

Popularization of Sweet corn (*Zea mays* L. *Saccharata*) Under Temperate Conditions to Boost the Socioeconomic Conditions.

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Introduction:

Maize is the third most important cereal in the world. Over 43 m ha of maize is grown in Asia producing 166 m tons with productivity of 3.8t/ha (FAO, 2002). Asia consumes more than 62% of its maize production in the form of animal feed and remaining for human consumption. India ranks in fifth in area and third in production and productivity among cereal crops. It ranks first in area, grown on approximately on 3.10 lakh hectares in J & K state (India). It is a staple food of tribes. The per unit returns of normal maize crop is low and hence has been pushed to the areas having fragile ecosystem where irrigation facility is either scanty or nonexistent. Owing to low returns per unit area in case of normal maize, growers are fast shifting to specialty corn production (Sweet corn) giving more returns and opening opportunities for employment generation. Out of various specialty corns, sweet corn has a very big market potential and has great genetic variability and scope to improve its nutritive value. This has potentiality not only in domestic market but also in the international market. In addition quality fodders (on the basis of sweetness) derived after harvest may be sold that brings handsome additional income to the farmers as it is highly cherished by the cattle.

Sweet corn is one of the most popular vegetables in the USA, Canada and Australia. It is becoming popular in India and other Asian countries. Sweet corn differs from other corns (field maize, pop corn and ornamental) because the kernels have a high sugar content in the milk on early dough stage. It is consumed in the immature stage of the crop. The kernels of sweet corn taste much sweeter than normal corn, especially at 25-30%. The quality and level of sweet corn depends on the type of gene involved for sweetness.

The sweet corn industry is expanding because of increasing domestic consumption, export development and import replacement. It is an attractive crop for producers to grow because the plant grows quickly and is considered a valuable rotational crop and farming operation can be mechanized. Most sweet corn is grown for the processing sector ending up on the super market shelves as products which include canned kernels, frozen cobetts and frozen kernels.

Planting usually commences in spring when soil temperature reaches above 12⁰C. In warmer regions with longer growing season allows two crops to be planted each year, however taking the

major constraints of shorter growing period (April to September) together with cold stress at early and late stages of crop growth restricts it to mono-cropping under temperate conditions.

Successful sweet corn production relies on:

1. Management planning well in advance of sowing (for instance, planting to ensure that harvesting meets the most profitable market niche and processor schedules.
2. Through research to identify market requirements, impediments to production and especially product specification.
3. Good cultural management tailored to suit particular cultivars with special attention given to harvesting technologies, establishment, plant population, fertilizer, irrigation, soil management and pest and disease control.

The sweet corn industry has recently achieved important advances in production and marketing through bench-marking, crop monitoring and adopting quality management. The factors that determine the progressive attitude of the industry are:

1. Development of export markets, particularly to Asia.
2. A steady increase in total production and per unit area production.
3. Increase in per capita consumption.
4. Following the latest practices identified as a technology and market innovator.
5. New super sweet cultivars are expected to increase the demand and strengthen the industry's position in the market place.
6. Development of new cultivars that show greater insect and disease tolerance and product style.

Cultivars:

Development of improved varieties (Cultivars) is subject to the fresh market and industry priority. Processors and fresh market buyers have specific characteristics they see as important. Before planting growers should ensure that the cultivars they have chosen meets market requirement. The sweet corn lines/varieties should possess the following attributes:

1. High yielding.
2. Good kernel set.
3. Sweetness depending on gene type.
4. Resistance to major diseases and insects.

The important breeding target under temperate conditions are high yield, early maturity owing to short growing season, drought tolerance, resistance to TLB and importantly the sweetness depending on gene type.

Su locus: A recessive gene (Su) at this locus interferes with the conversion of sugars to starch. The sugar content of homozygous recessive genotype (Su Su) is twice that of normal maize at the green leaf stage.

Se locus (Sugar enhancer): The recessive gene at this locus enhances the effect of the Su gene. Homozygous recessive Se Se, Su Su genotypes have higher sugar content than Su Su genotype and maintains their quality for large period.

Sh-2 locus (Shrunkek-2): Homozygous recessive Sh2 Sh2 genotypes have higher sugar content than Su Su types. There is no conversion of sucrose to starch and the level of water soluble polysaccharides is low. Shrunken2 varieties maintain acceptable quality for a longer period during harvest compared to sugar types and a watery rather than a creamy texture.

Worldwide a number of sweet corn varieties are grown both yellow and white grain type either as fresh market cobs or for processing unit. All these varieties are not suitable under temperate conditions because of their long duration or have their feasibilities to tropical and sub-tropical world. The notably mention of the varieties of such as composites PS-78, Madhuri, Priya and Almora have been tested evaluated and analyzed for various traits conditioning their grouping into sweet corn category. The composite PS-78 (Mishri Makai) is the native well adopted sweet corn under temperate conditions of Kashmir. The variety is early maturing with super sweetness nature. The main bottle neck of the variety is low yielding and proneness to TLB. The other three varieties were collected from Almora and evaluated for various precise characteristics which are prerequisite for such kind of specialty corn. The comparison of the varieties for various characters is given in table-I. The breeding programme is in progress for development of new varieties having the combinations of desired traits such as high yield, earliness, tolerance to various biotic and abiotic stresses together with super sweetness using the basic material/germplasm of above mentioned populations.

Crop planting:

Sweet and super sweet Sh2 cultivars are most exacting in their cultural requirements. Soil at planting needs to be friendly tilled, trash free with good soil moisture and to initiate germination. The minimum soil temperature needed at planting ranges between 14-16⁰C. Sowing should be made at a depth of 25-40mm.

Fertilizer:

Basal at sowing time, 40mm to one side and 60mm below seed. Apply 60 Kg N, 50 Kg P₂O₅, 30 Kg K₂O and 11 Kg Zn/ha. Side dress (21 days after emergence) 1/3rd of N₂ (20 Kg N) and 1/3rd (20 Kg N) at flower initiation stage.

Irrigation: Irrigation water is usually applied by furrow. As a general guide 25-50 mm per week is used to grow a crop with some moisture usually provided by rainfall Sweet corn is more

sensitive to moisture stress than field maize Under temperate conditions of Kashmir it is generally grown on marginal land as rainfed crop but if necessary life saving irrigations are provided to the crop at critical growth stages such as at flowering initiation stage.

Weed control:

Normally weeds are easily controlled in sweet corn crops by following range of options using herbicides and cultivations. Poorly managed weed populations can harbor pests and diseases that can restrict plant growth and cob quality. Rotation of crops and through ground preparation will minimize weed problem. Inter-row cultivation is usually necessary once or twice with 30 days of planting, to break soil crust and later can be combined with fertilizer side dressing and hilling up. Cultivation needs to be shallow as sweet corn roots are near the surface and must not be damaged. Atrazine @1Kg/ha has been proved through agronomic trials to control all pre emergent broad leaved weeds.

Harvesting:

Corn for the fresh market is generally harvested by hand or machine at higher moisture content of 70-80% and when the kernels at the top of the cob are 75% fill. Picking may take place over several days as the cobs seldom ripen evenly.

Visual assessment of cobs: The number of days is temperature dependent. The varieties known to be ready by 95 days take 120-125 days when grown under temperate Kashmir conditions. Randomly assess cobs in a field when silks are browned off and dry, mature cobs usually have the largest diameter. It usually takes 4-5 weeks from onset of silking to harvest under temperate conditions. However, careful choice and local trialing of cultivars is important as yield and cob quality can vary between cultivars.

Consignment and transport: Sweet corn cultivations lose their crispness and sweetness a few days after harvest. Hence before consigning fresh market sweet corn, it is necessary to be sure of buyer's specifications for product, packing, handling and cool chain management. Fresh sweet corn is highly perishable in hot weather. For every 5⁰C increase in pulp temperature, sugar breakdown to starch doubles, meaning that sweet corn can completely lose flavor in a short period of time. Within a few days at ambient temperatures, husks also dry out very quickly, silks dry out and darken and cobs sweat and caramelize, resulting in significant quality deterioration. The recommended pulp temperature throughout the cool chain (farm to consumer) is 0-2⁰C.

Export market: The super sweet cultivations have increased sweet corn's popularity in many countries such as USA, Australia and Japan where fresh packs and long life vacuum packs are popular. Bicolour and super sweet cultivars are preferred. However, buyer preferences can vary and research of market and product specification is important. Temperate conditions more particularly Kashmir climate is most popular for quality crop production. Hence there is high potential for export of the crop.

Processing: Sweet corn is processed into the different product like frozen cobs (protein of whole cobs), whole cobs and whole kernels. Beside canning operations in the form of whole kernels and cream styles viz-a-viz soups, mixed vegetable packs, corn jacks. Kernel products are the most popular processed lines with frozen whole cob and cobett products exported to improve their market share. In this regard the most important to mention here is the cob quality available for processing. Hence breeding for variety that is highly acceptable from processors point of view should be initiated. Under Kashmir conditions where there is a growing problem of unemployment, the processing unit for sweet corn has a potential to engage skilled and semiskilled people.

Pest control: For a pest problem to, the conditions that need to be met are (1) pest is present (2) a crop is susceptible to attack and environmental conditions favour pest increase. The integrated pest management strategy can be effectively used for the management of pests most economically with a minimum use of pesticide and reduce development of resistance. Under our conditions cut worms and Turcicum leaf blight are the most severe pests.

Conclusion:

Sweet corn is a crop showing increasing potential. Export by the fresh and processing sectors are developing especially to Asian market places where sweet corn popularity amongst consumers is increasing. It will be an attractive crop for growers more particularly under temperate conditions as cultural requirements are almost similar to normal maize, the crop grows quickly and all operations can be fully or partially mechanized for processing. By improving management and adopting innovative means like IPM on the farm, productivity can be increased. Increased planting densities and improved soil management options show promise and adoption by producers is expected to increase. In addition leading role played by processing sector has undertaken important initiatives aimed at becoming internationally more competitive and thus opening big opportunities for temperate agriculture known for quality crop production.

References:

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Table-I: Relative comparison of various traits for the sweet corn varieties evaluated under temperate conditions of Kashmir

Quality traits	Varieties		
	PS-78	Madhuri	Almora
Days to 50% Tasseling	60	75	78
Days to 50% silking	63	78	82
Days to maturity	120	135	136
Plant height (Cm)	180	220	225
Cob height (Cm)	95	115	115
Colour of the cob	Yellow	Yellow	Yellow
Taste	Super sweet	Super sweet	Sweet
No. of cobs/ plant	2	2	1-2
Fodder quality	Medium	Very good	Good
Cob yield (fresh) q/ha	90	130	120
Cob yield at 15% moisture level	30	50	45
Fodder yield	70	145	140
Harvest index	0.3	0.25	0.23
B/C ratio	2.3	2.8	2.7