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Short communication

PHYSICO-CHEMICAL PROPERTIES OF TEN COWPEA LINES ON RESISTANCE TO *CALLOSOBRUCHUS MACULATUS* (WALP)

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ABSTRACT: Ten IITA Cowpea lines were evaluated for their Physico-Chemical properties to assess their potential for resistance to *Callosobruchus maculatus*. IT 90K–277–2 showed highest resistance while IT 97K–497–2 showed least resistance (high susceptibility) on the basis of number of insect F1 generation (i.e. 454.00+149.61) and grain weight loss (7.33g). Correlation between fecundity and grain weight loss was positive. The result of the proximate analysis has no correlation with susceptibility. The seed coat texture plays significant role in inducing ovipositional response. Non-preference was suspected to be the resistant mechanism.

Key words/phrases: *Callosobruchus maculatus*, non- preference, resistance

INTRODUCTION

Cowpea, *Vigna unguiculata* (Walp) is one of the principal grain legumes in West Africa. Its economic and nutritional values have long been recognized in Africa, particularly as a subsistence crop to be relied upon before other crops mature (Aykroyd and Doughty, 1964).

Two-third of the world population are not adequately fed and yet about 2000 million tons of foods are lost each year as a result of poor storage and distribution (FAO, 1978). Most of these losses are recorded in the developing countries of the tropics where the prevailing climatic conditions make this grain prone to spoilage. Studies carried out in Lagos market stock by Railey (1972) revealed that 40–60 bruchid beetles emerge from every 100-cowpea seeds after maximum storage of three months.

Callosobruchus maculatus is the most important pest of stored cowpea in Africa (Singh, 1978). It causes weight loss; decrease germination potential and the commercial value of the seed (Booker, 1967; Caswell, 1981). Low utilization of cowpea in many countries is due to seed destruction caused by the larvae of *C.maculatus* (Gatehouse *et al*., 1985). In Nigeria, which is a major producer of Cowpea, losses ranging from 50% to100% of stored cowpea seeds have been attributed to *C. maculatus (*Singh, 1978).

This work attempts to investigate and assess the physico-chemical property of ten cowpea lines, as a factor conferring resistance on them, to *C. maculatus* as part of the efforts of finding solution to the storage problem of cowpea in the tropics.

MATERIALS AND METHODS

Ten IITA cowpea lines were used for this study. The lines are IT95–238–3, IT95k–1453–47, IT97–492–2, IT97–1068–7, IT95K1093–5, IT86D –719, 1T87D–941–1, IT89KD–288, IT90K– 277–2 and IT90K–59. The seeds were kept in the freezer for three weeks at 4°C before the commencement of the experiment to ensure that the seeds were free from any infestation prior to the experiment and were brought out thereafter to be equilibrated under atmospheric condition.

Insect culture

Some apparently clean, susceptible, untreated white seeds of cowpea (12% moisture content), were bought from a local market and kept in the freezer for seven days to kill all stages of bruchids contained in them. The seeds were taken out on the seventh day to attain room temperature at 30°C±0.5 and 70% r.h. for 7 days before bioassay. The seeds were kept in a wide-mouthed bottle; some unsexed bruchids were introduced into the bottle and the mouth was covered with a muslin cloth for aeration and secured with a rubber band to prevent the insects from escaping.

Physical characteristics of the cowpea lines used

The seed coat texture and colour were determined by visual examination, seed height measurement were taken as the maximum vertical dimension with the seed resting freely on the surface of a table, the length as the longest horizontal dimension in the plane surface of the

table and the width as the maximum linear dimension perpendicular to the helium.

The seed coat was carefully peeled off the cotyledon with a razor blade and the thickness measured with a micrometer screw gauge.

Susceptibility experiment

Ten virgin, unsexed, freshly emerged adult, *C. maculatus* were randomly selected and introduced into 20g of each cowpea line in four replications, this was to allow for artificial infestation. The adults were removed after ten days of oviposition and the number of F1 population were determined daily by counting and removing freshly emerged insect in each of the cowpea line for two months; the removal was done to prevent F2 progeny. Counting and removing started 3 days after oviposition. Data obtained were subjected to analysis of variance and means compared using DMRT (Duncan, 1955).

Chemical analysis

Proximate analysis was carried out on all the cowpea lines used. Analyses (in percentages) of: crude protein, crude fat, dry matter, crude fibre and ash content were determined. Samples were analyzed chemically, according to the method of the Association of Official Analytical Chemist at IITA Ibadan, Nigeria.

Weight loss

Mean weight loss of the seed were determined after 2 months as:

$$\frac{Final\ weight - initial\ weight}{n}$$

where n is number of replicates.

Mean weight losses of the seeds were determined immediately after FI progeny count according to Akintola and Oyegoke (2000).

RESULTS AND DISCUSSION

Data on seed dimension, colour and thickness and other physical characteristics of the cowpea lines are shown in Table 1. All the lines have rough seed coat texture except IT97K–1068–7 and IT90K–277–2, which have smooth testa.

Susceptibility test

Result of the analysis of variance showed that no two groups of the seeds were significantly different at .05 levels of significance. The mean F1 population of insect was in the order of IT97K–497–2 > IT87D–941–1 > 1T95K–1093–5 > IT86D–719 > IT89KD–288 > IT95K–1453–47 > IT97K–1068–7 > IT95K–238–3 > IT90K–59 > IT90K–277–2 (Table 2).

Weight loss

A reduction in mean weight was recorded in all the lines (Table 3). Mean weight loss ranged from 2.275 to 7.325 *(i.e.*, IT90K–277–2 and IT97K–497–2).

Proximate analysis

The percentages of dry matter, crude protein, crude fat, crude fibre and ash are shown in Table 4.

In IT90K–277–2, "non preference" by insects and hardness of the seeds (Painter, 1951) were suspected to be the resistant mechanisms in this study. The resistance (*i.e.,* low susceptibility which is 125.00+79.39) of this line had no effect on the seed coat thickness (*i.e.*, 0.067) and the result of its proximate analysis. Baker *et al.* (1989) had also suggested that seed coat thickness, seed density, moisture content of the seed, protein, fat, ash, carbohydrate and proteinase activity were not associated with the activities of *C. maculatus.* Seed colour and seed dimension had no effect on the susceptibility of the cowpea lines used (Tables 1 and 2).

Table 1. Physical characteristics of cowpea cultivars used.

Cultivars	Seed coat features			Seed dimensions (cm)		
	Colour	Texture	Thickness (mm)	Length	Width	Seed thickness
IT95K–238–3	White	rough	0.033	0.77	0.49	1.13
IT97K–497–2	White	rough	0.033	0.77	0.56	1.34
IT87D–941–1	Brown	rough	0.047	0.85	0.58	1.24
IT95K–1453–47	White	rough	0.073	0.70	0.50	1.20
IT86D–719	White	rough	0.065	0.70	0.51	1.10
IT89KD–288	Brown	rough	0.053	0.78	0.53	1.12
IT97K–1068–7	Dark Brown	smooth	0.061	0.80	0.54	1.16
IT90K–277–2	White	smooth	0.067	0.72	0.42	1.25
IT95K–1093–5	Brown	rough	0.073	0.67	0.48	1.10
IT90K–59	Brown	rough	0.047	0.64	0.46	1.10

Table 2. Mean number of F1 progeny observed on different cultivars of cowpea after 60 days of incubation.

Cowpea Cultivars	Mean no F1 + SE
IT97K–497–2	454.00 + 149.61
IT87D–941–1	374.33 + 173.46
IT95K–1093–5	342.00 + 166.50
IT86D–719	264.75 + 154.70
IT89K–288	260.00 + 179.46
IT95K–1453–47	227.25 + 146.80
IT97K–1068–7	200.00 + 96.99
IT95K–2383	171.50 + 72.13
IT90K–59	167.00 + 70.24
IT90K–277–2	125.00 + 79.39

Table 3. Mean weight loss of the different cowpea cultivars due to feeding of *C. mculatus.*

Cowpea cultivars	Mean weight loss(gm)
IT95K– 38–3	2.925
IT97K– 497–2	7.325
IT87D–941–1	5.450
IT95K– 453–47	3.825
IT86D–719	3.650
IT89K–288	3.375
IT97K–1068– 7	3.850
IT90K–277–2	2.275
IT95K–1093– 5	4.725
IT90K– 59	3.700

N.B The re is no significant difference at $p<0.05$.

Table 4. Result of the cowpea line.

Cowpea cultivars	%DM	%CP	%EE	%CF	%Ash
IT95K – 238–3	91.67	24.26	5.12	3.21	4.12
IT97K – 497–2	90.89	24.69	5.10	3.21	4.17
IT87D – 941–1	93.28	23.21	3.77	3.01	4.06
IT95K – 1453–47	93.01	19.63	3.11	3.11	4.14
IT86D – 719	92.38	22.19	4.86	2.35	4.02
IT89K – 288	92.47	26.18	3.24	1.79	4.08
IT97K – 1068	91.99	21.32	4.10	2.96	4.96
IT90K – 277 – 2	92.37	21.28	4.01	2.96	4.03
IT95K – 1095K	93.08	20.87	3.16	1.86	3.87
IT90K – 59	1.67	21.77	4.65	2.65	4.01

DM, Dry matter; CP, Crude protein; EE, Crude fat; CF, Crude fibre.

Data on mean weight loss after the experiment showed IT97K–497–2 to be highly susceptible while others were moderately susceptible (Table 2). This fair resistance (moderate susceptibility) shown by other lines could be linked to the presence of some antimetabolic compounds contained in them, which prevented insect attack. Witteaker (197I) and Grupta (1987) suggested that the presence of antimetabolic compounds in seeds have been associated with resistance to insect attack. Antimetabolic compound inhibits the development of the larval stages of insect by the production of substances that disrupt their metabolic activities.

Messina and Renwick (1985) reported a correlation between seed coat texture and oviposition by *C. maculatus,* and that smooth testa is preferred to rough one, the observation made in this work showed a complete deviation from their reports. Further investigation on the antimetabolic compound (s) contained in IT90K–277–2 is suggested.

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