INTRODUCTION

Cowpea (Vigna unguiculata (L) Walp) is an important crop in Africa and the major gain legume consumed in West Africa (Martin, 1984); while tomatoes (Lycopersicon esculentum Mill) are the second most important vegetables in many regions of the world, ranking second in importance to potatoes (Cobley and Steel, 1976). In Nigeria, cowpea is extensively cultivated in the savanna belts because of its tolerance to moisture stress while tomatoes are also widely grown in many northern states of Nigeria where irrigation facilities are available. In the southern states of Nigeria, cowpea and tomatoes are grown in small holdings and sometimes intercropped by the local farmers. Heavy rainfall, fungal and bacterial diseases limit the production of cowpea and tomatoes on a large scale in southern parts of Nigeria. Intercropping of these crops by local farmers in the southern states of Nigeria is aimed at ensuring some harvest in the event low yields caused heavy rainfall and diseases.

Intercropping is a popular crop production system in subsistence tropical agriculture (Willey, 1979). Reddy et al. (1993) as cited by Rajkhowa and Baroova (2000) reported that intercropping guaranteed more profit and less risk of crop failures to the farmers and minimized weed infestation; whereas (Yayock et al., 1988) observed better utilization of soil nutrients, space and reduction in the spread of diseases and pests.

Published information is available on the intercropping of cowpea and other crops (Remison, 1980; Karel et al., 1982, Ezumah et al., 1987; Mbowe, 1980; Myaka and Kabissa 1993 and 1996; Myaka, 1995; Rajkhowa and Baroova, 2000) but very little to the best of my knowledge on cowpea and tomato in the ecological zone under study in Nigeria. Odion et al. (1994) and Myaka (1995) reported that crop arrangement exerted great influence on the performance of crops in intercropping systems involving cowpea and millet, cowpea and maize respectively. Remison (1980) observed that planting ratios has no effect on the number of days to 50% flowering in maize; neither did they affect ear height of maize, number of maize plants lodged nor the number and weight of maize cobs per plant, but they significantly affected the number and weight of cowpea pods as well as the final

EFFECTS OF INTERCROPING COWPEA (VIGNA UNGUICULATA (L) WALP) AND TOMATO (LYCOPERSICON ESCULENTUM MILL) ON THEIR GROWTH, YIELD AND MONETARY RETURNS

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ABSTRACT

Cowpea (Ife brown) and Tomato (Esan local) varieties were grown at the following replacement ratios (100/0, 67/33, 50/50, 33/67 and 0/100) in a randomized complete block design to evaluate their growth, yield and monetary returns from their pure and mixed cultures. The different planting ratios significantly (P<0.05) affected plant growth in cowpea but in tomato, growth was similar at all combinations. Growing cowpea and tomato at 33/67 ratio respectively gave a higher yield and consequently, greater monetary returns than all other planting ratios tested. In the mixtures, yields of tomato were consistently greater in plots containing higher and equal proportions of tomato with cowpea, while cowpea yield was highest in its sole crop and also performed well when combined 67% cowpea with 33% tomato, it is more economical to intercrop cowpea and tomato at 33/67 ratio respectively.
yields in cowpea-maize mixtures.

Due to paucity of information on the interactions between cowpea and tomato, this study was undertaken to determine: (1) The appropriate planting ratios that would give high yields of cowpea and tomato; and (2) ascertain monetary returns from cowpea-tomato intercrops in a tropical humid environment using highly adapted cultivars.

MATERIAL AND METHODS

Experimental site: The experiments were conducted at the experimental farm of Department of Botany, Ambrose Ali University, Ekpoma between May and September of 2001 and 2002. The soil characteristics before sowing were: pH 5.2, percentage organic matter 1.63, total nitrogen (N) 0.13%, available P (mg/kg) 7.35 and exchangeable K (mg/100g of soil) 0.18. Ekpoma is situated at latitude 6° 45°N and longitude 7° 35° and exchangeable K (mg/100g of soil) 0.18. Ekpoma is situated at latitude 6° 45°N and longitude 6° 09° in Esan West Local Government Area of Edo State, Nigeria. It has an annual rainfall of 1,556 mm characterized by bimodal peaks occurring in July and September with a short dry spell usually in August. Mean daily temperature throughout the period of field study was 23±2°C.

Nursery bed: A nursery bed measuring 6 m x 4 m was cleared with a cutlass, ploughed and harrowed with a hoe. Seeds of a highly adapted focal variety of tomato (Esan local) obtained from the Agricultural Development Programme (ADP), Irrua, were spread evenly on the soil surface and gently covered with soil on the 11th of May each year. Shade was provided for the first ten days with palm fronds to minimize direct rays of the sun and watered every morning with a watering can until they were transplanted into the field at three weeks after nursery establishment.

Experimental layout: The experimental design was a randomized complete block consisting of five treatments and four replicates. Cowpea (Ife, brown), a bunchy variety obtained from ADP Irrua and Tomato were grown at the following replacement ratios: 100/0, 67/33, 50/50, 33/67 and 0/100 (figures represent percentages) In plots measuring 6 m x 4 m with a space of 1 m between plots to ease cultural operations. Cowpea was sown three seeds per hole at a depth 1.5 cm on the 11th of May each year at a spacing of 30 cm between and within rows; while tomato seedlings were transplanted into the plots at a spacing of 80 cm between cowpea plants.

Each plot of sole cowpea contained 260 stands while plots with only tomato sown had 60 stands. In plots where 67/33 cowpea-tomato mixture were grown, the plant population was 174 cowpea to 20 tomato plants per plot; whereas in 50/50 cowpea-tomato mixture, half the population in their pure cultures were sown, i.e. 130 cowpea to 30 tomato plants. Also in 33/67 cowpea-tomato mixture, the plot had 86 cowpea to 40 tomato plants. Plots received a basal dressing of 50 kg ha⁻¹ of NPK (15:15:15) as a side-banding at three days after transplanting tomato. Lambda cyhalothrin (karagas) was sprayed at the rate of 0.21 a.i. ha⁻¹ at 3 and 8 WAP to control insect pests that defoliate cowpea plants.

Plant height was measured at 3, 6 and 9 WAP, number of pods and seeds per plant were determined at the end of the experiment; number of tomato fruits per plant and days between sowing and 50% bloom were also recorded. Yields of both crops in pure and mixed cultures were estimated in kg ha⁻¹; their monetary equivalents were obtained by using the current market prices of cowpea and tomato in Ekpoma, Nigeria.

Data analysis: Data got from the
various parameters studied did not significantly vary across the years; they were pooled together and means calculated for each character. The mean data were analyzed statistically using analysis of variance (ANOVA) technique. The significance of mean difference was tested by Least Significant Difference test (LSD-test).

RESULTS AND DISCUSSION

General performance: Planting ratios significantly (P≤0.05) affected plant height at 6 and 9 WAP in cowpea but results were similar irrespective of cropping combinations at 3 WAP as shown in Table 1. In tomato, plant height was not significantly influenced by varying planting combinations at 9 WAP when the last plant height was determined; they ranged between 67.20 cm - 69.03 cm, Table 1. In all the studies, cowpea plants were shortest (34.20 cm) in plots containing only cowpea; while in the mixtures, cowpea was also shortest (34.80 cm) in plots with highest proportion of tomato, i.e. 33/67 cowpea-tomato mixtures (Table 1). This observation agreed with an earlier report by Remison (1978) when maize and cowpea were grown at varying ratios and different levels of N and P applications.

The cowpea variety used in this study was short and almost determinate in habit whereas tomato was indeterminate, that was why tomato became taller at 9 WAP. Tomato was not only taller but had wider and longer leaves than cowpea. Thus in the mixture of cowpea and tomato, the utilization of environmental resources especially light interception would higher in favour of tomato.

Planting ratios had significant (P≤0.05) affect on the number of days to 50% flowering in cowpea (Table 1). Fifty per cent bloom was earliest (44) days in 67/33 cowpea-tomato mixture and late (48 days) in sole cowpea; but in tomato, number of days to 50% flowering did not significantly vary at 5% level of significance irrespective of the planting combinations. Varying degrees of shading of cowpea by taller tomato plants especially at latter stages of growth could be responsible for the differences in days to 50% flowering in cowpea.

Cowpea produced more pods (40032) per plant at the highest frequency (67/33) cowpea-tomato mixture while the test pod productions of 28.60 per plant was observed in the sole cowpea, Table 2. In sole cowpea and at 50/50 cowpea-tomato mixture pod yield per plant was similar giving 28.60 and 29.40 respectively. Sole tomato gave the highest fruit yield of 71.33 per plant and fruit product significantly decreased with increase in the proportions of the cowpea sown (Table 2), thus indicating keen competition for nutrients.

Mean seed production per plant in cowpea was significantly influenced (P≤0.05) by varying planting frequencies as evident in Table 2. Sole cowpea produced a mean of 237 seeds per plant while at 50/50 cowpea-tomato mixture, 231 seeds per plant was produced. At 67/33 cowpea-tomato mixture, cowpea produced 28.9% (334.21 seeds) more seeds per plant compared to sole cowpea whereas at 33/67 cowpea-tomato ratio respectively, cowpea produced 277 seeds per plant. This varied significantly from the mean seed production in other combinations at 5% level. The data indicated that the best combination for cowpea-tomato 33/67 respectively based on pooled figures for the component yields in the mixtures (Table 2).

Stand yield and monetary returns: The highest stand yield were in the sole crops of cowpea (2,455 kg ha⁻¹) and tomato (37055.00 kg ha⁻¹). When cowpea and tomato yields were combined, highest yields were obtained in the mixtures containing 33/67 and 50/50 cowpea tomato respectively. The least harvest was recorded from tomato if combined
Table 1. Effects of different replacement ratios on plant height (cm) at 3, 6 and 9 WAP, and days from sowing to 50% flowering averaged for the two-year trials (2001-2002)

<table>
<thead>
<tr>
<th>Planting ratios</th>
<th>Plant height (cm)</th>
<th>Days to 50% flowering</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 WAP</td>
<td>6 WAP</td>
</tr>
<tr>
<td>Cowpea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomato</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sole cowpea</td>
<td>8.40</td>
<td>-</td>
</tr>
<tr>
<td>Asphalt + 67%</td>
<td>8.50</td>
<td>5.03</td>
</tr>
<tr>
<td>50%</td>
<td>8.10</td>
<td>4.00</td>
</tr>
<tr>
<td>67%</td>
<td>8.40</td>
<td>4.70</td>
</tr>
<tr>
<td>LSD</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

* Not significant.

Table 2. Effects of varying planting combinations on number of cowpea pods, tomato fruits, cowpea seeds per plant and monetary returns from the yields of tomato and cowpea averaged for two-year trials-2002

<table>
<thead>
<tr>
<th>Plant combinations</th>
<th>Cowpea pods Yield (kg ha⁻¹)</th>
<th>Cowpea seeds Monetary returns (* N ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tomato</td>
<td>Cowpea Tomato</td>
</tr>
<tr>
<td>Sole cowpea</td>
<td>28.80</td>
<td>237</td>
</tr>
<tr>
<td>Sole tomato</td>
<td>71.33</td>
<td>-</td>
</tr>
<tr>
<td>33% cowpea + 67%</td>
<td>34.91</td>
<td>63.01</td>
</tr>
<tr>
<td>50% cowpea + 50%</td>
<td>29.40</td>
<td>46.52</td>
</tr>
<tr>
<td>67% cowpea + 33%</td>
<td>40.32</td>
<td>37.51</td>
</tr>
<tr>
<td>LSD</td>
<td>3.45</td>
<td>4.37</td>
</tr>
</tbody>
</table>

* One hundred and twenty naira (N120.00) exchanged for US $ 1.

at 67/33 cowpea-tomato mixture (2177.5 kg ha⁻¹ for cowpea and 14,327.00 for tomato) (Table 2).

The total stand yield was mainly determined by the yield of the highest yielding component, which in this case was tomato, hence mixtures containing equal and higher proportions of tomato eventually had the highest yield. Another possible reason for the higher yield of tomato would be its longer vegetative growth (tomato combined to growth even after flowering) compared with Ife brown which showed near cessation of growth after flowering; a situation which probably reduced competitive stress in favour of tomato. Cowpea plants with longer vegetative phase are likely to succeed more in competition (Remison, 1980). Similar yield trends were reported by Rajkhowa and Baroova (2000) in rice-cowpea mixtures and Njorege and Kimemia (1995) where yields of coffee were significantly reduced by intercropping with sweet potato, peas, maize carrot and cabbages, and profuse vegetative growth of sweet potato smothered young coffee seedlings. In this study, cowpea plants were shorter and were effectively shaded by taller tomato plants in plots containing their mixtures thereby the amount of solar radiation reacting cowpea plants. This observation agreed with the reports by Igwilo (1994) in yam-maize mixtures. The monetary returns from cowpea-tomato mixture were controlled by tomato yield and price while cowpea contributed very little to the income of the farmer except at 67/33 cowpea-tomato mixture where cowpea contribution was higher (N32,662.50) compared to tomato estimated at
It was therefore more economical to intercrop cowpea and tomato than growing either of them alone. Replacement ratio at 33/67 cowpea-tomato mixture increased monetary returns by 8% compared to sole tomato and 54.5% more proceeds than sole cowpea. The conclusion was that if the aim was to obtain maximum yield and returns from cowpea and tomato, they should be grown at 33/67 cowpea-tomato mixture. Tomato may be grown alone as the difference in monetary returns from its sole crop did not significantly vary ($P > 0.05$) from the highest returns obtained from the intercrop with cowpea; but cowpea should not be grown alone.

ACKNOWLEDGEMENT

We are very grateful to our technical staff for assisting us to maintain the crops in the fields; and to ADP staff Irrua, for providing us with cowpea and tomato seeds.

REFERENCES


