Journal of Geoscience and Environment Protection, 2017, 5, 94-101
http://www.scirp.org/journal/gep
ISSN Online: 2327-4344
ISSN Print: 2327-4336

Effect of Different Sowing Dates on Disease Initiation and Development of Roselle (*Hibiscus sabdariffa* L.) Leaf Spot Disease Caused by *Coniella musaiensis* Var. *hibisci* in Makurdi, Central Nigeria

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How to cite this paper: Apeyuan, K.D., Nwankiti, A.O., Oluma, O.A.H. and Ekefan, E.J. (2017) Effect of Different Sowing Dates on Disease Initiation and Development of Roselle (*Hibiscus sabdariffa* L.) Leaf Spot Disease Caused by *Coniella musaiensis* Var. *hibisci* in Makurdi, Central Nigeria. *Journal of Geoscience and Environment Protection*, **5**, 94-101.
https://doi.org/10.4236/gep.2017.511007

Received: April 7, 2017
Accepted: November 6, 2017
Published: November 9, 2017

Abstract

The experiment was conducted mainly to investigate the effect of change in sowing dates on disease severity of Roselle (*Hibiscus sabdariffa L*) leaf spot caused by *Coniella musaiensis* Var *hibisci*, plant height, number of branches, number of fruits and calyx yield of Roselle (*H. sabdariffa L*). Five dates were selected with an interval of fourteen days (14) between the dates for two years (2003 and 2004) to determine the most appropriate time to sow the crop using two Roselle accessions; green (Acc_1) and red (Acc_3). The first date was determined by the establishment of the rains in the season. It was observed that change in sowing dates had significant ($p = 0.05$) effect on disease severity but not on plant height, number of branches, number of fruits and calyx yield. Plants sown on July 18/27 had lowest disease indices; and are thus the best and therefore recommended for cropping of Roselle.

Keywords

Accession, Sowing Date, Disease Severity, *Hibiscus sabdariffa* L., Yield. *Coniella musaiensis* Var *hibisci*

1. Introduction

Roselle (*Hibiscus sabdariffa* L.) locally called "ashwe" is an important vegetable crop in Nigeria. The plant is known by some common names such as red sorrel,

Jamaican sorrel, Bonga, Isapa, Aukan, Zobo, Sour-sour [1] [2] [3].

Most varieties are used as ornamental plants, but the swollen red calyces of the sabdariffa type are dried and used in the production of a drink called zoboin Nigeria [4]. It is also brewed into teas, and used in the processing of juices, jellies, jams, ice cream and flavors [3] [5]. The young shoot, leaves and calyces of the green type are eaten as vegetable in some Nigerian homes. According to Morton [1], the edibility of this type was recorded in Java as far back as 1687. The seeds are known to contain 3.29% protein and 17% edible oil that is similar in properties to cottonseed oil [3]. Extracts from the leaves are a good inhibitor of mild steel corrosion competing favorably with standard inhibitors [6]. According to Schippers [7], roselle is ranked the third most important vegetable in most Nigerian markets that is coming after tomatoes and okra in that order. According to Dalziel [8], roselle is used for bronchial remedy and also as an antiseptic. The extracts have been used in Senegal for lowering blood pressure [1]. According to Sharoff [9], the calyx extract has an antibiotic effect. It has been demonstrated that roselle extract decreases the rate of absorption of alcohol and is a favorite remedy for the effect of drunkenness [1]. It is also useful in bilious conditions, heart and nervous diseases [10]. It has been implicated in the treatment of many other ailments [11].

It is cultivated in tropical and sub-tropical regions with the major areas of production in Africa include Sudan, Senegal, Mali, and Egypt. On the whole, major producing countries are Mexico and Jamaica [12] [13]. Nigeria is not listed among producing nations coming from the fact that it is regarded as a minor crop, however, meaningful and substantial production has been reported in the country mainly in the Guinea and Sudan savanna zones with major growing areas being Niger, Kogi, Oyo, Kaduna, Bauchi and Kwara States [4]. Roselle is a short day plant and cannot be grown successively throughout the year [3]. Depending on the variety maturity takes about 12 - 16 weeks from time of planting where cases of pests and diseases are rare [3]. Planting of Roselle around makurdi, Central Nigeria is usually done at the onset of rains with no regards to pests and disease situation. However, several diseases affecting the plant have been identified and shown to limit the production of roselle worldwide. Apart from having the same disease situation as kenaf [14], it serves as an alternative host for most diseases of kenaf [15]. According to Alegbejo [4], this leaf disease, caused by *Coniella musaiensis* var*. hibisci*, remains the most important disease of roselle plant in the country. It has an overwhelming destructive ability on the plant as severe cases usually lead to death of the whole plant [15]. It was also observed that incidence and severity of the leaf spot disease varied from farm to farm. There is no available documentation of the control measures of the disease which includes adjustment in planting time. However there are reports where some plants diseases have been avoided to a large extent by adjusting sowing time. With this in view, five different sowing dates were scheduled for the study in order to determine the most appropriate date for planting Roselle in order to escape or limit the attack by *Coniella musaiensis* var *hibisci*.

2. Materials and Methods

2.1. Experimental Location

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

2.2. Field Preparation and Planting

The experimental area measured 140.6 m^2 (7.4 m × 19 m). The field was cleared and ridges molded manually. Each treatment was done on a plot of 1.8 m × 3 m with four (4) rows. Plots and blocks were separated by 1 m distance.

Seeds of green (Acc_1) and red (Acc_3) Roselle accessions were planted on ridges at a spacing of 60 cm. Five (5) different planting dates were involved at an interval of two weeks between the dates. In the 2003 cropping season, the first planting date was 20th June 2003 and the last planting date was 15th August 2003. While in the 2004 cropping season, the first planting date was 1st June 2004 and the last date was 27th July 2004. The dates for commencement were determined by the establishment of the rains in the respective years.

The dates served as treatments and were replicated three (3) times in a Randomized Complete Block Design (RCBD).

2.3. Data Collection

Five parameters were used. The parameters were:

1) Disease severity at 50% flowering
2) Number of branches at harvest
3) Number of fruits at harvest
4) Plant height (cm) at harvest
5) Calyx yield g/plot.

2.3.1. Disease Severity

Disease severity was taken after 50% of the plants had flowered using 1 - 5 rating scale adapted from Mohanan; Kaveriappa and Nambiar [16]. This depended on the percentage of the infected leaves. This was done by unaided eyes as described in Table 1.

Table 1. 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.

2.3.2. Number of Branches at Harvest

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

2.3.3. Number of Fruits per Plant at Harvest

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

2.3.4. Plant Height at Harvest

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

2.3.5. 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.

2.3.6. 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).

3. Result

3.1. Effect of Date of Planting on Disease Severity and Some Agronomic Characters of Two Roselle Accessions in Two Cropping Seasons

3.1.1. Effect of Date of Planting on Disease Severity and Some Agronomic Characters of Two Roselle Accessions during the 2003 Cropping Season

Result obtained in 2003 as presented in Table 2 showed that June/July sown plants had significantly ($p = 0.05$) greater disease severity scores more than the August sown plants.

Though July plants had higher severity scores than June, the difference was not significant at 5% level. There were differences in plant height, number of branches, number of fruits and calyx yield among the different planting dates but the differences were not significant. This result however presented July 18 as the best planting date for roselle since the highest calyx yield was recorded in that date as shown in Table 2.

Also, significant difference between accessions was observed in plant height and number of branches with Acc_3 being significantly taller with more branches than Acc_1 as indicated in Table 2. There was however no such difference for disease severity, number of fruits and calyx yield between the accessions tested.

Table 2. Effect of date of planting and accession on disease severity and some agronomic characters on roselle in Makurdi, Nigeria during the 2003 cropping season.

	Disease severity	Plant height (cm)	Number of branches	Number of fruits	Calyx yield (g/plot)
Sowing date					
June 20	3.14	84.10	29.50	103.80	33.10
July 4	3.19	77.20	26.70	96.60	33.90
July 18	2.72	80.20	23.83	96.00	35.00
August 1	1.09	73.90	24.23	71.80	34.30
August 15	1.31	73.20	23.93	67.50	33.80
		Accession			
1	2.56	68.00	23.37	87.50	32.40
3	2.02	87.40	27.91	86.80	35.60
LSD ($p = 0.05$) Date	1.37*	17.81^{ns}	4.06^{ns}	37.47^{ns}	7.07^{ns}
LSD ($p = 0.05$) Accession	0.87^{ns}	11.26*	2.57*	23.70^{ns}	4.47^{ns}

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

Analysis of variance showed that there was no significant interaction among the two factors.

3.1.2. Effect of Date of Planting on Disease Severity and Some Agronomic Characters of Two Roselle Accessions during the 2004 Cropping Season

In the 2004 result, roselle plants sown on the 15 of June had significantly ($p = 0.05$) greater disease severity scores than the rest of the plants sown in other dates except those plants sown on the 1st of June (Table 3). Superiority in terms of fruits produced was also observed in this date but not at significant level. Similarly roselle plants sown on the 1st of June were taller than the plants in the rest of the date but only at significant level to the plants in June 29, July 13 and 27. Roselle plants sown in July received the highest value in respect of calyx yield and as such the best planting date of the year under consideration. All the characters considered showed significant ($p = 0.05$) difference in the two accessions used. Disease severity was greater in red (Acc_3) accession than in green (Acc_1) accession while plant height, number of branches, number of fruits and calyx yield were significantly ($p = 0.05$) greater in green (Acc_1) accession than in red (Acc_3) accession.

3.1.3. Effect of Interaction between Date of Planting and Accession

Analysis of variance of the result showed significant ($p = 0.05$) interaction between sowing date and accession in regards to plant height (Table 4). The rest of the interactions were not significant. In accession green (Acc_1) June 1 sown plants received the highest scores which were significantly different from the other planting dates. The last date had the least score which was expected because

Table 3. Effect of date of planting and accession on disease severity and some agronomic characters on roselle in Makurdi, Nigeria during the 2004 cropping season.

	Disease severity	Plant height (cm)	Number of branches	Number of fruits	Calyx yield (g/plot)
Sowing date					
June 1	3.40	82.70	20.48	70.10	24.40
June 15	3.84	71.00	18.78	74.00	24.40
June 29	2.60	69.60	14.78	61.40	23.60
July 13	1.94	66.50	10.62	53.40	19.60
July 27	1.97	48.50	9.95	66.80	27.90
		Accession			
1	2.31	73.50	23.20	112.50	36.90
3	3.20	61.90	6.64	17.80	11.00
LSD ($p = 0.05$) Date	0.89*	11.83*	5.16*	34.90^{ns}	10.76^{ns}
LSD ($p = 0.05$) Accession	0.56*	7.48*	3.27*	22.07*	6.80*

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

Table 4. Effect of Interaction between date of planting and accession on plant height of two roselle accessions during the 2004 cropping season.

	Accession		
	1	3	Sowing date mean
	Sowing date		
June 1	94.70	70.70	82.70
June15	59.30	82.70	71.00
June 29	76.20	62.90	69.60
July13	90.30	42.80	66.50
July27	46.70	50.30	48.50
Acc. mean	73.50	61.90	67.70
LSD ($p = 0.05$)	Sowing date		11.83
LSD ($p = 0.05$)	Accession		7.48
LSD ($p = 0.05$)	Sowing date x Accession		16.73

LSD = least significant difference.

the plants had little time for growth before flowering. In accession red (Acc_3) June 15 date showed greater scores. The least was the June 13 sown date which was the second to the last planting date. The result shows that with respect to plant height, accession (Acc_1) performed better by June 1 date and accession (Acc_3) by June 15 date and these dates can be recommended to farmers.

4. Discussion

In the experiment to arrive at a suitable planting date for roselle, significant effect

of the alteration in planting dates was noticed for some of the traits including disease severity. Strategic alteration in planting dates is known to be effective in the control of some plant diseases. This has been used in many areas as a tool in controlling many plant diseases [17] [18] [19] [20].

Analysis of the result showed that planting dates had significant effect on plant height, number of branches and calyx yield. This is very usual for all growth related parameters. Disease severity was significant ($p = 0.05$) higher in early grown roselle than in the late grown ones. This was expected since the disease is that of the leaves and there were more leaves in the early grown plants than in the late ones. Here the plants benefit from better moisture conditions, resulting in a better vegetative and reproductive development thereby giving way to more infection courts.

There is indication that severity in this disease has little effect on performance of other agronomic characters particularly when the plant survives the attack. The result however point to the fact that delayed planting of this crop would be ideal and as such Mid-July date becomes ideal for planting of roselle.

5. Conclusion

Result from the trial on different sowing dates showed that delayed planting can help the plants to avoid the disease though with negative effect on other growth parameters but still with appreciable calyx yield. Drawing from the results of this study, it is clear that since the disease is that of the leaf, the more the leaves the more the level of infection from the pathogen. This is why early grown plants were more susceptible to the fungus because they had more leaves and had longer growth periods than the late-sown ones which were less susceptible. Since roselle is photosensitive, at whatever date the crop is planted, it will flower in August and be due for harvest in December. Hence, roselle should be cultivated mid-July to avoid the risk of heavy attack during heavy rains.

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