discharged blue green dyestuff into River Kaduna since 1953. For over 3 miles, the river is perpetually green year round except during the rainy season, June-November, when dilution occurs.

Before the advent of industrialization and urbanization of Kaduna, people could crop crocodiles and edible fishes, rich zoo and phytoplanktons were plentiful all the year round. Now, the story is different but children and adults still use the river water for recreational purposes. There was no primary aquatic hazard evaluation done on the effluent so it was decided to find the effect the dyestuff might have on agriculture.

This communication reports the effect of the use of the aged dyestuffed water for irrigational purposes.

MATERIALS AND METHODS

Dyestuff effluents were collected in jars from the point of discharge into the river and aged for three months. For the primary aquatic hazard evaluations, a pair of 9 sets of earthenware pots were filled with washed stream coarse sand. Healthy seeds of Zea mays were collected and planted 3 per pot to avoid overcrowding. These concentrations (100%, 90%, 80%, 60%, 50%, 30%, 10%, 5% and 0%) of the dyestuff were used in watering the seeds on a daily basis. The germination latency (after ripening stage) and seed viability were recorded. Growth rates and gross growth were measured with meter rule from the level of the soil to the tip of the tallest leaf. The results were subjected to analysis of variance to ascertain the effect of the treatment.

RESULTS AND DISCUSSION

The dyestuff effluents affected after ripening stages (germination latency) in *Zea mays* (Table 1). It was highly significant at 95%, 99% and 99.5% confidence intervals (C.l.) The latency periods at 0% concentration ranged from 4 - 6 days. Similar days

TABLE 1. Analysis of variance for after ripening stage (germination latency) in *Zea mays*.

Conc.	100%	90%	80%	60%	50%	30%	10%	5%	0%
Seed 1	5	7	7	7	6	5	7	5	5
Seed 2	7	8	7	8	7	8	7	5	6
Seed 3	7	9	7	4	8	8	5	5	6
Seed 4	6	5	9	7	4	7	6	7	4
Seed 5	7	8	0	7	7	7	7	0	0
Seed 6	7	8	0	0	7	7	0	0	0
y	39	45	30	33	39	42	32	22	21
n	6	6	4	5	6	6	5	4	4

Grand total = 308
Sum of squared observations = 2087
Sum of squared group totals over means = 2017.35
Correction term = 940.52173
SS total = 1182.4782
SS groups = 1112.8282
SS within group = SS total - SS groups = 69.65

ANOVA TABLE

Source of variation	SS	Ms	Fs
$\bar{y} - \bar{\bar{y}}$ among groups 8	1182.48	14.10	
$\bar{y} - \bar{y}$ within groups 37	69.65	1.8	7.5
	1252.13		

SS = sum of squares
Fs = 7.5^{xx}
$F_{.05}$ (8,37) = 2.27, $F_{.01}$ (8,37) = 3.7
$F_{.005}$ (8,37) = 3.58

were obtained for low concentrations of 10% and 5%. But the high concentrations of 90% and 80% effluent ranged from 8 to 9 days. There were variable latencies within the groups, probably due to genetic and environmental differences and among the groups due to the varying degrees of concentrations applied.

The 100% and 90% concentrations registered 100% germination, 80% was 66.7%, 60% = 83.5. Another 50% and 30% concentrations gave 100% each while 10% gave 83.5% and 5% was 66.7%. The varying concentrations of dyestuff appeared to stimulate seed viability. It would appear that bacteriostatic and fungiostatic compounds added in treating the fabric against spoilage increased viability.

The growth rates were measured from day zero of planting to 14 days after (all in mm day^{-1}) regardless of germination latency (after ripening stage) of the seeds. The mean growth rates day^{-1} are in Table 2. The result of analysis was highly significant at 95%, 99% and 99.5% confidence intervals (C.l.) The addition of

TABLE 2. Analysis of variance of growth rate measurements in *Zea mays*

Conc.	100%	90%	80%	60%	50%	30%
Seed 1	15.71	15	17.14	17.14	16.14	20.71
Seed 2	14.29	12.5	15	15	15	12.86
Seed 3	13.57	5	-	-	10.5	11.07
Seed 4	12.86	15.36	13	18.21	24.29	15.71
Seed 5	12.14	10.57	5.86	10.71	16.07	14.43
Seed 6	11.43	8.71	-	9.57	15.71	10.71
y	80	67.14	51	70.71	97.71	85.49
n	6	6	4	5	6	6
means	13.3	11.2	12.7	14.1	16.3	14.2

Conc.	10%	5%	0%
Seed 1	18.71	18.21	15.81
Seed 2	14.20	-	12.43
Seed 3	-	-	19.29
Seed 4	19.29	21.07	16.14
Seed 5	18.57	16.79	-
Seed 6	17.36	15	-
y	88.22	71.07	63.72
	5	4	4
means	17.6	17.7	15.9

dyestuff highly affected growth rate of *Zea mays*. The high concentrations 100% - 80% aged dyestuff gave negative growth rates when compared with the control. But the low concentrations, 50% - 5% tended to increase growth rates. The growth rates at 5% and 10% were 17.7 and 17.6 mm day^{-1} respectively, while the control was 15.9 mm day^{-1}.

The aged dyestuff affected gross growth of *Zea mays* three weeks after planting, see Table 3.

TABLE 3. Analysis of gross growth measurements of <u>Zea mays</u> after 3 weeks exposure to dyestuff effluent.

Conc.	100%	90%	80%	60%	50%	30%
Seed 1	320mm	290	315	335	310	390
Seed 2	270	257	300	324	395	272
Seed 3	224	140	-	-	238	215
Seed 4	230	260	242	355	420	325
Seed 5	215	195	-	210	275	294
Seed 6	215	230	-	175	258	218
means	245.7	228.7	285.7	297.7	299.3	285.7

Conc.	10%	5%	0%
Seed 1	410	375	265
Seed 2	320	-	250
Seed 3	-	-	-
Seed 4	370	420	305
Seed 5	324	290	255
Seed 6	-	275	-
means	356	340	268.8

SS total = 0.1803148 meter
SS group = 0.06290691 meter

ANOVA TABLE

	DF	SS	MS	Fs
$\bar{y} - \bar{y}$ among groups	8	0.1803148	0.2253955	
$\bar{y} - \bar{y}$ within groups	35	0.0629069	0.0017973	12.54

The result was highly significant at 95%, 99% and 99.5% confidence intervals. High concentrations of dyestuff retarded gross growth in <u>Zea mays</u>. The 100% concentration gave - 23 mm, 90% = - 40 mm, 80% + 17 mm, 60% = + 29 mm, 50% = + 30 mm, while 30% = + 17 mm, 10% = + 87 mm and 5% = 71 mm and 0% = 0 mm (hypothetical). The summation of the negative growth and the positive growth as recorded gave + 188 mm. The low concentrations of dyestuffs affected gross growth in <u>Zea mays</u> positively.

The potential hazard of a chemical substance to the ecosystem components is related both to its potency as a toxicant and its release to the environment in sufficient quantity to result in critical exposures to plants and animals. Some hazard assessments involve the environmental fate and ecological effects testing (Stern and Walker 1978). The aquatic hazard is manifested in many ways: overt toxicity, inhibition of reproduction, reduced growth and morphological malformations (Ball 1967; Dial 1978; Ozoh 1979). Our capabilities to predict the impact of environmental pollutants on the ecosystem will serve dual purposes: to determine the maximum acceptable concentration that can be released without adverse effect on humans and biota and to monitor their fates with a view of setting national standards.

The U.S. Department of Agriculture has performed thousands of tests to learn about the consequences of adding chemicals to plants. Here in Nigeria there are no baseline studies on hazard evaluations. The literature is scanty on the effect of dyestuff on the environment. However, in the present experiment, dyestuff effluent seemed to prolong germination latency (retardation) but enhanced seed viability. But high concentrations of dyestuff retarded growth rates but low concentration stimulated growth rates of Zea mays. Gross growth was stimulated by the dyestuff especially low concentrations. A possibility exists that either the dyestuffs stimulated the enzymatic conversion of insoluble food reserves to soluble forms or acted as growth stimulators. Pre-treating the dyestuff with ion exchange resins before discharge into the environment might reduce or eliminate completely the offensive color.

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