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Incidence And Prevalence of Ratoon Stunting Disease (Leifsonia Xyli Subsp. Xyli, Evtushenko) In The Mumias Sugar Cane Growing Zone Kenya

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Abstract: *Surveys of ratoon stunting disease (RSD) incidence in sugar cane crop (Sacharrum officinurum L) in Mumias were conducted between 2012-2016. Majority of farms constituted seed cane and commercial fields were randomly selected for survey purposes. Samples from 967 farms in four main growing zones including the miller-owned nucleus estate were collected and diagnosed. Multi-stage random sampling method was used to select 967 households, while purposive sampling was used to select commercial fields. The collected data was analyzed using descriptive statistics. Incidence of RSD in the mill supply areas stood at 37%. Disease prevalence was high in N 14 (50%) followed by KEN 83-737 (47%), CO 617 (42%), EAK 73335 (38%), CO 945 and CO 421 each at (37%) and other varieties (27%). There was a positive significant impact on disease occurrence on ratoon crops (p < 0.05). Variety, zone and crop cycle were all significant in influencing the prevalence of RSD. The incidence of RSD was serious in Mumias sugar zone and could be contributing to the low sugarcane yields. Rigorous field hygiene measures such as sterilization of cane knives at harvesting, eradication of volunteer cane and consistent production of healthy seed cane through hot water treatment should be emphasized.*

Keywords*: Crop, Hot water treatment Disease, Variety, Zone, ,*

I. Introduction

Ratoon stunt, also known as ratoon stunting disease (RSD) caused by *Leifsonia xyli subsp. xyli* [1] formerly named *Clavibacter xyli subsp.xyli* [2] is considered by many plant pathologists as the most important disease affecting sugarcane production worldwide [3]. To date, the disease has been reported from Australia, USA, India, Brazil, Florida, China, Fiji, Philippines and Africa [4];;[5];[6];[7];[8];[9];[10];[11].

Surveys done from 1993-1998 in Southern, Central and Eastern Africa have shown that RSD is common in most sugar industries [12]. In S. Africa in 1998, approximately 12% of commercial cane fields contained some level of RSD infection. Estimates of the number of infected fields in the other sugar industries were: Swaziland 30%, Zambia 50%, Kenya Uganda, Malawi and Zimbabwe 60-90%. Tanzania and Mafambisse estate in Mozambique 100% [13]. Field experiments have shown that RSD can cause reductions in yield of 15-30% under good irrigated conditions, and 20-40% under average rain fed growing conditions in varieties that are widely grown in Africa [13]

In Kenya, surveys done in 1993 confirmed the incidence of RSD in Mumias area 14% and South Nyanza 56% [14]. At the time, the sugar industry was predominantly based on Indian bred varieties CO 421 and CO 945. The recent introduction of varieties from S. Africa, Guyana, East African Community and the locally bred Kenyan varieties created the need to survey and test for RSD infection. It is worth noting that the Mumias sugar zone potentially accounts for 50-60% of national sugar production [14].

II. Materials and methods

Surveys of ratoon stunting disease (RSD) incidence in Mumias, Kenya were conducted between 2012-2016. Majority of farms constituted seed cane sources intended for planting. Additionally, commercial fields were randomly selected for survey purposes. Samples from 967 farms distributed in four main growing zones including the miller-owned nucleus estate were collected and diagnosed. An evaluation research design was adopted in this study. Multi-stage random sampling method was used to select 967 households, while purposive sampling was used to select commercial fields. The collected data was analyzed using descriptive statistics. The survey of RSD in Mumias sugar zone was based on the examination, by phase contrast microscopy (PCM), of xylem sap extracted from sugarcane stalks collected in the field [14]. Samples of twenty stalks were collected from mature fields 9-13 months old to increase the likelihood of detecting the disease. Knives were not used in the field when collecting stalks as they could be important source of RSD. Since the number of cane stalks collected from each field was small it was important to select the thin and stunted stalks to improve the chances of detecting the disease. Samples were not collected from the edges of fields. Large fields on the miller owned nucleus estate were divided into 5 ha blocks and a 20-stalk sample collected from the field. The stalks were bundled up together and labeled with all the field information.

1.1. Selection and cutting of internodes required for diagnosis

As soon as possible after collection from the field, the lowest undamaged internodes were cut from each stalk. The ends were cut as straight as possible to facilitate sap extraction. A special (sturdy) chopping knife and polystyrene board were used when cutting the stalks. The knife was washed with a clean sponge and soapy water and wiped with a dish cloth to remove any bacteria that might be present on the blade. The chopping board was also washed after each sample.

1.2. Extraction of sap and microscope slide preparation

The sap was extracted from the xylem vessels of the stalk piece using a compressed air equipment Airstream LT 24, 1.5 HP. The sap was then collected using a disposable pipette and a small drop placed on a microscope slide at opposite ends. A cover slip was placed on each drop of sap followed by a small drop of immersion oil before viewing under the phase contrast microscope at 1000 × magnification. One pipette was used for each 20-stalk sample. Pipettes were not re-used. The extraction was washed after each sample.

III. Results and Discussion

1.3. Results

Considering the data collected from 967 farms in the mill command area, overall disease incidence stood at 37%. The distribution of farms by sugarcane growing zone, crop cycle and variety is shown in Table 1.

Table 1: Distribution of farms by zone, crop cycle and variety

Zone			Variety							Total
			CO421	CO617	CO945	EAK73335	KEN-83737	N14	Others	
Busia	Crop cycle	PC	9	3	30	6			7	55
		RC	10	5	38	11			2	66
	Total		19	8	68	17			9	121
Eastern	Crop cycle	PC	11	14	161	13	5	4	7	215
		RC	12	16	43	35	3	2	9	120
	Total		23	30	204	48	8	6	16	335
N/Estate	Crop cycle	PC	7	6	67	10	3			93
		RC	1	4	27	14	1			47
	Total		8	10	94	24	4			140
Western	Crop cycle	PC	17	6	130	47	1	4	4	209
		RC	11	6	103	39	2	0	1	162
	Total		28	12	233	86	3	4	5	371
Overall	Crop cycle	PC	44	29	388	76	9	8	18	572
		RC	34	31	211	99	6	2	12	395
	Total		78	60	599	175	15	10	30	967

The disease prevalence was high in variety N14 (50%) followed by KEN 83 737 (47%), CO617 (42%), EAK 73-335 (38%), CO 421 (37%), CO 945 (37%) and other varieties 27% (Fig 1). Other varieties were represented by D 8484, KEN 82-401, KEN 82-472, KEN 82-601, KEN 98-530 and KEN 00-13. Disease prevalence was defined as the proportion of infected sample against the total sample population. To analyze the chance of disease occurrence, a Fischer regression model was considered. A response variable was defined as disease status which was denoted by 0 if no disease was detected (% occurrence = 0) or 1 if disease was detected (when % occurrence > 0). The categorical variables were variety, zone and crop cycle. The model revealed that there was a positive significant impact on disease occurrence in the ratoon crops ($p<0.05$).

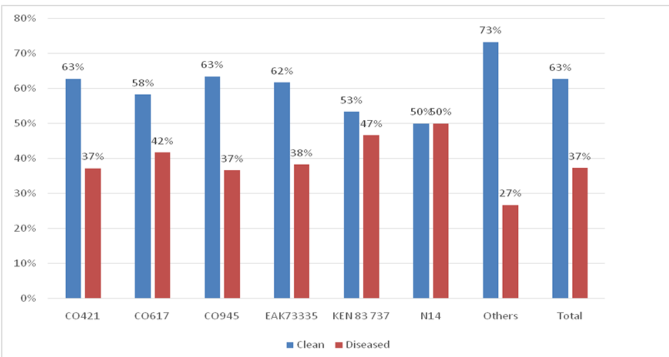

Figure 1: Disease status by variety

3.2 Discussion

The results obtained in this study corroborated earlier findings on the occurrence of RSD in the Kenyan sugar industry. While the high incidence on RSD on variety N 14 at Mumias may have been as a result of a smaller sample, reports from S. Africa indicate that varieties NI7 and N14 are quite intolerant to RSD infection [15]. Initial attempts to multiply variety N14 in the Mumias sugar zone have not been successful due to RSD infection. In India, Rao [15] reported clear symptoms of RSD on varieties Co 281, Co 312, Co 356, Co 421, Co 449, Co 617, Co 740, Co849, Co 975, Co 997, Co 1148, Co 1158, Co 1287, Co1305, Q 28 and CP52-68. Between 1993 and 1994,[17] carried out RSD survey in Mumias and South Nyanza mill areas in Kenya. The incidence of the disease was found to be high in Mumias 56% across varieties, and extremely high in South Nyanza [15]. The most affected varieties were Co 945 and NCo 376 with average RSD incidences of more than 50% in R1, R2 and R3 in Mumias, and Co 421, Co 1148, EAK 70-97 and Co 945 in South Nyanza nucleus estate with average RSD incidences of more 70% in ratoon crops. [17] observed that RSD flares up under drought conditions and the impact of the disease is more in the ratoon crop as compared to the plant crop. Samples of sugarcane varieties send to S. Africa in 2005 and 2006 revealed the occurrence of the disease in Homalime (Co 421) Kibos (Co 421, Co 617, N14, KEN 83-737, KEN 82-808) and Sugar Research Station, Kibos (KEN 83-737, D8484, KEN 82-472).

The sugar industry in Kenya is largely based on Coimbatore-India, Natal-S. Africa and Mtwapa - bred Kenyan varieties. Growing of sugarcane on the same land over the years with no well defined breaks, rotations or fallow periods between the previous crop and re-plant is a common practice [18]. Numerous volunteer plants survive from old crops into new plantings. These are the same conditions prevailing in the Mumias sugar zone and could be exacerbating the spread of the disease.

IV. Conclusion

Ratoon stunting disease appears to be a persistent and serious problem in the Mumias sugar zone and could be contributing to the low yields on the miller owned and out growers farms. Rigorous field hygiene measures such as sterilization of cane knives at harvesting with 10% Lysol solution, eradication of volunteer cane should be enhanced. Consistent production of healthy seed cane through hot water treatment (HWT) should be scaled up. Trials should be initiated to determine the effect of RSD on yields of current commercial and promising varieties. Identification of tolerant materials should be done.

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