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Original Research Article

Sweet-1: 1st Ever Sweet Corn Open Pollinated Variety in Punjab Pakistan

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Abstract: *Sweet corn (Zea mays L. var. saccharata) is a specialty type of maize primarily consumed after roasting. Despite its growing demand, its cultivation remains limited in Pakistan, and no officially approved sweet corn variety has been available for general cultivation. The development of a high-yielding, disease-resistant variety is crucial to reducing import dependency and enhancing local production.* ***Objective:*** *To develop and evaluate a high-yielding, disease-resistant sweet corn variety suitable for general cultivation in Pakistan, focusing on its agronomic performance, disease resistance, and yield potential.* ***Methods:*** *The variety Sweet-1 was developed through recurrent selection from the base population Yusafwala Pool-30, undergoing five selection cycles for enhanced grain yield and quality traits. The variety was assessed in station trials and National Uniform Maize Yield Trials across Pakistan, comparing its performance with a local landrace. Agronomic evaluations were conducted to determine optimal planting conditions during the Kharif and spring seasons. Resistance to Fusarium moniliforme (stalk rot) was tested over two growing seasons. Statistical analyses were performed to compare yield differences between Sweet-1 and the check variety.* ***Results:*** *Yield Performance: Sweet-1 exhibited a 28% higher yield in station trials and a 10% higher yield in national trials compared to the check variety.Disease Resistance: The variety demonstrated moderate resistance to stalk rot (Fusarium moniliforme), showing stable performance across two seasons. Agronomic Optimization: Kharif season: Best results were obtained with row-to-row spacing of 75 cm and plant-to-plant spacing of 15 cm. Spring season: Plant-to-plant spacing of 17.5 cm was found to be optimal for maximum grain yield.* ***Conclusion:*** *The approval and adoption of Sweet-1 will provide a high-quality sweet corn variety for general cultivation in Pakistan. Its higher yield potential, disease resistance, and optimized agronomic practices will contribute to enhanced local production, reducing reliance on imports and lowering the import bill.*

Keywords: *Zea Mays*, Recurrent Selection, Hooker, Half-Sib Mating, *Fusarium Moniliform*

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Introduction

Maize is a versatile crop and its various types are cultivated in the world i.e. flint, dent, baby corn, sweet corn popcorn, etc. Flint and dent are the most common types and are of prime importance with a maximum share in global maize production. Contrary to farmer two types, other types are known as specialty corns and are only grown for specified and limited usage. Sweet Corn is purely grown for eating purposes and is utilized after roasting. Its immature kernels, consisting mainly of endosperm and ovary wall (immature pericarp) are consumed. Sweet corn quality is determined by the flavor, aroma, and texture of the endosperm and the tenderness of the pericarp. Genes affecting ear and kernel appearance are also important. The sweet corn flavor is determined in part by sweetness, which is affected by the amounts of sugar and starch in the endosperm. Starch synthesis mutants may be divided into two classes based on their effects on endosperm composition (1). The class 1 mutants, brittle1 (bt1), brittle2 (bt2), and sh2 accumulate sugars at the expense of starch and have greatly decreased total carbohydrates at the mature seed stage. Class 2 mutants, amylose extender1 (ae1), dull1 (du1), su1, and waxy1 (wx1), alter the types and amounts of polysaccharides produced (**1**). Sweet corn having su1 endosperm originated in Central and South America during the pre-Columbian period (2, 3).

Researchers have used various breeding and molecular techniques for the development of sweet corn varieties including backcross and marker-assisted breeding (3, 4). Introgression of sweetness through the backcross method is effective but it's laborious and lengthy way. The trait being recessive also makes the backcrossing method complicated and lengthy. Marker-assisted breeding is a robust technique to identify the presence of sweetness genes but the facility is not always available to all breeders. Therefore, we used a simple recurrent selection to develop a high-yielding sweet corn variety which has already been used effectively by breeders for sweet corn (5).

Currently, there is no approved variety or hybrid of sweet corn in Punjab, Pakistan therefore either landraces or imported sweet corn is being utilized. The use of local landraces results in lower yield as well as inferior quality while imports create an extra burden on the country's economy. So, there was a dire need for indigenous sweet corn varieties in the country. Maize & Millets Research Institute, Yusafwala Sahiwal has developed a sweet corn variety suitable for local agroecological conditions with higher yield and better quality.

Methodology

The source population of sweet corn germplasm is known as Pool-30 at Maize & Millets Research Institute Yusafwala Sahiwal. This base population was enriched with one exotic genotype S-526 (China) and some local landraces from Mingora, Swabi, Mansehra, and Parachinar followed by open pollination in isolation for four seasons to attain

maximum genetic variability. The enriched Pool-30 base population was subjected to five cycles of half-sib selection. In this selection method, 250 superior plants were selected from the base population based on desirable traits, especially grain yield. Ears of these selected plants were sown in ear-to-row fashion in a 4:1 (female: male) ratio where the male was the bulk of all families. The selection was practiced for superior families and for better plants within the selected families to constitute a new base population. The process was repeated for five seasons and finally, 10 best-performing families, uniform in their morphology and phenology, were selected and subjected to half diallel for all possible combinations. The resulting seed was sown in isolation for open pollination and light rouging was practiced for homogenization (6, 7). The developed variety was evaluated at the institute as well as at various places in the country for its yield in comparison to local landrace "Local Swat Sweet corn". In addition to yield performance, Agronomic trials were also conducted to find out the optimum plant population and plant geometry to get maximum grain yield. Similarly, the newly developed variety was screened against stalk rot through artificial inoculation following the rating scale given by Hooker (1956). The variety was also tested for its grain quality i.e. Protein, fiber, fat, and ash using the standard method (7, 8).

Results & Discussion

Station Trials

The variety was tested in station trials for two years before its inclusion in the National Uniform Yield Trial and the variety performed better. It gave 7.7% and 49.6% higher yields higher than the check variety during Spring 2016 and Kharif 2016 (Table 1). It revealed that variety is very stable in its genetic potential and has the ability to perform in varying degrees of environments. Similar results have been reported by other researchers (9-12).

National Uniform Maize Yield Trials (NUMYT)

After the better performance in station trials, the seed of Sweet-1 was sent to The National Coordinator (Maize, Sorghum, Fodder & Other Cereals) Pakistan Agricultural Research Council (PARC), Islamabad to be included in the National Uniform Yield Trial. The variety was evaluated at six different agroecological zones across the country. It gave 16.17% and 5.3% higher yields than the check variety during Kharif 2017 and Spring 2018 respectively (Table 2). Similar results have been reported by other researchers (9-12).

Agronomic Studies

Five plant spacing were compared to obtain the maximum grain yield of Sweet-1 during Kharif 2016 and Spring 2017. It is evident from the results (Table 3) that plant spacing was significantly different from each other. The variety performed better at plant spacing of 15cm with a row-to-row spacing of 75cm by producing 5868 kg/ha grain yield during the Kharif season while 17.5cm spacing was found to be optimum during the spring season (5695 kg/ha). Gözübenli and Konuşkan (2010) have already reported significant differences in yield in response to plant spacing. Various researchers (13, 14) have reported a different planting geometry for obtaining the full potential of the sweet corn genotypes. These differences may be attributed to genetic differences between the studied material and the climatic conditions under which the study was conducted.

Pathological Studies

Disease resistance is critical for a variety to be released for general cultivation therefore the newly developed variety "Sweet-1" was tested against stalk rot disease through artificial inoculation at MMRI, Yusafwala Sahiwal. The results (Table 4) showed that Sweet-1 was found to be moderately resistant to stalk rot disease during Kharif 2016 and spring 2017. It is also evident that the variety showed stable behavior against the mentioned disease and remained moderately resistant during both of the years. Similar responses of varieties have also been reported by researchers for various OPVs (9-12).

Quality Analysis

Quality analysis of the variety was performed in the Cereal Technology Lab. Wheat Research Institute, AARI Faisalabad to compare it with the check variety. It is evident from the results (Table 5) that Sweet-1 has better protein and fat content while a lesser quantity of fiber than Check. It implies that the nutritional value of newly approved is higher than the local landrace.

Table 1: Yield (kg/ha) Performance in Micro Plot Maize OPVs Yield Trial

Year of Evaluation	Entries	Grain Yield (Kg/ha)	Percentage Increase/decrease over the check
Spring 2016	Sweet-1	4091	7.7
	Local Swat Sweet Corn	3798	
	CV	18.93	
	LSD	1693	
Kharif 2016	Sweet-1	4436	49.6
	Local Swat Sweet Corn	2965	
	CV	7.73	
	LSD	817	

Table 2: Yield (kg/ha) Performance in National Uniform Maize (OPVs) Yield Trial

Year of Evaluation	Entries	MMRI (Sahiwal)	AARI (Faisalabad)	NARC (Islamabad)	CARI Pirsbak	Average (Kg/ha)	Percentage Increase/decrease over the check
Kharif 2017	Sweet-1	4437	2955	3625	-	3677	16.17
	Local Swat Sweet Corn	3550	2908	3038	-	3165	
	CV	10.1	17.5	38.5	-		
	LSD	831	NS	NS	-		
Spring 2018	Sweet-1	6149	-	4042	3184	4458	5.3
	Local Swat Sweet Corn	5068	-	5054	2580	4234	
	CV	6.11	-	19.62	31.08		
	LSD	585	-	395	N.S		

Table 3: Optimum Plant Spacing for Sweet-1 for Higher Grain Yield

Sr. No	Planting method	Plant spacing	Grain Yield (kg/h)
Kharif 2016	Ridge sowing	R x R=75cm P x P=12.5cm	5710
	Ridge sowing	R x R=75cm P x P=15cm	5868
	Ridge sowing	R x R=75cm P x P=17.5cm	5047
	Ridge sowing	R x R=75cm P x P=20cm	5032
	Ridge sowing	R x R=75cm P x P=22.5cm	4274
	CV		11.66
	LSD		744
Spring 2017	Ridge sowing	R x R=75cm P x P=12.5cm	5540
	Ridge sowing	R x R=75cm P x P=15cm	5647
	Ridge sowing	R x R=75cm P x P=17.5cm	5695
	Ridge sowing	R x R=75cm P x P=20cm	5574
	Ridge sowing	R x R=75cm P x P=22.5cm	4537
	CV		3.92
	LSD		257

Table 4: Disease Reaction of "Sweet-1" against Stalk Rot (Fusarium moniliforme) by Artificial Inoculation using Hookers Scale

Name of OPV	Stalk Rot Reaction	
	Kharif 2016	Spring 2017
Sweet-1	MR	MR

Table 5: Quality parameters of Sweet-1 in comparison with check variety

Variety	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Ash (%)
Sweet-1	7.90	4.36	1.87	1.34
Local Swat Sweet Corn	6.80	3.75	2.1	1.37

Figure 1: Pictures of Sweet-1

Conclusion

It is concluded that the development of a new sweet corn variety through the Half-sib selection method is a good addition for farmers in Pakistan. Variety is stable in its performance across the country as well as over time. The variety has also shown moderate resistance to stalk rot so will have good yield performance in areas of stalk rot incidence.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned.

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

AH, GM, WA
Review of Literature, Data entry, Data analysis, and drafting article.
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Manuscript drafting, Study Design,
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Conception of Study, Development of Research Methodology Design
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Study Design, manuscript review, critical input.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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