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Characterization of Selected Maize Varieties for All-Year-Round Sweet Corn Production in Malawi

Blessford Chisata Mubanga[1*] Kabwe Harnadih Mubanga [2] Tobias Alubi [3]
1.School of Management, Northern Canada University, PO box 1178, Toronto M3A 2K7, Canada Department of Horticulture, Jomo Kenyatta University of Agriculture and Technology, PO box 62000, Nairobi, Kenya
2.Department of Geography and Environmental Studies, University of Zambia, PO box 32379, Lusaka, Zambia
3.Department of Horticulture, Jomo Kenyatta University of Agriculture and Technology, PO box 62000, Nairobi, Kenya

Abstract
In Malawi, production and consumption of sweet corn have been on the increase. An estimated 11-16% of the country's annual maize production is consumed as sweet corn. In this study, we evaluated characteristics of eight maize varieties suitable for all year round sweet corn production based on sweetness, disease susceptibility, and yield. The attributes assessed included; days to horticultural maturity, total yield, sugar content and susceptibility to maize stalk borers, maize streak virus and grey leaf spot. Six of the maize varieties assessed were early to medium maturing hybrid varieties (DKC 8033, DKC 8053, MH 18, SEEDCO 403, PAN 53 and PAN 4M-19) with a local variety (Bantam) as a negative control and STAR 7714 as a positive control. The results showed that DKC 8053 and PAN 4M-19 were both high yielding varieties with a mean yield of 14.93 tha^{-1} while STAR 7714 was the lowest yielder at 11 tha^{-1}. However, STAR 7714 (12 % brix) was the sweetest variety followed by DKC 8033 (11 %), DKC 8053 (10%) and MH 18 (9%) respectively. Even though STAR 7714 and PAN 4M-19 were highly susceptible to grey leaf spot, all the varieties showed tolerance and resistance to maize streak virus and maize stalk borer. From the overall characteristics of the maize varieties selected, DKC 8033, DKC 8053 and MH 18 had a better mix of attributes for all-year-round sweet corn production in Malawi.
Keywords: Certified seed, grey leaf spot, sugar content, yield, *Zea mays*

1. Introduction

Maize is the staple crop for Malawi and 11% of the total maize production in the country is consumed as green maize [Government of Malawi (GOM) 2006]. Sweet corn (Zea mays L.) is harvested and consumed at milk stage when seed moisture content is between 70-80%. It is consumed as a vegetable, a snack, or as the main meal. The crop is harvested and consumed when the kernels are fully grown but still soft. In this form, the crop is classified as a vegetable (Ali *et al.* 2003). Besides being a food crop, sweet corn is also a cash crop as it is a prominent source of income for small-scale farmers involved in its production.

In Malawi, production, marketing and consumption of sweet corn especially on the domestic market have increased. In 2006, consumption of sweet corn in Malawi was estimated at 286 000 tons (dry weight) and increased to 385 000 tons by the 2011/2012 farming season, attesting to the increasing demand for sweet corn consumption in the country (Manda & Makowa 2012). Ministry of Agriculture and Food Security for Malawi estimated that between 11-16% of the country's annual maize production was consumed as sweet corn (GOM 2006). In spite of the increase in production and consumption of sweet corn in Malawi, most farmers grew low yielding varieties, susceptible to pest and diseases (Grain Bulletin 2010) as there were no expert-recommended maize varieties meant for all year round sweet corn production. The most commonly used sweet corn varieties were the open pollinated varieties (OPVs) and local varieties whose yield and quality was not guaranteed especially for all year round production. These varieties were often naturally low yielding ranging from 880 kg/ha to 1300 kg/ha, making their winter production uneconomical due to high input costs in the off-season in addition to the costs of winter irrigation (GIEWS 2010). The varieties were also very susceptible to pest and diseases resulting in even lower yields and lower quality (GOM 2003; Smale and Jayne 2003).

Although there were improved hybrid sweet corn varieties in Malawi such as Strike and Shield crest, availability of these was limited due to the high costs of purchase. For example, at the time of data collection STAR 7714 which is a certified hybrid sweet corn variety cost US$ 45.32/kg compared to US$ 1.02/kg for DKC 8033, a regular field maize hybrid variety. The high productivity of imported sweet corn varieties grown in Malawi could not be guaranteed as the crop lacks the necessary adaptation capacity to be able to grow well in some regions (Davies 2005). While Davies (2005), made this assertion after experiments conducted in some areas of America, no similar study has been conducted in Malawi, hence the adaptability of exported sweet corn varieties to Malawian climates could not be ascertained conclusively.

High starch content hybrid varieties initially meant for commercial hybrid maize production and intended for maize flour were also an alternative sweet corn variety. However, most of these varieties were not recommended for sweet corn production as their sugar levels responsible for sweetness was low. Further, the adaptation of certain maize varieties needed to be evaluated since wet and cool seasons were associated with poor seedling vigor, small ear size, low yield and non-uniform maturity (Hemphill 2005).

This study was aimed at evaluating the yield and sweetness of selected commercial regular maize varieties for all year round production of sweet corn in Malawi, by comparing the yields and sweetness of selected varieties against standard sweet corn varieties in order to determine the most suitable varieties for all year round production of sweet corn in Malawi. The number of days to horticultural maturity, total soluble solids (Brix), maize stalk borers, grey leaf spot, maize streak virus and total yield were assessed in selected certified hybrid maize varieties in order to determine suitability for all-year-round sweet corn production.

According to International Institute of Tropical Agriculture report (2009), Sweet corn can be produced from either certified sweet corn varieties, commercial hybrid maize varieties or open-pollinated varieties. However, the lack of agricultural information and knowledge by farmers on the choices of suitable sweet corn varieties has contributed to the poor selection of varieties for sweet corn production. This has also lead to sweet corn yield reduction because the choice of variety is based on farmer's convenience and not on expert recommendations for varieties with the best mix of qualities for production in Malawi.

1.1 Production levels and trends

The average maize yields for Malawi range from 2000 to 3000 kg/ha for hybrids, 1400 to 2400 kg/ha for OPVs and 880 to 1300 kg/ha, for local maize cultivars in terms of dry weight. According to GOM (2003), potential yields of up to 10000 kg/ha for hybrids, 5000kg/ha for OPVs and 3000kg/ha for local maize varieties can be attained with good management. This yield gap is a major challenge associated with yields of corn in Malawi, but it also presents a direction of where agricultural interventions should focus in order to ensure improved yields. The harvesting stage is very critical in the distinction of sweet corn and field maize. Butron *et al*. (2008) said that corn requires between 60 to 100 days before reaching harvest depending on the variety and weather. Corn is ready for harvest when ears turn dark green, silks turn brown, and kernels are soft and plump, squeezing a kernel and the juice will be milky. Each stalk of corn will produce one or two harvestable ears of corn. Harvesting usually comes about 20 days after the silks appear. Harvesting corn in the morning and plunging ears immediately into cold water to preserve sweetness is a common practice (Butron *et al*. 2008). Sweet corn may have a wide range of harvesting days depending on varieties and environmental conditions prevailing during the growing period of the crop. The sugar content in sweet corn is very unstable just as that of the field corn hence the need to reduce the convention rate of sugars as a post-harvest handling technique. This implies that even field maize if exposed to the same quality preservation techniques, can be used as sweet corn.

1.2. Total soluble solids of sweet corn

Total soluble solids is a biochemical maturity index that measures the solids dissolved in a substance and used by consumers as a measure of quality sweetness in sweet corn. This parameter is influenced by the sugar level content, and the rapid change of sugar to starch at maturity or after harvest during warm weather reduces sweetness in sweet corn. When sweet corn is harvested at optimum maturity, the silks are brown and dry and kernels are plump, sweet, milky, tender, and almost maximum size. Sweet corn has a short harvest period, and harvesting on the day of optimum maturity preserves the quality of the yield (Butron *et al*. 2008). The generic sweet corn is different from field maize in that its kernel has the ability to accumulate sugars instead of starch. However, these natural sugars do not remain for long and this is why proper handling is important. The most important factor affecting the flavor of sweet corn is the time and temperature between picking and eating. As the ear matures, the kernels pass through stages called pre-milk, milk, early dough, and dough during which sugars change to starch and the hull becomes tougher. The higher the field temperatures, the quicker the kernel goes through these stages. At field temperatures of about 15 ℃, an ear may remain in prime condition for 5 days. At 21 ℃ it will pass this stage in 1 or 2 days (Taber and Lawson 2005). This implies that despite the high sugar levels in sweet corn, strict post-harvest handling is very essential, otherwise, the sweetness might be lost through the conversion of natural sugars to starch. In order to preserve the sugar levels, there is need to increase the shelf life for sweet corn. Sweet corn is ready for consumption when it contains 70 % water (Lawson & Taber 2005). If harvested too young, the kernel contents are thin, watery, and lack flavor. It should be harvested when the kernels are just beginning the milk stage. At this stage, the silks are brown and dry beyond the end of husks and the ear is large enough to fill the husk tightly to the top. The kernels have nearly attained maximum size, but they are still soft and tender and filled with a clear to milky juice when punctured with a thumbnail. The number of days from silk emergence to harvest is usually 18 to 22. However, if days and nights are exceedingly warm the prime maturity may be reached in 15 days or less after silking (Hemphill 2005).

1.3. Pest and diseases

The common pests and diseases which attack sweet corn are maize stalk borers, maize streak virus, grey leaf spot, cutworms, wireworms, flea beetles, corn earworms, and corn borers. This study concentrated on attacks from maize stalk borers, maize streak virus, and grey leaf spot on selected maize varieties. Corn earworms deposit eggs on developing silks; later the small caterpillars will follow the silks down into the ears, where they feed on the tips. Corn borers tunnel into stalks and ears to begin feeding. The garden must be kept free of debris where earworms and borers can live (William II 2008).

2. Materials and methods

2.1. Study site description

This study was conducted at Bunda College of Agriculture (Horticulture Students Demonstration site) during 2013/2014 growing season. The site was selected, cleared, marked land prepared manually. The experimental plots were demarcated into uniform sizes. The ridges were prepared spaced at 0.75m and NPK fertilizer (23: 21: 10) applied using dollop method before sowing the seeds spaced at 0.25m. Application of top dressing fertilizer, Urea (46%N) was done three weeks after emergence of the maize seedlings using banding method. Other horticultural practices included manual weeding, scouting of pests and diseases.

2.2. Variety selection

Eight varieties were selected for evaluation of sweet corn production in Malawi. Six of these were early to medium maturing. These included DKC 8033, DKC 8053, MH 18, SEEDCO 403, PAN 53 and PAN 4M-19. The experiment had two check varieties, STAR 7714 and Bantum. STAR 7714 was selected due to its generic characteristics and Batum is widely used as a local popular sweet corn variety. The DKC maize varieties were obtained from Monsanto, PAN varieties from PANNAR seed company, MH 18 were obtained from Chitedze Research Institute, STAR from the local supermarket and Bantum from local farmers respectively (Table 1).

Table 1: Sources and treatments used in the experiment (2013/2014 season)

Maize variety	Seed company	Treatment
V1	SEEDCO	SEEDCO 403
V2	PANNAR	PAN 53
V3	PANNAR	PAN 4M-19
V4	STARKE ARYES	STAR 7714
V5	Local variety	Bantam (local)
V6	Monsanto	DKC 8053
V7	Monsanto	DKC 8033
V8	Chitedze Research Institute	MH 18 (Chokonoka or Mukangala)

2.3. Experimental design

The experiment had eight treatments (Varieties) replicated four times and laid in a Randomized Complete Block Design. Use of this design was fitting as the soil in the fields was not homogenous in terms of fertility and the farm plot used for the experiment had a slope. All the treatments within the block were laid across the gradient. A plant population of 60 per plot was obtained in the gross plot with dimensions of 2.25m x 5m. Three ridges with an inter-row spacing of 0.75m and intra-spacing of 3m were used and the net plot from middle ridge constituted 12 plants per plot for data collection. Five plants were randomly selected, marked with a red cotton wool and total yield obtained from the net plot.

2.4. Data collection

The quantitative data were collected on days to horticultural maturity, ear length, ear diameter, ear weight, total soluble solids and total yield.

Days to horticultural maturity: The days from silking to time of harvesting and consumption acceptable by most consumers were collected and appropriately recorded.

Total soluble solids: This parameter is a biochemical maturity index which was determined when the maize attained horticultural maturity. A hand refractometer (Model 500, Atango & Tokyo, Japan) was used to determine the total soluble solid level in all the treatments per plot and then expressed as Brix.

Pest and Disease: The disease (grey leaf spot and maize streak virus) and pest (maize stalk borer) prevalence were assessed using a pest and disease scale chart of 1-5 according to Golden Valley Agricultural Research Trust report (GART 2010). This qualitative data was converted to quantitative data (Tables 2 and 3). Data entry was done concurrently with data collection.

Table 2: Description of disease scores and symptoms related to the score

Score	Category	Quantitative description of above ground symptoms
1	Resistant	No visible symptoms
2	Tolerant	Slight foliar lesion with no stem lesions
3	Susceptible	Foliar lesions with mild stem lesions but no dieback
4	Highly susceptible	Foliar lesions and pronounced stem lesions with beginning of dieback
5	Very highly susceptible	Defoliation with pronounced dieback and stem lesions

GART, 2010.

Table 3: Description of pest scores and the percentage of plants attacked per plot

Score	Category	Percentage of plants per plot
1	Resistant	0-20% plants attacked
2	Tolerant	21-40% plants attacked
3	Susceptible	41-60% plants attacked
4	Highly susceptible	61-80% plants attacked
5	Very highly susceptible	81-100% plants attacked

GART, 2010.

The yield parameters: This constituted ear length and diameter, measurements recorded using a tape ruler, while measurement of ear weight involved selection of five (5) cobs per plot which were harvested and weighed using a laboratory digital scale. The weights were recorded and converted to tons per hectare (t/ha).

2.5. Data Analysis

The data were subjected to analysis of variance (ANOVA) for Completely Randomized Block Design (CRBD) using Genstat statistical package (2012). In cases of the ANOVA generating significant differences, Fishers' least significant difference (LSD) test was used to estimate the differences among variables and separation of treatment means. All the tests were conducted at 95% level of significance ($p=0.05$).

3. Results

3.1. Plant growth and Yield Related Parameters

The yields of STAR 7714 (Mean = 11.41 t/ha), which was used as a control variety, were significantly less than those of PAN 53 (Mean = 13.87; $F = 8.693$; $p = 0.001$), PAN 4M-19 (Mean = 14.93; $F = 9.738$; $p = 0.001$), DKC 8053 (Mean = 14.93; $F = 9.738$; $p = 0.001$), and DKC 8033 (Mean = 12.80; $F = 5.726$; $p = 0.004$) (Fig 1a). However, the yields of the control variety did not significantly differ from those of SEEDCO 403, Bantam and MH 18 varieties.

The generic sweet corn variety STAR 7746 matured significantly earlier than all the other varieties ($F = 13.842$; $p = 0.001$) (Fig 1b). Its mean number of days to maturity from planting of 70 meant the variety matured at least 15 days earlier than the next early maturing variety SEEDCO 403 and MH 18 which took 85 days from planting. The local breed BANTAM was the last to mature at 97 days from the time of planting.

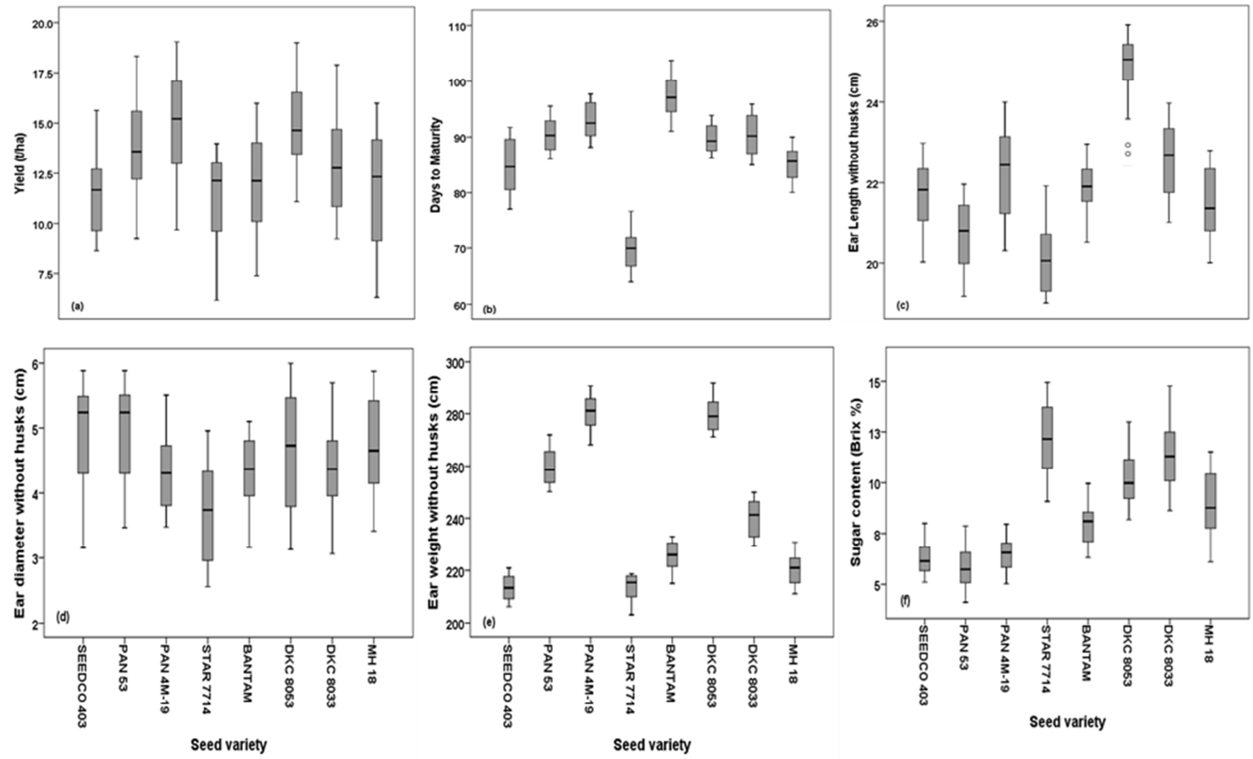

Figure 1. Box and whisker plots showing (a) differences in yields between the control variety STAR 7714 and the selected commercial varieties SEEDCO 403, PAN 53, PAN 4M-19, BANTAM, DKC 8053, DKC 8033 and MH 18, (b) differences in the number of days taken from planting to harvesting between the control variety STAR 7714 and the selected commercial varieties, (c) differences in ear length with no husks between the control variety STAR 7714 and the selected commercial varieties, (d) differences in ear diameter between the control variety STAR 7714 and the selected commercial varieties, (e) differences in ear weight between STAR 7714 and the selected control varieties and (f) differences in sugar content between the control variety STAR 7714 and the selected commercial varieties. The extreme ends of the boxes are the upper and lower quartiles, box heights are interquartile ranges, the top and bottom whiskers represent the range for each variable measured on the y-axis while the horizontal line in each box is the mean.

STAR 7746 generally had small ears compared the commercial varieties, with significantly shorter ears (mean = 20.2 cm) compared to the other varieties (range = 20.7 cm to 24.8 cm) (F = 6.439; p = 0.001). DKC 8053 had the longest corn ears (Fig 1c). The corn ears for STAR 7746 were also the least wide of the varieties compared (F = 7.517; p = 0.001) with a mean 3.7 cm while the other varieties ranged from 4.3 cm to 5.9 cm, and the widest being SEEDCO 403 (Fig 1d). Only the corn ears for SEEDCO 403 (mean = 213 g) had no significant difference in weight with the control variety STAR 7746 (mean = 214 g) (F = 1.352; p = 0.761) (Fig 1e). Other varieties (range = 220 g to 280 g weighed significantly more than STAR 7746 (F = 8.847; p = 0.001). In terms of sugar content, the control variety STAR 7746 which is also a generic sweet corn variety was significantly more sweeter (mean brix % = 12%) than the other varieties (brix % range = 6% to 11%) (Fig 1f). The sugar content was measured and detected using the refractometer in the field at harvest.

3.2. Pest and disease occurrence

The maize varieties were observed for pest and disease occurrence by scoring the number of plants that were affected by a particular pest or disease per plot. The control variety STAR 7714 was the most susceptible variety to Grey Leaf Spot and the percentage of plants attacked by the disease was significantly higher than the other selected varieties (percentage attacked per plot = 91%; F = 17. 968; p = 0.001) (Fig 2a). PAN 4M-19 was the second most highly susceptible variety to Grey Leaf Spot and was also highly affected by the disease (percentage attacked per plot = 77%; F = 15.682; p = 0.001). The other varieties were all resistant to Grey Leaf Spot and had less than 20 % of their plant population attacked.

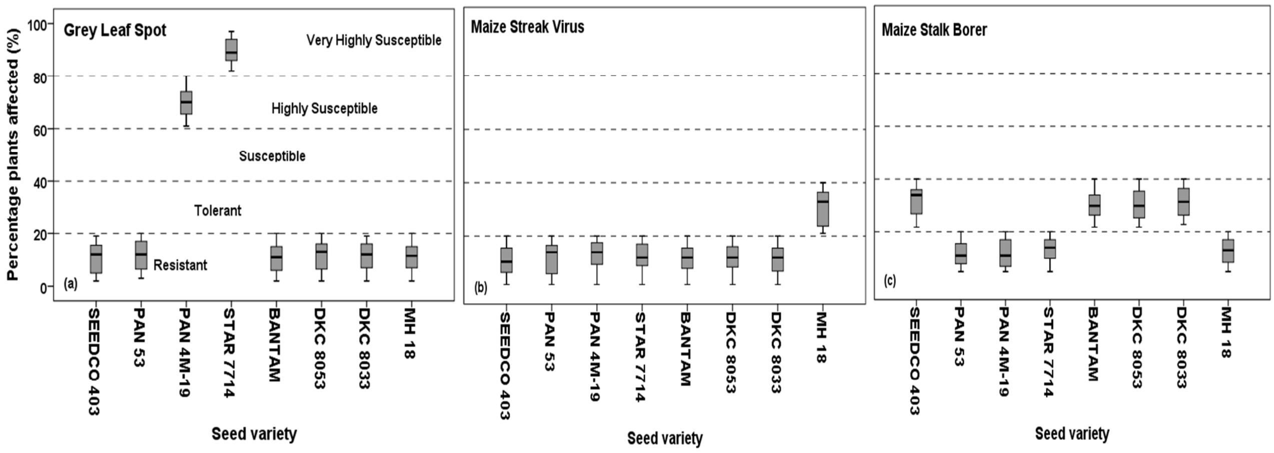

Figure 2. Box and whisker plots classifying selected maize varieties into classes of resistance, tolerance, and susceptibility to Grey Leaf Spot, Maize Streak Virus and Maize Stalk Borer based on the percentage of plants of a particular maize variety attacked per plot. (a) Percentage of plants affected by Grey Leaf Spot for each of the eight varieties selected per plot (b) the percentage of plants attacked by Maize Streak Virus for each of the eight varieties selected per plot (c) the percentage of plants attacked by Maize Stalk Borer for each of the eight varieties selected per plot. The extreme ends of the boxes are the upper and lower quartiles, box heights are interquartile ranges, the top and bottom whiskers represent the range from the least number of plants attacked to the highest number attacked for each plot of a particular maize variety while the horizontal line in each box is the mean.

Only MH 18 was tolerant to the Maize Streak Virus while the other varieties were resistant (Fig 2b). The percentage attack for the virus was very low and did not significantly affect the plant population and the yields. Of the three pests and diseases considered, Maize Streak Virus was the least destructive to the yields in the study environment. Maize Stalk Borers affected more plat populations than did the Maize Streak Virus. STAR 7714, PAN 53, PAN 4M-19 and MH 18 were all resistant to the Maize Stalk Borer pest while the rest of the varieties were tolerant to the pest (Fig 2c).

4. Discussion

4.1. Plant growth and development parameters

The eight varieties emerged within the period ranging from four to six days because most of them were early to medium maturing varieties and were certified. The rainfall occurrence a night before planting ensured the soil was at field capacity during planting. This could have contributed to the quick germination. The seed viability differed among the varieties and this could be attributed to some seed being destroyed while in storage at commercial outlets or the period of time the seed had stayed from the time it was produced. This agrees with the findings of William (2008) who stated that starting out with fresh purchased seed each year is advisable because sweet corn is relatively short-lived even under ideal storage condition. Further, seed production strategies by seed companies where farmers were engaged under out-grower schemes to grow seed on behalf of seed breeders in order to meet the increasing commercial demands may have led to reduced quality of certified seed varieties which further reduced the seed viability.

The generic sweet corn variety STAR 7714 is earlier maturing compared to the other varieties assessed. In spite of the statistical difference in the number of days to harvesting, all the varieties were within the acceptable range of maturity days for sweet corn. According to Hemphill (2005), the acceptable range of days to harvesting for sweet corn is between 60 to 100 days, implying that all assessed varieties were within this range. Harvesting on time is important and sweet corn is usually ready for harvesting 15-21 days after half-silk, depending on temperatures. Warmer weather favors early maturity. Delay of harvest for a few days is permissible as the sweetness of sweet corn holds longer (Albert 2009). Williams (2008) stated that the number of days to tasseling, cobbing, and maturity can be used to prevent different varieties from being at pollinating stage at the same time. Maturity isolation can be achieved by varying planting dates or by selecting cultivars that mature at different times.

4.2. Yield and sweetness for selected maize varieties

Pan 4M-19, DKC 8053, PAN 53, DKC 8033, MH 18 and Bantam all recorded higher yields than the control variety STAR 7714. Yet to recommend a variety for all-year-round production, other attributes such as the sweetness, pest tolerance, and disease resistance should also be taken into consideration. For instance, PAN 4M-19 which had the highest yields at 14.93 t/ha was very susceptible to Grey Leaf Spot where about 70% of the plants per plot were affected by the disease. Hence, it would not be recommended to grow these variety all-year round as Grey Leaf Spot is a serious problem in Malawi, particularly during the dry season. Further, the low sugar content (6%) in PAN and SEEDCO varieties reduced their suitability to be used as sweet corn. The sweetness of sweet corn is determined by the sugar content which was measured by the brix percentage in the maize. As stated by Larson and Debra (2003), the sugar content is very cardinal in the determination of sweet corn quality and flavor and prolonging the shelf life of the corn, the higher the sugar level the better the corn quality. DKC 8053 yielded 14.93 t/ha just as PAN 4M-19 but was more pest tolerant and disease resistant and had a higher sugar content at 10% brix percentage. DKC 8033 yielded 12.80 t/ha and had 11% sugar content and was tolerant to pest and diseases. These varieties exhibited attributes necessary for all year round cultivation of sweet corn. The higher potential yields in DKC 8053 made it a slightly better choice than DKC 8033 which had a percentage more sugar content than DKC 8053. While both Bantam and MH 18 were relatively high yielding, the lower sugar content levels made these varieties less attractive for sweet corn production. However, MH 18 with sugar content percentage of 9% would be recommended for cultivation in the absence of the two DKC varieties. In fact, based on sugar content, MH 18 could be classified as a standard sweet corn variety under heterozygous varieties (Albert 2009) and its potential for sweet corn production was exacerbated by its tolerance to pests and diseases.

4.3. Classifying maize varieties based on sugar content

Albert (2009) devised a method of classifying sweet corn in terms of sugar content (Brix %). He identified the first category of maize as having a sugar content ranging from 5% to 10% and called this standard sweet corn. This type of sweet corn is usually grown for processing and for much of the fresh market. The second category is from 12% to 20% and classified as sugary enhanced corn and for this category, kernels are very tender with good corn flavor. The third category is from 20% to 30% and is classified as super sweet corn and the corn texture is crispy rather than creamy as with the standard and enhanced varieties (Debra 2003). Fresh market shelf life for corn is extended because of the slower conversion of sugars to starch after harvest (Albert 2009). Relating to this study, the sugar content in STAR 7714, DKC 8033 and DKC 8053 implied these were sugary enhanced corn varieties and would likely make very good quality sweet corn. The rest of the varieties studied were standard sweet corn varieties.

Hemphill (2005) observed that the rapid conversion of the sweet sugars to starch that takes place after harvesting of sweet corn poses a risk of these varieties to fall out of the range of sweet corn (Hemphill 2005). Hence, sweet corn should be properly managed from harvest onwards to enhance its sweetness and add to the shelf life. Albert (2009) cautioned that sweet corn should be held at 0 ℃ and 95% to 98 % relative humidity. Storage for more than a few days results in deterioration and loss of tenderness and sweetness. The sugar content, which so largely determines quality in corn decreases rapidly at ordinary temperatures and the decrease, is less rapid if the corn is kept at about 0 ℃. Albert (2009) estimated the loss of sugar content to be about four times more at temperatures of 10 ℃ than at 0 ℃. At 29 ℃, 60 % of the sugars may be converted to starch in a single day as compared to only 6 % at 0 ℃. Since corn loses sweetness even at 0 ℃, maize varieties with 7% or less sugar content are more likely to fall out of the range for sweet corn after harvest. This implied that SEEDCO 403, PAN 53, PAN 4M-19 and BANTAM were unlikely to be used as sweet corn varieties as their sugar content will likely fall out of range shortly after harvest. The risk of these varieties losing their sweetness is even more critical in Malawi where mean temperatures rise above 18 ℃ and the infrastructure for cooling the product is not readily available.

4.4. Pest and diseases

The maize varieties studied were relatively resistant to Maize Stalks Borers and Maize Streak Virus. However, STAR 7714 and PAN 4M-19 were more susceptible to Grey Leaf Spot with about 90 % and 70 % of the plants attacked by the disease, respectively. This finding is an indicator of the vulnerability of the generic sweet corn STAR 7714 and PAN 4M-19 if they were to be used for all year round production of sweet corn because the pressure of Grey Leaf Spot increases towards the end of rainy season and through the cool to dry seasons (Ward *et al*. 1999). MH 18 was tolerant to Maize Streak Virus having 31 % of the plants attacked compared to the other varieties which were resistant to the maize virus. These results were in conformity with the study by GART (2010) in Zambia where DKC 8033, DKC 8053, PAN 53, PAN 4M-19 and SEEDCO 403 showed resistance to Maize Streak Virus and tolerance to Maize Stalk Borers while Pan 4M-19 was very susceptible to Grey Leaf Spot. This implies that both the generic sweet corn variety STAR 7714 and PAN 4M-19 were not likely to perform well outside the rainy season when the disease pressure for Grey Leaf Spot was very high. It could also be one of the reasons why STAR 7714 despite being generic sweet corn variety had proven to be a challenge in Malawi when grown as sweet corn (GOM 2006). PAN 4M-19 yielded better results probably because the severity of Grey Leaf Spot was in week nine, the time the crop was almost attaining the harvesting time. This scenario might be different if the variety was to be grown entirely in the dry season when the environmental conditions for Grey Leaf Spot are favorable. Therefore caution must be taken when making a decision to use such a variety for all year round sweet corn production in Malawi.

5. Conclusion

The eight maize varieties used in this study were evaluated and the selection was done based on varieties with the best combination of high yield potential, sugar content and also resistance and tolerance to Maize Streak Virus, Maize Stalk Borers, and Grey Leaf Spot, which are the critical diseases and pests of sweet corn in Malawi. It was concluded that DKC 8033, DKC 8053 and MH 18 had the better combination of attributes to enable all year round sweet corn production. Although STAR 7714 is a generic sweet corn variety, it's susceptible to Grey Leaf Spot and should be used with caution particularly if it's grown during the dry season. It is recommended that the spectrum of this study be expanded to include more hybrid varieties whose attributes should be evaluated in order to identify suitable ones for all year round sweet corn production.

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