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Effect of Intercropping Roselle with Maize on the Disease Initiation and Development of Roselle (Hibiscus Sabdariffa L.) Leaf Disease Caused by Coniella Musaiensis Var. Hibisci in Makurdi, Central Nigeria

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Abstract- A field experiment was carried out to investigate the effects of spatial arrangement on incidence of roselle leaf spot disease caused by *Coniella musaiensis* var *hibisci* in a roselle/maize intercrop. Two accesions of roselle (green accession (Acc_1) and red accession (Acc_3)) and three spatial arrangements or patterns (Sole roselle, single of 1:1 roselle/ maize & double of 2:2 Roselle/maize were investigated. The result showed that intercropping in the entire patterns used could not reduce disease severity in the two accessions investigated though high yield was recorded in the single pattern in both the green and red accessions tested.

Keywords- *Intercropping, Pattern, Hibiscus Sabdariffa L., Accession, Coniella Musaiensis var. Hibisci, Disease Initiation, Maize*

I. INTRODUCTION

Roselle (*Hibiscus sabdariffa* L.) is an important vegetable crop in Nigeria. According to Schippers[1], roselle is ranked the third most important vegetable in most Nigerian markets that is coming after tomatoes and okra in that order. It has medicinal [2,3,4,5], nutritional [6,7,8,4,9,10] and economic values[7,11,12]

The cultivation of the crop suffers setbacks due to attack by pests and diseases. Rice *et al*.[13] reported anthracnose caused by *Colletotrichum sp*., fruit rot caused by *Phytophthora parasitica* and leaf blight caused by *Phyllosticta hibisci*, as major diseases of roselle. According to Alegbejo [7], a leaf disease, caused by *Coniella musaiensis* var. *hibisci*, though not noticed in Nigeria for long, remains the most important disease of roselle plant in the country. This has an overwhelming destructive ability on the plant as severe cases usually lead to death of the whole plant [14].

Control measures for fungal diseases have been found useful for the control of this disease. However, such measures are rather expensive for the resource poor farmers and not environment friendly thus the need to search for alternative measure of intercrop.

Intercropping is the practice of producing multiple crops in a given space with several advantages. It has a long history, and is employed in many regions. It is a common form of cropping system around central Nigeria practice by poor resource farmers is the traditional mixed cropping, where they introduce the crops simultaneously with no definite pattern.

Intercropping has been found to be very effective in the control of many plants' pests and diseases [15, 16, 17, 18]. Blade, Mather, Singh & Smith [19] reported that intercropping maize with cowpea significantly reduced pest population in the field. According to Trenbath [20], the presence of associated plants in the intercrop can lead to attack escape in three ways, all involving lower population growth rate of the attacking organism. In one, the associates cause plants of the attacked component to be less good hosts; in the second, they interfere directly with activities of the attacker; and in the third, they change the environment in the intercrop so that natural enemies of the attacker are favoured. Similar approaches may control the leaf disease of roselle

The objective of this research is to determine the effect of intercropping roselle with maize and appropriate planting density to be adopted so as to reduce the incidence and severity of leaf spot disease of roselle.

II. MATERIALS AND METHODS

A. Experimental location

All field experiments were carried out in the Teaching and Research Farm of the University of Agriculture, Makurdi ($7^{o}44'0''$N; $8^{o}32'0''$ E) in Benue State, Central Nigeria.

B. Field preparation and planting

The field was cleared manually and ridged. The ridges were 1m apart and plots were separated by a distance of 1m. The

experiment fitted in an area of 180.0m^2 (2.4x25 m) with the three patterns; sole (s_1) (that is Roselle plants only), single (s_2) (that is one line of the component crop (maize) alternating with a line of Roselle) and double (s_3) (that is two Roselle rows separated by two rows of component crop), covering 2.4 m x 3 m, 2.4 m x 3 m and 2.4 m x 5 m respectively.

The green (Acc_1) and red (Acc_3)(see appendix 1) Roselle were planted on ridges at an intra-row spacing of 60 cm in July of the 2003 cropping season and in June of the 2004 cropping season. Maize also was planted at the same intra-row spacing of 60cm. The plants, for Roselle, were thinned to one plant per stand after four weeks of growth while maize was two plants per stand. All the crops were introduced simultaneously.

This was replicated three times in a randomized complete block design.

The plots were maintained clean of weeds by manual removal of the weeds using hoe and hands.

C. Data collection.

Five parameters were used. The parameters were;

a) Disease severity at 50% flowering

b) Number of branches at harvest

c) Number of fruits at harvest

d) Plant height (cm) at harvest

e) Calyx yield g/plot.

1) Disease severity

Disease severity was taken after 50% of the plants had flowered using 1-5 rating scale adapted from Mohanan; Kaveriappa and Nambiar [21]. This depended on the percentage of the infected leaves. This was done by unaided eyes as described in Table 1.

TABLE I. TABLE OF DISEASE DESCRIPTIVE SCALE

Disease Score	% of leaves with symptoms	Remarks
1	0	No infection
2	1-20	Slight infection
3	21-50	Moderate infection
4	51-70	Severe infection
5	71-100	Very severe infection

The experimental plots had 20 plants each of green and red and 6 plants each were selected from the two middle lines and visually rated as stated above for infection.

2) Number of branches at harvest

The branches of the 6 selected plants were counted and recorded separately at harvest period.

3) Number of fruits per plant at harvest

The number of fruits found on each of the selected plants were counted and recorded at harvest.

4) Plant height at harvest

The height of each of the plants was measured in centimeters and recorded.

5) Calyx yield g/ha

Calyces from the fruits in 2.3.3 were removed using sharp knives, dried to stable weights and weighed. The weights were recorded as dry weight of calyces. The size of the plot from where the selected plants were drawn was 1.2 m^2. This was used in converting the data to grams per hectare.

6) Analysis of variance

The analysis of variance was performed for the five traits studied. All statistical analyses were performed using GenStat 5 version 3.2, 1995 (laws Agricultural trust: Rothamsted Experimental Station, UK).

III. RESULT

A. Effect of Maize Intercrop on Disease Severity and some Agronomic Characters of two Roselle Accessions (Acc_1 & Acc_3) in two Cropping Seasons

1) Effect of maize intercrop on disease severity and some agronomic characters of two roselle accessions (Acc_1 & Acc_3) in 2003 cropping season

Result presented in Table 2 shows that there was significant difference in plant height, number of fruits produced and calyx yield among the various cropping patterns tried. Significantly taller plants were produced when roselle was intercropped with maize than when they were solely planted. There was no significant difference however, between roselle plants which were planted in alternate single rows and in double rows with their component maize plants. More fruits were produced under intercrop than sole cropping although there was equally no significant difference between those in single and double patterns (Table 2). There was significantly greatest calyx yield obtained from roselle planted in single alternate rows compared to other cropping patterns. The result also showed that disease severity was not significantly different between the cropping patterns.

TABLE II. EFFECT OF MAIZE INTERCROP ON DISEASE SEVERITY AND OTHER AGRONOMIC CHARACTERS OF TWO ROSELLE ACCESSIONS (ACC_1 & ACC_3) IN 2003 CROPPING SEASON

	Disease severity	Plant height(cm)	No. of branches	No. of fruits	Calyx yield(g/plot)
Pattern					
Sole	3.28	74.00	20.80	68.00	20.50
Single	4.25	95.70	25.00	142.80	45.90
Double	4.83	89.60	31.80	128.70	34.90
Accession					
1	4.85	81.70	27.00	112.00	30.90
3	3.39	91.20	24.70	114.20	36.70
LSD(p=0.05)Treat.	2.49^{ns}	16.35*	13.74^{ns}	26.64*	11.22*
LSD(p=0.05)-Acc.	2.03^{ns}	13.35^{ns}	11.21^{ns}	21.75^{ns}	9.16^{ns}

LSD = least significant difference. ns = indicates not significant at 5%. * = Significant at 5%.

All the parameters tested were different in the two accessions but not at significant level at 5% level of significance. This result showed high disease severity in single quite alright, but still single came as the best treatment giving a higher value of calyx yield. There was significant difference between the interaction between pattern and accession as shown in Tables 3 for plant height. Single pattern had greater value for plant height in the green accession (Acc_1) than the red accession (Acc_3). While double had it more in the red accession (Acc_3) than the green accession (Acc_1). This result showed that the red accession (Acc_3) is favoured by double cropping pattern while the green accession (Acc_1) is favoured by single cropping pattern.

2) Effect of maize intercrop and accession on plant height of two roselle accessions, (Acc_1 & Acc_3) during the 2004 cropping season

In 2004 cropping season, the result (Table 4) showed that treatment had no significantly different effect on all the characters scored. Better yield was however obtained from plants in single rows than in sole and double rows cropping while the less infected plants were those shown in sole. Significant difference was observed in the two accessions in respect of disease severity, plant height, number of fruits and calyx yield. Significantly greater disease severity was noticed in accession three the red (Acc_3) than accession one the green (Acc_1). Height of plants was significantly more in Acc_1 than in Acc_3. Similarly Acc_1 had significantly more fruits and yield than Acc_3. Based on the result for the year single treatment was best for the two roselle accessions in similarity to the result of 2003. There was no interaction that was significant at 5 % level of significance.

IV. DISCUSSION

Intercropping two or more plant species together can also result in disease suppression. This has been achieved in some diseases as reported by some researchers [22, 20, 23, 24, 18]. In some other cases where such diseases are vectored by insects, control of such insects through intercrop greatly reduced the incidence of the diseases [25, 26, 27]. In the case of the intercrop, single pattern was favoured in both the two accessions as far as yield was concerned. None of the patterns appeared to have any positive influence on the disease severity as the severity was more in the double and followed by the single pattern. This means that the micro environment created by the intercrop could not help in checking the incidence and spread of the disease. It is possible that the mixture was not a good one.

TABLE III. EFFECT OF MAIZE INTERCROP AND ACCESSION ON PLANT HEIGHT OF TWO ROSELLE ACCESSIONS (Acc_1 & Acc_3) DURING THE 2003 CROPPING SEASON

	Accession		
	1	3	Pattern mean
Pattern			
Sole	68.40	79.70	74.10
Single	103.30	88.10	95.70
Double	73.30	105.90	89.60
Acc. Mean	81.60	91.20	86.50
LSD (p=0.05) – Pattern 16.35			
LSD (p=0.05) – Accession 13.35			
LSD(p=0.05)-Pattern x Accession 23.18			

LSD = least significant difference.

TABLE IV. EFFECT OF MAIZE INTERCROP ON DISEASE SEVERITY AND SOME AGRONOMIC CHARACTERS OF TWO ROSELLE ACCESSIONS (Acc_1 & Acc_3) IN 2004 CROPPING SEASON

	Disease severity	Plant height(cm)	No. of branches	No. of fruits	Calyx yield(g/plot)
Pattern					
Sole	3.00	39.00	10.55	49.00	17.40
Single	3.22	29.50	11.27	72.10	21.30
Double	3.97	36.00	11.14	51.40	17.00
Accession					
1	2.85	43.80	11.28	92.80	24.90
3	3.94	25.90	10.70	22.20	12.20
LSD(p=0.05)Treat.	0.99^{ns}	18.74^{ns}	5.13^{ns}	34.85^{ns}	9.16^{ns}
LSD(p=0.05)- Acc.	0.81*	15.30*	4.19^{ns}	28.46*	7.48*

LSD = least significant difference. ns = indicates not significant at 5%. * = Significant at 5%

V. CONCLUSION

Though intercropping roselle with maize in the patterns studied had no positive effect on disease severity, single row alternating pattern however, gave better effect than the sole and double patterns on growth and calyx yield for roselle.

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APPENDIX

Figure 1. Green accession (Acc_{1}): Green calyces with green finger like leaves

Figure 2. Red accession (Acc_{3}): Red calyces with free epicalyces green simple ovate leaves