

Research Paper

Differential Susceptibility of some Cowpea Varieties to Field infestation by ~~Arthropod~~^{Insect} 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

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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* Trobom and the pod-sucking bug complex, *Clavigralla 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,

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

54

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

69 **Materials and method**

70 **Study area**

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

73 latitude 10°11N and longitude 13°19E at an altitude of 696 above sea level (Adebayo and Tukur
74 1999).

75

76 **Land preparation**

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

81

82 **Source of planting material**

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

87

88

89

90 **Sowing and spacing**

91 Planting were done at a space of 1m x 30cm. inter and intra row respectively on 4th August,
92 2011. Three seed were planted per hill and hill that did not germinate or destroy^{d.} by birds during
93 sporting was supplied 6 days after planting. The seedlings were thinned to two plants per stand
94 ten (10) days after sprouting.

95

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96 Each plot consists of 4 rows of 22 stand per row, making the total plant per plot to be 88 stands.

97 Regular weeding of the farm was done 3 times before maturity to control weeds that harbour pest
98 and disease.

99

100

101 **Experimental design and layout**

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

104 **Data collection**

105 Data was collected on the following:-

106 **Days to 50% flowering**

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

109 **Days to 50% pod setting**

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

112

113 **Days to 50% pod maturity**

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

116

117

118

*How about pesticide application?
Was there any? If the answer
is yes, how do you standardize btw. plots?*

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119 **Mean number of flower set**

120

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

123

124 **Numbers of flowers producing pods**

125

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

127

128 **Numbers of pods surviving**

129

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

131

132 **Numbers of healthy pods**

133

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

135

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 hand lens and images were compared with plates

How frequent did you sampled
the pests?
- when?

141 slides of photographs from a book "Cowpea Pest and Diseases" by Singh and Allen (1978) for
142 identification.

143

144 **Output per cultivar**

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

146 **Statistical Data Analysis**

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

154

155 **RESULT**

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

157 The result for days to 50% flowering, podding and Pod Maturity is presented on Table1. The
158 result show that, there is no significant ($P>0.05$) difference among the variety in terms of days to
159 50% flowering and that of pod maturity. The result equally indicate that, there is no significant
160 ($P>0.05$) difference in mean days to 50% podding for Iron beans, Samira and Kanannado, but
161 they are significantly different from Ite brown and BOSADP.

162

163

*How do you
convert them?*

*unit? please
state.
kg/ha?*

*one way?
2 way?*

*one way?
2 way?*

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 <i>a</i>	86.75 $\pm$ 0.25 <i>a</i>	91.25 $\pm$ 0.25 <i>a</i>
Ife brown	79.5 $\pm$ 0.50 <i>a</i>	80.50 $\pm$ 3.59 <i>b</i>	90.75 $\pm$ 0.25 <i>a</i>
BOSADP	76.0 $\pm$ 3.00 <i>a</i>	80.0 $\pm$ 2.38 <i>b</i>	90.00 $\pm$ 0.58 <i>a</i>
Samira	78.0 $\pm$ 0.58 <i>a</i>	85.0 $\pm$ 3.33 <i>a</i>	90.75 $\pm$ 0.25 <i>a</i>
Kanannado	76.0 $\pm$ 1.0 <i>a</i>	85.5 $\pm$ 1.90 <i>a</i>	90.00 $\pm$ 0.57 <i>a</i>
LSD (P=0.05)	6.32	6.42	1.25

or any similar
scenarios

DOT= days to
Means followed by same letter are not significantly different at 5% probability level.

please check your analysis output

please give letters to indicate significance or non-significance.

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

⊗ make sure the means and their standard error have the same decimal place

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 ± 1.47) 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 ± 3.24) while the least mean number of healthy pods was observed on kanannado (1.0 ± 0.71) 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

199

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.

204

205 Table 5 Yield per variety of cowpea tested

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

206 Show the significance letters.

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 phenological 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 BOSHDP 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

g/m^2 ?

tonnes/he.
~~kg/he~~?

Are these means?
 Should be.

Please follow the
 format of presentation
 of previous tables

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

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

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

The study have also shown that, number of healthy pods produced at the end of the cropping season shows that significant difference ($p=0.05$) exist among iron beans, BOSADP 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 *not in ref.*
 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 reveals 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). *remember percentage*

255 Yield obtained from the varieties have shown that, iron beans produced the highest yield *should be same unit as shown*
 256 of 2144g/16m² and the lest was produced from Samira with 728g/16m². This means that, in the *in*
 257 face of pest infestation, variety that produced the highest yield /hectare and hence could be *Table 5*
 258 concluded that, *f* farmers using these varieties *do you mean only iron bean?* 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).

265 *→ a or b?*
 266
 267

268 Conclusion

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

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