Effect of Sowing Date on the Incidence, Apparent Infection Rate and Severity of Scab on Cowpea


INTRODUCTION

Cowpea (Vigna unguiculata L. Walp) is one of the most widely cultivated food legume in the northern savanna states of Nigeria where rainfall is generally scanty and soils are sandy and relatively infertile. It is a cheaper source of protein than the rural and urban poor in most developing countries (Henriet et al., 1997; Ogbuinya, 1997; Fawole et al., 2006). The crop is highly valued for both its grain and forage and therefore often has a dual use (Henriet et al., 1997; Ogbuinya, 1997).

The major constraints to cowpea production in Nigeria are pests and diseases. Scab, caused by the fungus Sphaceloma sp. is one of the most destructive diseases of cowpea in Nigeria and could account for more than 30% of the country’s total cowpea crop production losses (Mungo, 1996). Scab is a seed-borne disease, and affects all the above ground parts of the plant - leaves, petioles, stems, peduncles and pods (Emechebe, 1980; Iceduna, 1993). Lesions on stems often coalesce and cover the entire stem while those on leaves often give rise to shot holes which may be confused with insect damage (Iceduna, 1993). Under severe infection conditions, these coalescing lesions, cause leaf distortion, and in some cases flower bud abortions thereby reducing podding and causing malformation of pods with almost no seed set. Yield losses of up to 80% and even total crop destruction under disease epiphytotic conditions have been reported in Nigeria (Emechebe, 1980; Mungo et al., 1995).

Subsistence farmers in developing countries, including those in Nigeria have very few options for the control of cowpea diseases on their crops. The use of fungicides is very limited because of the associated costs of these chemicals as well as handling issues and safety concerns to the users and to the environment. They therefore rely mainly on cultural practices as an important aspect for their disease control. The practices used include crop rotations, intercropping and crop spacing (Adebian and Ikorun, 1996). Sowing dates have been reported to reduce the effects of diseases such as anthracnose (Colletotrichum lindemuthianum), brown blotch (Colleotrichum capsici), and web blight (Thanatephorus cucumeris) on cowpeas (Yayock et al., 1988). Limited...
The following subjective rating scale, of 1-10, modified from Emechebe (1981), was used to assess disease severity on the leaves, stems, peduncles, flower cushions and pods: 1 = No symptoms; 2 = Few pin point lesions; 4 = Few lesions, 3-5 mm in diameter with well defined borders; 6 = Many lesions, some larger than 5 mm in diameter, with dark brown or white centres; 8 = Large coalescing lesions with shot hole spots and 10 = Severely damaged with marked distortion and stunting.

The rates of scab incidence, apparent infection rate and severity on the three cowpea varieties were recorded for each of the 4 sowing dates during 2004, 2005 and 2006 production seasons.

At crop maturity, pods were harvested from all plants in the three middle ridges of each plot of the three varieties evaluated. The harvested pods were sun-dried over 4 week period to about 14% dry matter. Pod weight was taken for each plot. Combined seed yields from the harvested ridges of each plot were recorded after hand-threshing and winnowing by weighing on a balance, to determine if the different sowing dates affected the plot yields because of the differential scab infections.

All the data collected for scab disease incidence and severity were subjected to an Analysis of Variance (ANOVA) as described by Snedecor and Cochran (1967), using the statistical soft ware, SAS (1998). Mean separations were performed with the Student Newman Keuls (SNK) Test to determine sowing dates effects.

RESULTS

In all three seasons of the study, scab lesions were first observed on plants during the vegetative growth stages for the first plantings and this determined the commencement of the ratings. These lesions generally increased in severity with growth throughout the season as shown by the mean rating values at different dates after sowing.

Disease incidence data recorded in the three-year study showed that at 42 to 49 DAS, scab incidence increased with plant age in all the three cowpea varieties.
There were no increases in the rates of scab per day on the leaves, flower cushions and pods for TVx3236 in all the four sowing dates (Tables 2, 3 and 4). The apparent infection rates of leaf and stem scab on SAMPEA-6 were lower on early sown crops than on the late sown ones, with a significant difference (p<0.05) for the stem ratings (Table 2). Peduncle scab, however, showed the reverse with SAMPEA-6 exhibiting the highest incidence followed by IT93K452-1 and then TVx3236 which had the lowest scab incidence (Table 1). In general, scab incidence during the three years of the study confirmed the reactions of the varieties to the disease in the with early sown crops having a high apparent infection rate than the late sown crops (Table 3). The apparent infection rates on the leaves, stems, peduncles and flower cushions and pod scab of IT93K452-1 was generally higher on early sown crops than on the late sown ones, though not significantly so in some cases (Tables 2, 3 and 4). There was no increase in the rate of stem scab on the third and fourth sowing dates of TVx3236 (Table 2), fourth sowing date on peduncle scab of IT93K452-1 (Table 3) and third and fourth on pod scab of the same variety (Table 3). Generally, the apparent infection rates of scab on the different plant parts of the three cowpea varieties sow in at different dates were higher on early sown crops than on the late sown crops in all the years of evaluation combined.

Table 1: Incidence of scab on three cowpea varieties at different sowing dates in northern Nigeria, combined for the 2004, 2005, and 2006 production seasons

<table>
<thead>
<tr>
<th>Variety</th>
<th>Sowing dates</th>
<th>42 DAS</th>
<th>49 DAS*</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVx3236</td>
<td>July – 26</td>
<td>0.59a</td>
<td>2.09a**</td>
</tr>
<tr>
<td></td>
<td>August – 02</td>
<td>0.06b</td>
<td>1.81a</td>
</tr>
<tr>
<td></td>
<td>August – 09</td>
<td>0.00b</td>
<td>1.09a</td>
</tr>
<tr>
<td></td>
<td>August – 16</td>
<td>0.00b</td>
<td>0.71a</td>
</tr>
<tr>
<td>SAMPEA-6</td>
<td>July – 26</td>
<td>0.95a</td>
<td>11.27a</td>
</tr>
<tr>
<td></td>
<td>August – 02</td>
<td>1.91b</td>
<td>10.5a</td>
</tr>
<tr>
<td></td>
<td>August – 09</td>
<td>0.065b</td>
<td>4.78b</td>
</tr>
<tr>
<td></td>
<td>August – 16</td>
<td>0.13b</td>
<td>3.46b</td>
</tr>
<tr>
<td>IT93K452-1</td>
<td>July – 26</td>
<td>2.31a</td>
<td>6.42a</td>
</tr>
<tr>
<td></td>
<td>August – 02</td>
<td>1.29b</td>
<td>4.95ab</td>
</tr>
<tr>
<td></td>
<td>August – 09</td>
<td>0.25b</td>
<td>2.63bc</td>
</tr>
<tr>
<td></td>
<td>August – 16</td>
<td>0.19b</td>
<td>1.79c</td>
</tr>
</tbody>
</table>

*: DAS = days after sowing  **: Values in the column followed by the same letter are not significantly different at p<0.05 (SNK Test)

following increasing order: SAMPEA-6>IT93K452-1>TVx3236. Sowing dates significantly (p<0.05) influenced the incidence of scab in the field, with the July 26 sowing showing a significantly higher scab incidence than the August 16 sowing which exhibited the lowest incidence for the first rating at 42 DAS. (Table 1). Generally, the effect of sowing date on scab incidence was significantly different (p<0.05) on the three cowpea varieties with the July 26 and August 2 plantings having a higher scab incidence when compared to the August 9 and August 16 sowing dates.

Table 2: Effect of sowing date and apparent infection rate (r) of scab on leaves and stems of three cowpea varieties in northern Nigeria at 56, 63, 70 and 77 days after sowing combined for the 2004, 2005 and 2006 production seasons

<table>
<thead>
<tr>
<th>Plant part</th>
<th>Variety</th>
<th>Sowing date</th>
<th>Proportion of plant parts with disease at:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>56 DAS</td>
</tr>
<tr>
<td>Leaf</td>
<td>TVx3236</td>
<td>July – 26</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td>SAMPEA-6</td>
<td>July – 26</td>
<td>0.10a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.07ab</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.01b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.01b</td>
</tr>
<tr>
<td></td>
<td>IT93K452-1</td>
<td>July – 26</td>
<td>0.06a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.04a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.00a</td>
</tr>
<tr>
<td>Stem</td>
<td>TVx3236</td>
<td>July – 26</td>
<td>0.01a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td>SAMPEA-6</td>
<td>July – 26</td>
<td>0.10a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.06b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.01c</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.00c</td>
</tr>
<tr>
<td></td>
<td>IT93K452-1</td>
<td>July – 26</td>
<td>0.06a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.03ab</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.00a</td>
</tr>
</tbody>
</table>

*: DAS = days after sowing  **: Values in the column followed by the same letter are not significantly different at p<0.05 (SNK Test)
Table 3: Effect of sowing date and apparent infection rate (r) of scab on peduncles and flower cushions in three cowpea varieties in northern Nigeria at 63, 70 and 77 days after sowing combined for the 2004, 2005 and 2006 production seasons

<table>
<thead>
<tr>
<th>Plant part</th>
<th>Variety</th>
<th>Sowing date</th>
<th>63 DAS</th>
<th>70 DAS</th>
<th>77 DAS*</th>
<th>Apparent infection rate (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peduncle</td>
<td>TVx3236</td>
<td>July – 26</td>
<td>0.03a</td>
<td>0.07a</td>
<td>0.16a</td>
<td>0.04a**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.00a</td>
<td>0.01b</td>
<td>0.10ab</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.00a</td>
<td>0.00b</td>
<td>0.03bc</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.00a</td>
<td>0.00b</td>
<td>0.02c</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td>SAMPEA-6</td>
<td>July – 26</td>
<td>0.21a</td>
<td>0.59a</td>
<td>0.69a</td>
<td>0.17a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.11a</td>
<td>0.41a</td>
<td>0.66a</td>
<td>0.21a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.10a</td>
<td>0.37a</td>
<td>0.63a</td>
<td>0.17a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.09a</td>
<td>0.32a</td>
<td>0.53a</td>
<td>0.14a</td>
</tr>
<tr>
<td></td>
<td>IT93K452-1</td>
<td>July – 26</td>
<td>0.16a</td>
<td>0.35a</td>
<td>0.57a</td>
<td>0.18a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.13ab</td>
<td>0.32a</td>
<td>0.49a</td>
<td>0.14a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.04bc</td>
<td>0.24a</td>
<td>0.41a</td>
<td>0.13a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.01c</td>
<td>0.17a</td>
<td>0.29a</td>
<td>0.09a</td>
</tr>
<tr>
<td>Flower cushion</td>
<td>TVx3236</td>
<td>July – 26</td>
<td>0.00a</td>
<td>0.01a</td>
<td>0.03a</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.00a</td>
<td>0.00a</td>
<td>0.01a</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.00a</td>
<td>0.00a</td>
<td>0.00a</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.00a</td>
<td>0.00a</td>
<td>0.00a</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td>SAMPEA-6</td>
<td>July – 26</td>
<td>0.13a</td>
<td>0.13a</td>
<td>0.34a</td>
<td>0.11a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.04a</td>
<td>0.06a</td>
<td>0.18a</td>
<td>0.08a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.06a</td>
<td>0.04a</td>
<td>0.20a</td>
<td>0.08a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.04a</td>
<td>0.04a</td>
<td>0.28a</td>
<td>0.11a</td>
</tr>
<tr>
<td></td>
<td>IT93K452-1</td>
<td>July – 26</td>
<td>0.09a</td>
<td>0.09a</td>
<td>0.18a</td>
<td>0.07a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.04a</td>
<td>0.04a</td>
<td>0.11ab</td>
<td>0.02a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.03a</td>
<td>0.03a</td>
<td>0.09a</td>
<td>0.02a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.01a</td>
<td>0.01a</td>
<td>0.14b</td>
<td>0.00a</td>
</tr>
</tbody>
</table>

*: DAS = days after sowing
**: Values in the column followed by the same letter are not significantly different at p<0.05 (SNK Test)

Table 4: Effect of sowing date and apparent infection rate (r) of scab on pods in three cowpea varieties in northern Nigeria at 77 and 84 days after sowing combined for the 2004, 2005 and 2006 production seasons

<table>
<thead>
<tr>
<th>Plant part</th>
<th>Variety</th>
<th>Sowing date</th>
<th>77 DAS</th>
<th>84 DAS*</th>
<th>Apparent infection rate (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pod</td>
<td>TVx3236</td>
<td>July – 26</td>
<td>0.03a</td>
<td>0.07a</td>
<td>0.00a**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.01a</td>
<td>0.06a</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.00a</td>
<td>0.00b</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.00a</td>
<td>0.00b</td>
<td>0.00a</td>
</tr>
<tr>
<td></td>
<td>SAMPEA-6</td>
<td>July – 26</td>
<td>0.20a</td>
<td>0.41a</td>
<td>0.06a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.13a</td>
<td>0.28a</td>
<td>0.07a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.11a</td>
<td>0.25a</td>
<td>0.05a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.10a</td>
<td>0.25a</td>
<td>0.05a</td>
</tr>
<tr>
<td></td>
<td>IT93K452-1</td>
<td>July – 26</td>
<td>0.13a</td>
<td>0.27a</td>
<td>0.08a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 02</td>
<td>0.11a</td>
<td>0.20ab</td>
<td>0.02ab</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 09</td>
<td>0.07a</td>
<td>0.10ab</td>
<td>0.00b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August – 16</td>
<td>0.03a</td>
<td>0.04b</td>
<td>0.00b</td>
</tr>
</tbody>
</table>

*: DAS = days after sowing
**: Values in the column followed by the same letter are not significantly different at p<0.05 (SNK Test)

Table 5: Severity of scab on the different plant parts of three cowpea varieties in northern Nigeria at different sowing dates combined for the 2004, 2005 and 2006 seasons

<table>
<thead>
<tr>
<th>Variety</th>
<th>Sowing date</th>
<th>Leaf</th>
<th>Stem</th>
<th>Peduncle</th>
<th>Flower cushion</th>
<th>Pod</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVx3236</td>
<td>July-26</td>
<td>1.00a</td>
<td>1.00a</td>
<td>2.22a</td>
<td>1.56a</td>
<td>1.11a</td>
</tr>
<tr>
<td>August-02</td>
<td>1.00a</td>
<td>1.00a</td>
<td>1.96a</td>
<td>2.11b</td>
<td>1.11b</td>
<td>1.78b</td>
</tr>
<tr>
<td>August-09</td>
<td>1.00a</td>
<td>1.00a</td>
<td>1.56a</td>
<td>1.78b</td>
<td>1.00b</td>
<td>1.00a</td>
</tr>
<tr>
<td>August-16</td>
<td>1.00a</td>
<td>1.00a</td>
<td>1.44a</td>
<td>1.44b</td>
<td>1.00b</td>
<td>1.00a</td>
</tr>
<tr>
<td>SAMPEA-6</td>
<td>July-26</td>
<td>1.75a</td>
<td>6.22a</td>
<td>7.33a</td>
<td>6.89a</td>
<td>2.00a</td>
</tr>
<tr>
<td>August-02</td>
<td>6.22a</td>
<td>7.11a</td>
<td>5.56b</td>
<td>6.89a</td>
<td>4.22a</td>
<td>2.44a</td>
</tr>
<tr>
<td>August-09</td>
<td>4.89a</td>
<td>7.11a</td>
<td>4.44b</td>
<td>4.44b</td>
<td>3.89a</td>
<td>2.44a</td>
</tr>
<tr>
<td>August-16</td>
<td>4.33a</td>
<td>6.44a</td>
<td>4.00b</td>
<td>6.22a</td>
<td>5.56b</td>
<td>5.22a</td>
</tr>
<tr>
<td>T93K452-1</td>
<td>July-26</td>
<td>8.49a</td>
<td>3.33a</td>
<td>5.33a</td>
<td>5.56a</td>
<td>5.64a</td>
</tr>
<tr>
<td>August-02</td>
<td>3.78a</td>
<td>4.33a</td>
<td>3.33a</td>
<td>4.56b</td>
<td>4.00a</td>
<td>4.89a</td>
</tr>
<tr>
<td>August-09</td>
<td>2.67a</td>
<td>3.78a</td>
<td>2.78a</td>
<td>3.67b</td>
<td>2.89b</td>
<td>4.22b</td>
</tr>
<tr>
<td>August-16</td>
<td>2.00b</td>
<td>2.67b</td>
<td>1.78b</td>
<td>2.33c</td>
<td>3.56b</td>
<td>1.11a</td>
</tr>
</tbody>
</table>

*: DAS = days after sowing
**: Values in the column followed by the same letter are not significantly different at p<0.05 (SNK Test)
The severity of scab on the different plant parts of the three cowpea varieties was generally higher on early sown than on late sown crops with the fourth sowing date having the lowest severities (Table 5). There was no scab recorded on the leaves of the resistant variety, TVx3236, and scab severity on flower cushions and pods of this variety were not significant in the three years of study (Table 5). Generally, the severity of scab on the three cowpea varieties in the three years of the study, was in the order: SAMPE-6>IT93K452-1>TVx3236.

In 2004, the effect of sowing dates on seed yield of the three varieties was not significantly different from each other. The significant (P≤0.05) differences observed on seed yield of TVx3236 were statistically similar but the August-16 plantings had a higher seed yield compared to the July-26 plantings. A general trend was observed for TVx3236 and IT93K452-1 with early sown crops having a lower pod and seed yields than late sown crops (Table 6).

In 2005, the differences on yield were not also significantly different from each other but a significant (P≤0.05) difference was observed on pod yield of IT93K452-1 with the August-16 having a higher pod yield compared to the other sowing dates (Table 6).

In 2006, cowpea varieties TVx3236 and IT93K452-1 showed the same trend for yield as in 2004 with the August-16 plantings doing better than the other sowing dates (Table 6).

**DISCUSSION**

Higher incidences, apparent infection rates and severities of scab were recorded on the early sown cowpeas than the late sown crops. This is in agreement with earlier reports, which showed an increase in the infection of some diseases as a result of early sowing of the crop (Mungo, 1996; Alabi, 1994). Another report by Gurama et al. (1998), however, gave contrary results to what has been observed in this and other earlier studies; reporting that scab severity was lower on early sown cowpea than on late sown crops. The severity of scab, however, may be attributed to changes in the microclimate of the environment, more specifically rainfall and relative humidity within the plant community, which might have favoured disease development. This confirms previous reports (Emechebe, 1980; Edema et al., 1997), that scab is more severe under wet conditions and consequent high relative humidity because the conidia are supposedly dispersed by rain splash and wind-driven moisture. These requirements probably partly explain the report from Uganda by Edema et al. (1997) that the severity of scab was higher during the second rains. They also confirm that scab is favoured by high plant populations, which are conducive for rain splash dispersal and high relative humidity.

Reaction of the three cowpea varieties to scab varied from moderately resistant to susceptible. The variety SAMPE-6 was susceptible and IT93K452-1 was moderately susceptible to the disease, since both varieties had high scab incidences and severities. The variety TVx3236 was moderately affected by the disease in all the years of study. This confirms that this variety is moderately resistant to scab as there was no increase in the rate of the disease on the leaves, flower cushions and pods. All the varieties exhibited symptoms of the disease in some form. All the above ground parts of susceptible plants were affected, as is typical of scab infection as also reported by Iceduna et al., (1994), Nakawuka and Adipala, 1997. Similar observations have been made in earlier studies on these varieties under Nigerian conditions by Mungo, (1996) and Gurama et al., (1998) and in Ugandan conditions by Iceduna et al., (1994), Nakawuka and Adipala, (1997). The severity of scab on susceptible varieties showed that the disease can be very devastating when susceptible cowpea varieties are planted in the northern Guinea Savannas of Nigeria. This also confirms previous reports and the recommendations to use mainly resistant varieties, when available, in these environments (Iceduna et al., 1994).

The effect of sowing date on the yields of the three cowpea varieties infected with scab indicated that early sown cowpea had a lower yield for TVx3236 and
IT93K452-1 than late sown crops, for all three seasons of the study. The reverse was true for SAMPEA-6. This was in conformity with earlier reports for this variety (Gurama et al., 1998). In general, this study demonstrated that it is better to delay the sowing of moderately cowpea varieties such as TVx 3236 and IT93K452-1 to minimise scab infection which also could affect the pod and seed yields as demonstrated from the higher infections and lower corresponding yields from the early plantings.

ACKNOWLEDGMENT

This study is part of a PhD thesis submitted by the first author to the Department of Crop Protection at Ahmadu Bello University, Zaria, Nigeria. Funding was partly provided by the International Institute of Tropical Agriculture (IITA), Kano, Nigeria; University of Dschang and the Ministry of Higher Education, Cameroon, through a Subvention and Mobility Scheme award. We thank A. Anyanwu for technical assistance and the staff of I.A.R. Samaru for providing all the varieties of cowpea used and analysing the data.

REFERENCES


