

## Research Paper

### **Differential Susceptibility of some Cowpea Varieties to Field infestation by Arthropod Pests in Mubi region of Sudan Savannah ecological zone of Nigeria.**

#### **ABSTRACTS**

Study was carried out in 2011 cropping season at Adamawa State University Research and Teaching Farm Mubi, to assess the comparative susceptibility of five cowpea varieties to field insect pest infestation. The varieties are the treatments and were replicated four times (4x) and laid out in a Randomized Complete Block Design (RCBD). Data were collected on days to 50% flowering, days to 50% pod setting, days to 50% pod maturity, mean number of flower producing pods, mean number of surviving pods, mean number of healthy pods produced and the total output per variety/cultivar. The result revealed that Iron beans had the least degree of susceptibility to field pest infestation and correspondingly recorded the highest yield of 2.144kg/plot and 1.34ton/ha. While the highest degree of susceptibility was recorded with Samira which gave a yield of 728g/plot and 0.455kg/ha. Four species of insects were also found on the plots. The implication of these with respect to cowpea pest management in this locality were discussed.

**Key words:** Susceptibility, Cowpea varieties, Field Pests infestation, Ecological zone, Differential

#### **Introduction**

Cowpea, *Vigna unguiculata* (L.) Walp., is one of the most important grain legumes which is widely cultivated in semi-arid areas of the tropics and subtropics for human as well as animal consumption (Singh and van Emden, 1979). In west and central Africa, the most important cowpea growing regions in the world, cowpea constitutes the cheapest source of dietary protein for the low income sector of the population (Rachie, 1985). Cowpea leaves, green pods, green peas and dry grains are consumed as food by humans and the haulms which contain about 20% protein are fed to livestock. However, yields at farmers level are low averaging only 50-350kg/ha (Rachie, 1985; Jackai and Daoust, 1986; Mortimore *et al.*, 1997; Karungi *et al.*, 2000a). The major causes of the low yields are insect pests, diseases, parasitic weeds drought and low soil

28 fertility, of which insects constitute the major constraint (Singh *et al.*, 1990; Karungi *et al.*, 1999;  
29 Nampala *et al.*, 1999).

30 The presence of many insect pest species from seedling to harvest is a feature of cowpea  
31 production system. However, flower and pod attacking pests are the most important arthropod  
32 pest of cowpea (Raheja, 1976; Kyamanywa, 1996; Karungi *et al.*, 2000a,b,c). Losses in grain or  
33 foliage attributed to field pests of cowpea ranges from 20% to almost 100% (Raheja, 1976; Singh  
34 and Allen, 1980). These high losses have contributed immensely to cowpea's subsidiary position  
35 in the farming systems of several countries in the tropics (Jackai *et al.*, 1985; Mortimore *et al.*,  
36 1997). Control of these pests is therefore crucial to sustainable production of cowpea.

37 Although there are several commercial insecticides available for the control of these pests with  
38 resultant increases in grain yield by several folds. Use of such insecticides are often too  
39 expensive for resource-poor farmers, unavailable in local markets and can also result in food  
40 contamination or environmental pollution (Karungi *et al.*, 2000a). In order to reduce both over  
41 dependence on insecticides and grain yields reduction due to insect pests damage, the search for  
42 cowpea cultivars resistant to these pests has been intensified by scientists in the international  
43 institute of tropical Agriculture (IITA) and others institutions notably Makerere University in  
44 Eastern Africa and Bunda College in South Africa. However, it has not, to date, been possible to  
45 find high levels of resistance and/or multiple pest resistance to certain major pests such as the  
46 legume pod-borer, *Maruca (testulalis) vitrata* Fab., the legume flower thrips, *Megalurothrips*  
47 *sjotedti* Troborn and the pod-sucking bug complex, *Clavinggralla tomentosicollis* Stal, *Mirperus*  
48 *jaculus* Thunberg, *Nezara viridula* L. and *Anoplocnemis curvipes* Fab.; although several high  
49 yielding early maturing cultivars well-adapted to different ecological zones have been developed.  
50 Therefore, until transgenic insect resistant cowpea has been developed through biotechnology,

integrated pest management (IPM) will remain the best option to reduce risks of crop losses due to insect pests and increases grain yield for the resource poor farmers who grow and derive a sizeable portion of their protein and part of income from cowpea (Alabi *et al.*, 2003).

In Nigeria, Cowpea (*Vigna unguiculata*) is a major food crop grown. Yield are however generally low, sometimes total yield losses occur (Olatunde, *et al.*, 1991). Successful cowpea production should depend on correct time of planting, cultural, physical/mechanical practices and the resistance capability of the variety because most of these pest and disease bred on volunteer grasses and wild legumes species (Singh and Ven Emdem, 1979). Therefore, there is possibility of high population of such pest around farmers' farm right from the onset of the crop. This has necessitate the persistent use of pesticide in all cowpea production enterprises. However, improper application of these pesticide has resulted in environmental, human health problem and insect resistance (Perkins 1982). Hence, this study on the comparative susceptibility of different varieties of cowpea to field pest infestation is to prospect for varieties that guarantee productivity in face of such infestations. The **objectives** of this study is therefore, to compare the susceptibility of some cowpea varieties (*Vigna unguiculata*) to infestation by field pest to ascertain the best cultivar that can be grown in this locality and similar ecologies with reduce insecticide application in an integrated pest management and good agricultural practice fashion.

## **Materials and method**

### **Study area**

The study was conducted at the research and teaching farm of the faculty of Agriculture Adamawa State University, Mubi, during 2011 cropping season. The research farm is located on

latitude 10<sup>0</sup>11N and longitude 13<sup>0</sup>19E at an altitude of 696 above sea level (Adebayo and Tukur 1999).

## **Land preparation**

The land was prepared by ploughing and harrowing with a tractor in the early season i.e. onset of rainfall. The plot were prepared manually using shovels and hoes in the late season prior to sowing. Experimental plots measured 4m x 4m each with inter-plot space of 1m in-between plots were also marked out manually.

## **Source of planting material**

Five varieties of cowpea namely Kanannado, Ife-brown, Samira, or English beans, Iron beans and BOSADP were compared in this experiment. The varieties were obtained from Mubi market (Kanannado, Ife brown and Samira) and Adamawa Agricultural Development Programme Mubi (BOSADP and Iron beans).

## **Sowing and spacing**

Planting where done at a space of 1m x 30cm. inter and intra row respectively on 4<sup>th</sup> August, 2011. Three seed were planted per hill and hill that did not germinate or destroy by birds during sporting was supplied 6 days after planting. The seedlings were thinned to two plants per stand ten (10) days after sprouting.

Each plot consists of 4 rows of 22 stand per row, making the total plant per plot to be 88 stands. Regular weeding of the farm was done 3 times before maturity to control weed that harbour pest and disease.

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## 101 **Experimental design and layout**

The experiment consists of 5 treatment and 4 replicates fitted into a randomized complete block design (RCBD, the varieties were the treatments.

## 104 **Data collection**

Data was collected on the following:-

### 106 **Days to 50% flowering**

Number of days when 50% of the plants have flowered were taken for each plot of each variety and the means were recorded.

### 109 **Days to 50% pod setting**

Numbers of days when 50% of the plants have started podding were taken on each plot for each variety and their mean was recorded as the days to 50% podding setting

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### 113 **Days to 50% pod maturity**

Numbers of days at which 50% of the plant have shown pod maturity were also taken for each plot of each variety and their mean was recorded as days to 50% pod maturity.

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## 119 **Mean number of flower set**

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121 Numbers of flower sets per plot for each variety were taken on every other day basis and average  
122 recorded.

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## 124 **Numbers of flowers producing pods**

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126 Numbers of flowers producing pods were also taken and recorded.

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## 128 **Numbers of pods surviving**

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130 Numbers of surviving pods on tagged plants were also counted and their average taken.

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## 132 **Numbers of healthy pods**

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134 Numbers of healthy pods found on each variety were counted and recorded

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## 136 **Insect pest collection and identification**

137 Observation (inspection) was done visually to ascertain the presence of insect pests on each plot  
138 and for each variety. Insects species found on flowers were collected by beating and jarring  
139 method, using an improvised beating sheet. Available insect were transfer into collection bottles  
140 (killing jars) and were later observed under handlens and images were compared with plates

slides of photographs from a book “Cowpea Pest and Diseases” by Singh and Allen (1978) for identification.

## **Output per cultivar**

Final yield for each cultivar was taken and interpolated to output per hectare.

## **Statistical Data Analysis**

All data collected were subjected to ANOVA. Data on days to 50% flowering, days of 50% podding and 50% pod maturity were analyzed using Genstat statistical package, means were separated using Least Significant Difference (LSD). Data on number of flower set, number of flower producing pods, number of pods surviving and number of healthy pods were to be subjected to ANOVA using SAS statistical packages. Means were separated using Duncan's Multiple Range Test (DMRT). Mean yield for each variety under study was computed on plot and later extrapolated to hectare basis.

## **RESULT**

### **Days to 50% flowering, podding and Pod Maturity**

The result for days to 50% flowering, podding and Pod Maturity is presented on Table1. The result show that, there is no significant ( $P>0.05$ ) difference among the variety in terms of days to 50% flowering and that of pod maturity. The result equally indicate that, there is no significant ( $P>0.05$ ) difference in mean days to 50% podding for Iron beans, Samira and Kanannado, but they are significantly different from Ife brown and BOSADP.

164 Table1 Means number of days to 50% flowering, podding and Pod Maturity

| Variety      | Mean $\pm$ SE     |                  |                      |
|--------------|-------------------|------------------|----------------------|
|              | DOT 50% Flowering | DOT 50% Podding  | DOT 50% pod maturity |
| Iron beans   | 77.5 $\pm$ 2.50   | 86.75 $\pm$ 0.25 | 91.25 $\pm$ 0.25     |
| Ife brown    | 79.5 $\pm$ 0.50   | 80.50 $\pm$ 3.59 | 90.75 $\pm$ 0.25     |
| BOSADP       | 76.0 $\pm$ 3.00   | 80.0 $\pm$ 2.38  | 90.00 $\pm$ 0.58     |
| Samira       | 78.0 $\pm$ 0.58   | 85.0 $\pm$ 3.33  | 90.75 $\pm$ 0.25     |
| Kanannado    | 76.0 $\pm$ 1.0    | 85.5 $\pm$ 1.90  | 90.00 $\pm$ 0.57     |
| LSD (P=0.05) | 6.32              | 6.42             | 1.25                 |

DOT= days to

## 165 Mean number of flower set and flowers producing pods

166 The result for number of flowers set is presented on Table 2 The result shows that iron beans  
 167 produced the highest mean number of flowers (85 $\pm$ 2.86) while the least mean flower was set by  
 168 Kanannado (65 $\pm$ 2.86) significant (P< 0.05) difference however, exist among some means  
 169 (Table 2).

170  
 171 The result for number of flowers producing pods is also presented on Table 2. The result reveal  
 172 that iron beans had the highest number of flowers producing pods (80 $\pm$ 2.20) while the least mean  
 173 flower producing pods was recorded on kanannado (55 $\pm$ 2.08). Statistically significant (p< 0.05)  
 174 difference were however observed among some means (Table 2)

175 Table 2 Mean Number of flower set and flowers producing pods

| Variety    | Mean $\pm$ SE  |                        |
|------------|----------------|------------------------|
|            | flower set     | flowers producing pods |
| Iron beans | 85 $\pm$ 2.86a | 80 $\pm$ 2.20a         |
| BOSADP     | 84 $\pm$ 2.86a | 73 $\pm$ 2.12a         |

|           |            |            |
|-----------|------------|------------|
| Samira    | 80±5.08ab  | 65±1.87b   |
| Ife brown | 71±5.10 bc | 61±3.24 bc |
| Kanannado | 65±2.86c   | 55±2.08c   |

Means followed by the same letter(s) are not significantly different using Duncan's multiple range test at  $p=0.05$  (DMRT).

### Mean number of pod surviving and Healthy pod produced

The result for mean number of pods surviving in each variety is presented in Table 3. The results shows that significant ( $P<0.05$ ) differences exist among some means (Table 3). However iron beans recorded the highest number of pods, while the least surviving pods was recorded on Ife brown ( $40\pm1.47$ ) as shown on (Table 3).

Table 3 Mean number of surviving and Healthy pods produced

| Variety    | Mean $\pm$ SE |                       |
|------------|---------------|-----------------------|
|            | Surviving pod | Healthy pods produced |
| Iron beans | 70±1.78a      | 41±3.24a              |
| Samira     | 61±2.34b      | 24.0±1.08b            |
| BOSADP     | 50±1.83c      | 10.0±1.29c            |
| Kanannado  | 49±2.16c      | 1.0±0.71d             |
| Ife brown  | 40±1.47d      | 2.0±0.40d             |

Means followed by the same letter(s) are not significantly different using Duncan's multiple range test at  $p=0.05$  (DMRT).

The result for number of healthy pods produced is also presented on Table 3. The result shows that there is significant ( $p=0.05$ ) difference among the varieties. However, iron beans recorded the highest number of healthy pods ( $41\pm3.24$ ) while the least mean number of healthy pods was observed on kanannado ( $1.0\pm0.71$ ) as shown on (Table 3).

194 **4:8 Insects collection and identification**

195 The result for insect collection and identification is presented on Table 4. The result  
196 indicates clearly that the pest identified belong to four different orders and families and they feed  
197 on either flower or pods (Table 4)

198 Table 4 Insects pest collected and identified

| S/No | Common name      | Scientific name                 | Order: family           | Part of plant n                                                             |
|------|------------------|---------------------------------|-------------------------|-----------------------------------------------------------------------------|
| 1    | Flower thrips    | <i>Megalurothrips sjostedti</i> | Thysanoptera: Thripidae | Feed on flower buds and flowers                                             |
| 2    | Legume pod borer | <i>Maruca testulalis</i>        | Lepidoptera: Pyralidae  | Feeds on tender part of stem, peduncles, flower buds, flower and pods       |
| 3    | Blister beetles  | <i>Mylabris spp</i>             | Coleoptera: Meloidae    | The beetle feeds on flowers                                                 |
| 4    | Pod sucking bug  | <i>Anoplocnemis curvipes</i>    | Hemiptera: Lygaeidae    | They suck sap from green pods causing them to shriveled and dry prematurely |

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200 **Yield per variety**

201 The result for yield per variety is presented on Table 5. The result shows that, Iron beans had the  
202 highest yield of 2144g and per hectare 1.340 tons respectively, and the least yield was obtained  
203 with Samira 728g/plot and 455kg/ha.

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205 Table 5 Yield per variety of cowpea tested

| variety    | Yield/plot (g) | Yield/Hectare (tones) |
|------------|----------------|-----------------------|
| Iron beans | 2144           | 1.340                 |
| BOSADP     | 1600           | 1.00                  |
| Ife Brown  | 1287           | 0.804                 |
| Kanannado  | 994            | 0.621                 |
| Samira     | 728            | 0.455                 |

206

## 207 Discussion

208 The result from this study showed that mean number of days to 50% flowering, podding  
 209 and pod maturity have shown no significant ( $p>0.05$ ) difference (Table 1). This implies that all  
 210 the varieties have similar phonological productive stages and hence were prone to same levels of  
 211 pest infestation at same period in their productive cycle.

212 Similarly the result revealed that differential susceptibility with respect to insect pest  
 213 infestation exists among the varieties tested. Mean number for flower set (Table 2) shows that,  
 214 there is no significant difference among the flower produced on Iron beans BOSADP and  
 215 Samira, significant difference exist between mean flower set in Ife brown and kanannado. This  
 216 means that, yield of Iron beans, BOSADP Samira and that of Ife brown and kanannado will be  
 217 nearly equal, all things being equal/under normal cropping circumstances.

218 But in terms of flowers producing pods, there is a drop in mean number of pods by 5% in  
 219 iron beans, 10% in Ife brown 19% in BOSADP 7% in Samira and 10% in kanannado. The above  
 220 percentage losses are an index of differential susceptibility of the respective varieties under study  
 221 to the effects of infestation by flower pest (flower thrips and blister beetles). Therefore drop in

222 number of pods produced will lead to low output, which is expected also follow in the same  
223 pattern.

224 However, in terms of pods surviving as shown on Table 3. The result have shown that,  
225 some varieties are more susceptible to insect infestation during pod formation. Percentages, pods  
226 surviving on iron beans dropped by 90% from pods produced in Table 3 Samira by 88%,  
227 BOSADP by 85%, Ife brown by 88% and kanannado by 85% respectively. Loss in yields are  
228 also expected to be sustain in each of the varieties in live with the above. It has been reported  
229 that, more than 70% of total loss, in yield of cowpea is attributable to insect as a result of damage  
230 during the flower and pod formation stages (kyamanywa, 1997, Karungi et al 2000b,c). The  
231 implication of the results of this study are that, yield reduction occurs between flowering and  
232 podding stages in the phenology and control of field pest infestation during flowering and pod  
233 formation is the best way of combating field pest attack on cowpea. Similarly the associated loss  
234 in yield will equally be reduced drastically by such intervention at this point. This findings  
235 agrees with (Anonymous 1954-85; Patel 1997) which says; some genotype in cowpea varieties  
236 were found moderately susceptible to pest. Thus none of genotype was found in cowpea free  
237 from the incidence of pest attack. Therefore, spraying at these stages produces healthy pods,  
238 hence better yield.

239 Therefore, farmers in this ecological zone should go for varieties like iron beans, Samira  
240 and BOSADP, because they have shown some degree of resistance to some field pest, especially  
241 flowering insect pest attack, by producing highest mean number of surviving pods Table 3.

242 The study have also shown that, number of healthy pods produced at the end of the  
243 cropping season shows that significant difference ( $p=0.05$ ) exist among iron beans, BOSADP  
244 and Samira but no significant difference between Ife brown and kanannado in terms of healthy

245 pods produced. The rate of insects infestation to cowpea is affected by the degree of the  
 246 resistance of a cultivar which through physical or mechanical barriers (Sample, 1992). However  
 247 iron beans and BOSADP used in this study are improved varieties expected to have some degree  
 248 resistance to some pest. The use of these varieties along good Agricultural practices or  
 249 management strategies will reduced field pest infestation. (Ahoaka-Atta, *et al* 1983). Therefore  
 250 result of this study reveal that resistance alone does not offer effective control against all the  
 251 cowpea pest. However, where a given cultivar gives higher yield advantage in the face of pest  
 252 infestation will implies that, the varieties is less susceptible to the attack of the insects pest  
 253 species in the locality and hence can be easily grown with less pesticide using integrated pest  
 254 management (IPM).

255 Yield obtained from the varieties have shown that, iron beans produced the highest yield  
 256 of 2144g/16m<sup>2</sup> and the lest was produced from Samira with 728g/16m<sup>2</sup>. This means that, in the  
 257 face of pest infestation, variety that produced the highest yield /hectare and hence could be  
 258 concluded that. Farmers using these varieties along other pest management strategies will have a  
 259 better yield guarantee than those using the other varieties.

260 Therefore, a management strategy that involves other control tactics to complement  
 261 resistance is needed. It should target the most important pest in the locality, taking into account  
 262 the resistance of a cultivar or variety to pest. This result is consistent with report that plant  
 263 resistance in cowpea reduces pest infestation and markedly increase crop yield (Karungi et, al  
 264 2000, Jackai and Daoust, 1986).

## Conclusion

It could be concluded that Iron beans and BOSADP out of the five cultivars tested have demonstrated the least level of susceptibility to field pest infestation, hence relatively more resistant to field pest infestation. Therefore, Iron beans and BOSADP due to their low susceptibility to field pest Infestation, gave high yield per plot and per hectare when compared to other varieties. They could therefore be varieties of choice for cultivation in this locality.

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