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EFFECT OF LOW-INPUT MANAGEMENT ON PEST DAMAGE TO RICE (*ORYZA SATIVA* L) UNDER NATURAL INFESTATION IN SOUTHEASTERN NIGERIA

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ABSTRACT
Seven rice lines, selected for their good performance under Low-input management condition, were studied under low and high-input management conditions in Umudike in Abia State and Uyo in Akwa-Ibom State , to establish the effect of low-input management on diseases and pests of rice under natural infection and infestation in the humid zone of Southeastern Nigeria. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Data were collected on leaf blast, glume discoloration, brown leaf spot, kernel smut, and stem borer infestations under both low and high-input management conditions. Glume discoloration was most severe under zero fertilizer rate. However, there were no clear trends in the attack by diseases and insect pests based on management levels. Damage level by insects were not significantly different under low-input and high-input management conditions and infection levels by diseases were also not significantly different under low-input and high-input conditions. Therefore low-input cannot be said to aggravate pest infestation or disease infection in rice.
Key Words: *Low-input, High-input, management, diseases, insect pests and rodents.*

INTRODUCTION
Rice is the third most important cereal crop in the world today after wheat and maize. It is a major source of energy in the diet of people in the tropics (Onwueme and Sinha, 1991, Schalbroeck, 2001). Apart from being the staple food for the majority of tropical people particularly in big towns and cities, rice also serves as feed component in livestock industries. (Onwueme and Sinha, 1991).

Although rice is often considered to be a tropical crop, it is grown in almost all the countries of the world particularly in the temperate regions in Asia, North America and in Southern Europe (Onwueme and Sinha, 1991). Generally speaking, however, the production regions of *O. sativa* lie between Latitudes 45^0N and 30^0 S and cover the entire African contents. The extreme latitudes at which rice is cultivated are situated in China at 50^0N and in Australia (New South Wales) at 35^0 (Schalbroeck, 2001). Over 90% of the World's rice is grown in Asia. India has the largest area of Land under rice cultivation (42.2 million hectares) while

China is the principal producer of rice (187.5 million tonnes) (Schalbroeck, 2001).
Africa with production level of 13 million tonnes and about 7 million hectares under rice cultivation accounts for only 2% of World rice production. Nigeria, Egypt and Madagascar are the biggest African producers with 3.2, 3.1 and 2.2 million tonnes per annum respectively (Schalbroeck, 2001).

A major constraint to increased rice production in Nigeria is the problem posed by insect pests, rodents, birds, diseases and weed. Effective control of these problems would no doubt reduce yield losses in rice (Okocha, 2000)

Although rice cultivation is on the increase in Nigeria, output does not meet the high demands placed on it. Therefore, more resources are expected to be invested into rice production. Even though rice breeders have developed high yielding varieties, these require high doses of fertilizer and good management to realize their yield potentials. Since the majority of rice farmers in Nigeria are resource poor, it has been difficult to adopt these high input varieties (Okocha, 2000). Consequently; these high yielding varieties have not contributed meaningfully to increased rice production because of non-availability of needed inputs at the right time, in required quantities and at affordable prices to the resource poor farmers. It is a well-known fact that high relative humanity (more than 90%) and high nitrogen fertilizer application favour the spread of diseases and pests attacks (Lawson and Alluri, 1986). The prevailing high humidity and long period of favourable temperatures in Southeastern Nigeria favour several fungal pathogens and insect pests, most important among them are those that cause blast and grain discoloration, stem borers among others (Lawson and Alluri, 1986).

According to Onwueme and Sinha (1991) rice has been bred and selected for dependable yields under low management levels. Such rice varieties should be tolerant to variations in water level in the field and should compete reasonably well with weeds. They should also endure low soil fertility conditions and be fairly resistant to insect and disease attacks (Onwueme and Sinha, 1991).

Studies carried out between 1995 and 1999 led to the selection of eight rice lines, which performed relatively well under both low and high-input management conditions. (Okocha, 2000, Okocha and Nwosu, 2003, Okocha, Nuga and Muoneke, 2004 and Okocha, Munoeke and Nuga, 2005).

The general objective of this research work, therefore, is to develop a protocol for the cultivation of low-input rice varieties in Southeastern Nigeria while the main objective is to establish the effect of low-input management on disease infection and pest damage to rice under natural infestation condition in the humid zone of Southeastern Nigeria.

MATERIALS AND METHODS

The experiment was carried out in two locations viz: Umudike in Abia state and Uyo in Akwa Ibom State both in the humid forest zone of Southeastern Nigeria. In Umudike, the experiment was sited at the Michael Okpara University of Agriculture Research Farm, (05029', N, $07^0$33' E, 122 m above sea level). In Uyo, the experiment was located at the National Cereals Research Institute (NCRI) Research Farm (05030'N, $07^0$5' E, and 100m above sea level). The total rainfall, mean temperature and relative humidity in 2000 and 2001 were 1681 mm and 2190 mm, 27^0C and 27.5^0C, respectively in Umudike and 1664 mm and 2177 mm, 26.8^0C and 26.8^0C and 80.5% and 81%, respectively in Uyo. The soil was a loamy sandy in both sites and mean particle sizes for sand, clay and silt were 75.2%, 6.4% and 18.4% while in Uyo they were 79.2%, 3.4% and 17.4%, respectively. The results of the chemical analyses of the soil at 0-15cm were 0.14 and 0.19% total N, 64.4 and 91.6 mg/g available P, 0.08 and 0.08 Cmol k/kg, 0.67 and 0.57 Cmol Ca/kg, 0.33 and 0.38 Cmol Mg/kg, 0.68 and 0.92% organic C, 0.05 and 0.05 Cmol exchangeable acidity/kg and 1.27 and 1.22 Cmol effective cation exchange capacity/kg for Umudike and Uyo, respectively.

Seven (7) rice lines selected on the basis of their excellent performance under low-input management conditions between 1995 and 1999 (Okocha, 2000) were used in the study. The rice lines were laid out in a randomized complete block design (RCBD) with three (3) replications. The plot size was 4X3m with spacing of 20X20 cm. in both years, 4-6 rice seeds were direct seeded into one hole.

The entries (rice lines) were tested under four fertilizer (NPK) levels that included 100% NPK, 50%, 25% of the recommended fertilizer rate and 0% or no fertilizer application. High input management was taken to be 100% of the recommended fertilizer rate for the zone which is 80kg N, 30kg P_20_5 and30kg K_2O/ha for the zone (WARDA, 1995) and weeding at two weeks after sowing and at the booting stage, just before fertilizer application. The fertilizer was applied in two split applications(a basal application of 60kg N, 30kg P_20_5 and 30kg k_2O/ha, two weeks after germination using compound fertilizer NPK: 20:10:10 and top dressing with urea at the rate of 20 kg N/ha at the booting stage).

According to Okocha et al, (2004) and Okocha et al, (2005) high input management should comprise a minimum of two weddings, which may include chemical control measures for weeds, pests and diseases, if the need arises. Low-input management was taken to be the use of 0%, 25% or 50% recommended fertilizer rate for the zone and only one hand weeding at four weeks after germination. No chemical should be used for weed or disease and insect pest control.

Data were collected on diseases infection and insect pests infestation according to the Standard Evaluation System (SES) for rice (IRRI, 1988) under natural conditions. Such data included glume discolouration, leaf blast, rodent damage, brown leaf spot, and kernel smut and stem borer infestation using a score of 0-9. Phenotypic acceptability of the rice plants was also scored.

For leaf blast caused by (*Pyricularia oryzae)* ratings were 0= no lesions; 1- small brown specks of pinpoint size or large brown specks without sporulating center; 2-small roundish to slightly elongated necrotic gray spots, about 1-2mm in diameter, with a distinct brown margin with lesions mostly on lower leaves;3- Lesion type is the same as in 2, but a significant number of lesions are on the upper leaves; 4- typical susceptible blast lesions 3mm or longer, infecting less than 2% of the leaf area; 5- typical blast lesions infecting 2-10% of the leaf area; 6-typical blast lesions infecting 11-25% of the leaf area; 7- typical blast lesions infecting 26-50% of the leaf area; 8- typical blast lesions infecting 51-75% of the leaf area and many leaves dead; and 9-more than 75% leaf area affected.
For brown leaf spot caused by *Bipolaris oryzae* and *Drechslera oryzae* ratings were: 0-no incidence; 1- less than 1%; 2-1-3%; 3-4-5% 4-6-10%; 5-11-15%; 6-16-25%; 7-26-50%; 8-51-75% and 9-76-100%.

Glume discolouration caused by the following species (*Helminthosporium*, *Cercospora, Gerlachia, Fusarium, Phoma, Curvularia*; *Trichoconiella* and *Pseudomonas*) were assessed as follows; 0-no incidence; 1-less than 1%; 3-1-5%; 5-6-25%; 7-26-50% and 9-51-100%. Kernel Smut caused by Tilletia *barclayana* was assessed as follows: 0- no incidence; 1-less than 1%; 3-1-5%; 5-6-25%; 7-26-50% and 9-51-100%. The rice plant is attacked by three species of stem borers which include: *Chilo suppressalis* (striped), *Scirpophaga incertulas* (yellow) and Sesamia inferens (pink). Symptoms of stem borer attacks on rice are dead hearts and white heads. For deadhearts ratings were: 0-no damage; 1-1-10%;3-11-20%; 5-21-30%; 7-31-60% and 9-61% and above, while for whitehead ratings were: 0-no damage; 1-1-5%;3-6-10%; 5-11-15%; 7-16-25% and 9-25% and above. Rodent damage (grass cutter) was rated as follows: 0-no damage; 1-less than 5%; 5-6-25% and 9-26-100%.

Phenotypic acceptability was assessed visually, using a scale of 1-9, where 1= excellent, 3-good, 5-fair, 7-poor and 9 = unacceptable. The data were subjected to analysis of variance procedure for factorial arrangement in randomized complete block design (Gomez and Gomez; 1984) and significant treatment effects were determined according to Duncan's new multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

RESULTS

The prevailing high humidity and long periods of favourable temperatures in the southeast favour several pathogens and insect pests. More important among them are blast, grain discolouration and stem borers (Lawson and Alluri, 1986). The result of this experiment showed that glume discolouration and stem borer were the most prevalent disease and insect pest attacks, respectively under both low-and high-input management conditions.

In Umudike, there was no effect of NPK fertilizer level on glume discolouration and phenotypic acceptability in 2000 but in 2001 glume discolouration was least severe under no fertilizer application treatment (Table 1). However, there were no significant differences between glume discolouration infection at 25, 50 and 100% fertilizer application (Table 1) in 2001. Phenotypic acceptability at both 0 and 100% fertilizer levels were similar but higher than at 25% fertilizer level, which was also not different from 50% fertilizer rate (Table 1).

Rodent damage ranged from 12.6 to 20% but this was not influenced by fertilizer level (Table 1).

In 2000, BG 90-2 and Suakoko 8 had the best score to glume discolouration while TOX 3084-136-1-3-1-2 was the most susceptible genotype (Table 2). There was no significant difference in the reaction of the other genotypes to glume discolouration. In 2001, BG 90-2 still recorded the best resistance score while TOX 3084-136-1-3-1-2 and IR 54 were the most susceptible (Table 2). There was no rice genotype effect on phenotypic acceptability and rodent damage (table 2). Similarly, there was no fertilizer level X genotype interaction on glume discolouration and phenotypic acceptability in Umudike in both 2000 and 2001.

In Uyo, interaction effect on the diseases in 2000 showed that for glume discolouration, suakoko 8 had the best resistance score at 100% fertilizer level while TOX 3084-136-1-3-1-2 was highly susceptible at 0 and 50% fertilizer levels (Tables 3).

All the seven rice genotypes had poor phenotypic acceptability score under the various low-input management levels but they were highly acceptable at 100% (high input) fertilizer level with the exception of TOX 3084-136-1-3-1-2 (Table 4).

Suakoko 8 was free from stem borer infestation at 0% fertilizer level. Similarly, IR 54, BG 90-2 and TOX 3118-47-1-1-2 were also free from stem borer attacks at 25% fertilizer rate while stem borer attacks were more on ITA 324 at 25 and 50% fertilizer levels (Table 5). The stem borer infestation were generally low and do not have economic consequence in all the treatment combinations (Table 5). In 2001, some diseases were observed on some rice lines under Umudike condition. These included leaf blast (*Pyricularia oryzae*) on TOX 3118-47-1-1-2 and BG 90-2, brown leaf spot (*Bipolaris oryzae* and *Drechslera oryzae)* on TOX 3118-47-1-1-2, each with resistance score of 1. The most widespread disease was kernel smut (*Tilletia barclayana)* on all the rice lines, also with resistance score of 1.

DISCUSSION

According to Johnson (1992), the growing public sensitivity to the excessive use of potentially dangerous chemicals to control diseases and pests and the ephemeral nature of effective control by some chemicals as well as the escalating costs of development of the so called 'safe" chemicals have highlighted the attributes of durable host resistance. Any cultural/management practices that would enhance increased resistance of rice genotypes to diseases and insect pests could be of immense benefit to the farmer. The result of this research has shown that low input management did not aggravate pest's damage to the rice plants.

There were generally speaking no significant difference in disease infection and insect pest infestation on the rice genotypes based on management level. Rodent damage in the rice lines ranged between 7.5 to 27.5% with a score of 5, according to the standard evaluation system (SES) for rice, which was a moderate attack on the crop. However, the damage was least on IR 54 than on the other lines. According to IRRI, 1988, there is no genetic resistance to rodent damage. This is because rodents just like birds will attack any rice genotype when they are hungry. However, in the midst of several genotypes, rodents show preference in their choice of genotypes to attack. In this experiment IR 54 was least preferred.

Phenotypic acceptability was better for all the rice genotypes under high input than under low-in put management conditions (Table 4). This showed that better management practices positively influence phenotypic acceptability in rice.

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Table 1: Main Effects of Npk Fertilizer Level on Glume Discolouration (Gd), Phenotypic Acceptability (Pa), Percent Rodent Damage (Rd), Leaf Blast (Lb), Brown Leaf Spot (Bls), and Kernel Smut (Ks) in Umudike, 2000 and 2001 Seasons

NPK Fertilizer level	**2000**		**2001**					
	GD	PA	GD	PA	RD	LB	BLS	KS
0	4.71	4.00	3.48b	4.33a	20.00	0	0	1
25	4.05	3.91	4.57a	3.33c	14.86	0	0	1
50	4.81	3.48	5.29a	3.57bc	12.62	0.5	0	1
100	4.91	4.14	4.91a	4.10ab	14.29	0	0	1
Se	0.261	0.191	0.290	0.201	4.312			

Means with different letter(s) are significantly different according to Duncan's new multiple range test (P<0.05). Se = standard error of a treatment mean.

Table 2: Main effects of rice lines on glume discolouration (gd), phenotypic acceptability (pa), percent rodent damage (rd), leaf blast (lb), brown leaf spot (bls) and kernel smut (ks) in umudike, 2000 and 2001 seasons

Rice line	**2000**		**2001**					
TOX 3084-136-1-3-1-2	6.33a	3.42b	5.50a	3.75	13.33a	0	0	1
SUAKOKO 8	3.67c	4.33a	4.00bc	3.75	27.50a	0	0	1
IR 54	5.17b	4.00ab	5.33a	3.42	7.50b	0	0	1
TOX 3154-17-1-3-2-2	5.17b	3.58b	4.67ab	3.83	20.00a	0	0	1
BG 90-2	2.50d	4.33a	3.33c	4.25	14.58a	1	0	1
TOX 3118-47-1-1-2	4.83b	3.50b	4.50ab	3.58	16.00a	1	1	1
ITA 324	4.67b	4.00ab	4.58ab	4.25	9.17a	0	0	1
Se	0.345	0.253	0.385	0.266	5.705			

Means with different letter(s) are significantly different according to Duncan's new multiple range test (P<0.05). Se = standard error of a treatment mean.

TABLE 3: INTERACTION OF NPK FERTILIZER LEVEL AND RICE LINES ON GLUME DISCOLOURATION OF RICE AT UYO IN 2000 CROPPING SEASON

Rice line	**NPK fertilizer levels (%)**				
	0	25	50	100	Rice line means
TOX 3084-136-1-3-1-2	5.67a	3.00cd	5.67a	5.00ab	4.83a
SUAKOKO 8	3.67bcd	5.00ab	3.00cd	2.33d	3.50bc
IR 54	3.00cd	3.67bcd	3.67bcd	3.00cd	3.33bc
TOX 3154-17-1-3-2-2	3.00cd	3.00cd	3.00cd	3.67cd	3.33bc
BG 90-2	3.00cd	3.67bcd	4.33abc	4.33abc	3.83b
TOX 3118-47-1-1-2	3.67bcd	3.67bcd	3.64bcd	3.00cd	3.50bc
ITA 324	3.00cd	3.00cd	3.00cd	3.00cd	3.00cd
Fertilizer level means	3.57	3.57	3.86	3.48	

For each parameter in each rice line fertilizer means value with the same letter(s) are not significantly different (p >0.05). Within the cells, any two fertilizers x rice line means with the same letter(s) are not significantly different (p > 0.05).

TABLE 4: INTERACTION OF NPK FERTILIZER LEVEL AND RICE LINES ON PHENOTYPIC ACCEPTABILITY OF RICE AT UYO IN 2000 CROPPING SEASON

Fertilizer levels (%)					
Rice lines	0	25	50	100	Rice line means
TOX 3084-136-1-3-1-2	5.00	5.00	5.00a	5.00a	5.00a
SUAKOKO 8	5.00	5.00	4.33b	3.00c	4.33b
IR 54	5.00	5.00	5.00a	3.00c	4.33b
TOX 3154-17-1-3-2-2	5.00	5.00	5.00a	3.00C	4.50b
BG 90-2	5.00	5.00	5.00a	3.00c	4.50b
TOX 3118-47-1-1-2	5.00	5.00	5.00a	3.00c	4.50b
ITA 324	5.00	5.00	5.00a	3.00c	4.50b
Fertilizer level means	5.00a	5.00a	4.91a	3.29b	

For each parameter in each rice line, fertilizer means value with the same letter(s) are not significantly different (p >0.05). Within the cell, any two fertilizers x rice line means with the same letter(s) are not significantly different (p > 0.05).

TABLE 5: INTERACTION OF RICE LINES AND NPK FERTILIZER LEVELS ON STEM BORER DAMAGE IN UMUDIKE, 2001.

Rice lines	NPK FERTILIZER LEVELS (%)			
	0	25	50	100
TOX 3084-136-1-3-1-2	0.67bc	1.00abc	0.67bc	0.67bc
SUAKOKO 8	0.00c	0.33bc	0.67bc	0.33bc
IR 54	1.00abc	0.00c	0.33bc	0.67bc
TOX 3154-17-1-3-2-2	0.33bc	0.33bc	0.67bc	0.67bc
BG 90-2	1.00abc	0.00c	0.67bc	0.67bc
TOX 3118-47-1-1-2	0.33bc	o.00c	0.33bc	1.00abc
ITA 324	0.33bc	2.00a	1.33ab	0.33bc

Within the cells, any two fertilizers X rice line means with the same letter(s) are not significantly different (p>0.05). Standard error of rice line x fertilizer level means = 0.342, standard error of rice line X fertilizer level means = 0.342.