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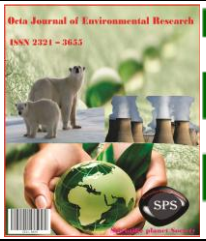

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MAIZE PRODUCTION TECHNOLOGIES IN INDIA- A REVIEW

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Abstract: Maize is considered a promising option for diversifying agriculture in upland areas of India. It now ranks as third most important food grain crop of India. The maize area has slowly expanded over the past few years to about 6.2 million ha. This area would further grow further to meet future food, feed, and other demands, especially in view of the booming livestock and poultry producing sectors in the country. Since opportunities are limited for further expansion of maize area, future increases in maize supply will be achieved through the intensification and commercialization of current maize production systems.
Keywords: Maize, Production, Kharif, RCTs, QPM.
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INTRODUCTION

Maize (*Zea mays* L) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Globally, maize is known as queen of cereals because it has the highest genetic yield potential among the cereals. It is cultivated on nearly 179.72 m ha (2014-15) in about 160 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 36 % (1014.37 million metric tons) in the global grain production. The United States of America (USA) is the largest producer of maize contributes nearly 35.6 % of the total production in the world and maize is the driver of the US Economy. The USA has the highest productivity (>10.73 metric tons/ha) which is double than the global average (5.64 metric tons/ha). Whereas, the average productivity in India is 2.63 metric tons/ha India share in global export of maize is 14% (2014-2015) (USDA, 2016). In India, maize is the third most important food crops after rice and wheat. It accounts for 9% of total food grain production of the country. Maize consumption has increased at a CAGR of 3.6% over the last five years; poultry feed accounts for 50% of maize consumption. According to advance estimate its production is 16.26 million tonnes (2014-15) mainly during *Kharif* season which covers 80% area. Maize in India, contributes nearly 9 % in the national food basket and more than Rs. 100 billion to the agricultural GDP at current prices apart from the generating employment to over 100 million man-days at the farm and downstream agricultural and industrial sectors. In addition to staple food for human being and quality feed for animals, maize serves as a basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries etc. (KPMG India, 2014). Recent trends (2004-05 to 2014-15) in growth rate of area (2.5 %), production (5.5 %) and productivity (2.9 %) of maize in India has been of high order and experienced highest growth rate among the food crops. Since 1950-51, the area, production and productivity of maize have

increased by more than 3.4, 12 and 4.5 times from 3.2 m ha, 1.7 m t and 547 kg/ha to current level of 9.43 m ha, 24.35 m t and 2583 kg/ha, respectively due to increasing maize demand for diversified uses. Production of maize in India is dominated by Andhra Pradesh and Karnataka which contributes to 38% of total production. In India, the maize is used as human food (23%), poultry feed (51 %), animal feed (12 %), industrial (starch) products (12%), beverages and seed (1 % each). Introduction of Single cross hybrid (SCH) seeds coupled with adequate rainfall in 2007-08 contributed to 20% increase in yield (KPMG India, 2014).

Current Maize Utilization Pattern

The maize is cultivated throughout the year in all states of the country for various purposes including grain, fodder, green cobs, sweet corn, baby corn, popcorn in peri-urban areas. The predominant maize growing states that contribute more than 80 % of the total maize production are Andhra Pradesh (4 million tons), Karnataka (4.4 million tons), Rajasthan (2.1 million tons), Maharashtra (2.6 million tons), Bihar (1.4 million tons), Uttar Pradesh (1.1 million tons), Madhya Pradesh (1.0 million tons). Apart from these states maize is also grown in Jammu and Kashmir and North-Eastern states. Hence, the maize has emerged as important crop in the non-traditional regions i.e. peninsular India as the state like Andhra Pradesh which ranks 5th in area (0.7 m ha) has recorded the production (4 million tons) and productivity (5.3 t/ha) in the country although the productivity in some of the districts of Andhra Pradesh is more or equal to the USA (Agri. Stat. Div., 2015).

Soils: Maize can be grown successfully in variety of soils ranging from loamy sand to clay loam. However, soils with good organic matter content having high water holding capacity with neutral pH are considered good for higher productivity. Being a sensitive crop to moisture stress particularly excess soil moisture and salinity stresses; it is desirable to avoid low lying fields having poor drainage and also the field having higher salinity. Therefore, the fields having provision of proper drainage should be selected for cultivation of maize (Plessis, 2003).

Time of sowing: Maize can be grown in all season *viz*. Kharif (monsoon), post monsoon, *Rabi* (winter) and spring. During *Rabi* and spring seasons to achieve higher yield at farmer's field assured irrigation facilities are required. During *Kharif* season it is desirable to complete the sowing operation 12-15 days before the onset of monsoon. However, in rainfed areas, the sowing time should be coincided with onset of monsoon.

Table 1. Optimum sowing time of maize

Season	Optimum time of Sowing
Kharif	Last week of June to first fortnight July
Rabi	Last week of October for inter cropping and up to 15th of November for sole crop
Spring	First week of February

Seed rate and Plant geometry: To achieve higher productivity and resource-use efficiencies optimum plant stand is the key factor. The seed rate varies depending on purpose, seed size, plant type, season, sowing methods etc. The following crop geometry and seed rate should be adopted.

Table 2. Seed rate and planting geometry of Maize according to purpose

S.No.	Purpose	Seed rate (kg/ha)	Planting Geometry	Plant Population
1.	Grain (normal and QPM)	20	60 x 20 75 x 20	83333 66666
2.	Sweet corn	8	75 x 25 75 x 30	53333 44444
3.	Baby corn	25	60 x 20	83333

			60 x 15	111111
4.	Pop corn	12	60 x 20	83333
5.	Green cob (normal maize)	20	75 x 20 60 x 20	66666 83333
6.	Fodder	50	30 x 10	333333

Seed Treatment

To protect the maize crop from seed and major soil borne diseases and insect-pests, seed treatment with fungicides and insecticides before sowing is advisable/ recommended as per the below given details.

Table 3. Major diseases and their Treatments with Chemicals

Disease/insect pest	Fungicide/pesticide	Rate of application (g/kg seed)
Turcicum Leaf Blight, Banded Leaf and Sheath Blight, Maydis Leaf Blight	Bavistin + Captan in 1:1 Ratio	2.0
BSMD	Apran 35 SD	4.0
Pythium Stalk Rot	Captan	2.5
Termite and shoot fly	Imidachlorpid	4.0

Tillage and Crop Establishment

Tillage and crop establishment is the key for achieving the optimum plant stand that is the main driver of the crop yield. Though the crop establishment is a series of events (seeding, germination, emergence and final establishment) that depends on interactions of seed, seedling depth, soil moisture, method of sowing, machinery, etc. but, the method of planting plays a vital role for better establishment of crop under a set of growing situation. Maize is mainly sown directly through seed by using different methods of tillage and establishment but during winters where fields are not remain vacant in time (till November); transplanting can be done successfully by raising the nursery. However, the sowing method (establishment) mainly depends on several factors *viz.* the complex interaction over time of seeding, soil, climate, biotic, machinery and management season, cropping system, etc. Recently, resource conservation technologies (RCTs) that include several practices viz. zero tillage, minimum tillage, surface seeding etc. had come in practice in various maize based cropping system and these are cost effective and environment friendly. Therefore it is very important that different situations require different sowing methods for achieving higher yield as described below:

(i) Raised bed (ridge) Planting: Generally the raised bed planting is considered as best planting method for maize during monsoon and winter seasons both under excess moisture as well as limited water availability/rainfed conditions. Sowing/planting should be done on the southern side of the east-west ridges/beds, which helps in good germination. Planting should be done at proper spacing. Using raised bed planting technology, 20-30% irrigation water can be saved with higher productivity (Plessis, 2003).

(ii) Zero-till Planting: Maize can be successfully grown without any primary tillage under no-till situation with less cost of cultivation, higher farm profitability and better resource use efficiency. Under such condition one should ensure good soil moisture at sowing and seed and fertilizers should be placed in band using zero-till seed-cum-fertilizer planter with furrow opener as per the soil texture and field conditions.

(iii) Conventional till flat Planting: Under heavy weed infestation where chemical/herbicidal weed management is uneconomical in no-till and also for rainfed areas where survival of crop depends on conserved soil moisture, in such situations flat planting can be done using seed-cum-fertilizer planters.

(iv) Furrow Planting: To prevent evaporative losses of water during spring season from the soil under flat as well as raised bed planting is higher and hence crop suffers due to moisture stress.

(v) Transplanting: Under intensive cropping systems where it is not possible to vacate the field on time for planting of winter maize, the chances of delayed planting exists and due to delay planting crop establishment is a problem due to low temperature so under such conditions transplanting is an alternative and well established technique for winter maize. Therefore, for the situation where fields are vacated during December-January, it is advisable to grow nursery and transplant the seedlings in furrows and apply irrigation for optimum crop establishment. For planting of one hectare, 700 m^2 nursery area is required and the nursery should be raised during second fortnight of November. The age of seedlings for transplanting should be 30-40 days old (depending on the growth) and transplant in the month of December-January in furrows to obtain higher productivity (Plessis, 2003).

Nutrient Management

Among all the cereals, maize in general and hybrids in particular are responsive to nutrients applied either through organic or inorganic sources. The rate of nutrient application depends mainly on soil nutrient status/balance and cropping system. Therefore, for higher economic yield of maize, application of 10 t FYM/ ha, 10-15 days prior to sowing supplemented with 150-180 kg N, 70-80 kg P_2O_5, 70-80 kg K_2O and 25 kg $ZnSO_4$/ ha is recommended. Full doses of P, K and Zn should be applied as basal preferably drilling of fertilizers in bands along the seed using seed-cum-fertilizer drills. Nitrogen should be applied in 5-splits as detailed below for higher productivity and use efficiency. N application at grain filling results in better grain filling. Therefore, nitrogen should be applied in five splits as per below mentioned for higher N use efficiency.

Table 4. Nitrogen application split doses

S.No.	Crop stage	N (%)
1.	Basal (at sowing)	20
2.	V4 (Four leaf stage)	25
3.	V8 (Eight leaf stage)	30
4.	VT (Tasseling stage)	20
5.	GF (Grain filling stage)	5

Water management: The irrigation water management depends on season as about 80% of maize is cultivated during monsoon season particularly under rainfed conditions. In general, the irrigation should be applied in furrows up to 2/3rd height of the ridges/beds. Young seedlings, knee high stage (V8), flowering (VT) and grain filling (GF) are the most sensitive stages for water stress. In raised bed planting system and limited irrigation water availability conditions, the irrigation water can also be applied in alternate furrow to save more irrigation water (Morris *et al*., 1999).

Weed Management: Weeds are the serious problem in maize, particularly during kharif/monsoon season they compete with maize for nutrient and causes yield loss up to 35 %. Therefore, timely weed management is needed for achieving higher yield. Atrazine being a selective and broad-spectrum herbicide in maize checks the emergence of wide spectrum of weeds. Pre-emergence application of Atrazine (Atratraf 50 wp, Gesaprim 500 fw) @ of 1.0-1.5 kg/ha in 600 liter water, Alachlor (Lasso) @ 2-2.5 kg/ha, Metolachlor (Dual) @ 1.5-2.0 kg/ha, Pendimethalin (Stomp) @ 1-1.5 kg/ha are effective way for control of many annual and broad leaved weeds. For areas where zero tillage is practiced, pre-plant application (10-15 days prior to seeding) of non-selective herbicides *viz*. Glyphosate @ 1.0 kg/ha in 400-600 liter water or Paraquat @ 0.5 kg/ha in 600 liter water is recommended to control the weeds (Morris *et al*., 1999).

Crop Protection

a. Insect-Pest Management

i. Stem Borer (*Chilopartellus*): Major pest of maize in India is Stalk borer. *Chilopartellus*, popularly known as stalk borer that occurs during monsoon season is a major pest throughout the country.

ii. Pink Borer (*Sesamia inference*): *Sesamia inference* occurs during winter season particularly in peninsular India. The moth of the *Sesamia* is nocturnal and lays eggs on lower leaf sheath.

For control of *Chilo and Sesamia*, foliar spray of 0.1 % Endosulfan {700 ml (35 EC) in 250 liter water} 10 days after germination is very effective. The *Chilo*can also be controlled by

release of 8 Trichocards (*Trichogramma chilonis*) per hectare at 10 days after germination. Intercropping of maize with suitable varieties of cowpea is an eco-friendly option for reducing the incidence of *Chilo*on maize.

iii. Shoot Fly *(Atherigona* sp.): In South India it is a serious pest but it also appears on spring and summer maize crop in North India. It attacks mainly at seedling stage of the crop.

Control of Shoot fly

• Sowing must be completed before first week of February so that the crop will escape shoot fly infestation.

• Spring sowing must be accompanied with seed treatment with Imidacloprid @ 6mL/kg seed.

iv. Termites *(Odontotermesobesus*)

Termite is also an important pest in many areas. For control of termite fepronil granules should be applied @ 20 kg/ ha followed by light irrigation.

b. Disease Management

Across the country several diseases occurs during different seasons, if they are not managed at proper time than they leads to yield loss. Estimated losses due to major diseases of maize in India are about 13.2%. The major diseases and their management practices are described as below:

i. Turcicum Leaf Blight (*Exserohilum turcicum*): The disease is prevalent in cooler condition with high humidity of Jammu & Kashmir, Himachal Pradesh, Sikkim, etc. Grow PEMH-5, Vivek 21, Vivek 23, Vivek 25, Pratap Kanchan 2, Nithyashree in the recommended areas followed by need based sprays of mancozeb @ 2.5 g/liter (with adjuvant @ 0.05%) at 8-10 days interval.

ii. Maydis Leaf Blight (*Dreschlera maydis*): It is a major disease in the states of Jammu & Kashmir, Himachal Pradesh, Sikkim, Meghalaya, Punjab, Haryana, Rajasthan, etc. having warm humid temperate to tropical climate in the cropping period. Growing of HM 10, PAU 352, Malviya Hybrid Makka 2, EMH 1, HQPM 7, HQPM 5, HQPM 1, Shaktiman 3, Shaktiman 4, PEMH– 5, HQPM-4, and HSC-1 with need based sprays of mancozeb or zineb @ 2.5g/liter of water.

iii. Common rust (*Puccinia sorghi*): This rust attacks in the maize growing areas with subtropical temperate and high land environment of Jammu & Kashmir, Himachal Pradesh, Sikkim, Meghalaya, etc. It appears at the time of tasseling. Adopt promising hybrids/ varieties *viz*. Buland, Sheetal, HHM 1, HHM 2 and HQPM 1, Nithyashree. Spray of mancozeb@ 2.5g/liter of water at first appearance of pustules. Prefer early maturing varieties.

iv. Polysora Rust (*Puccinia polysora*)**:** It is reported from coastal areas of A.P. and Karnataka where mild temperature and high relative humidity prevail. The maize composites namely NAC-6002 (early maturity) and NAC-6004 (late maturity) and the hybrid Hema (NAH–1137), Nithyashree (NAH–2049) and Deccan–105 were resistant to Polysora rust disease of maize.

v. Banded leaf and sheath blight (*Rhizoctonia solani* f. sp. s*asakii*)**:** This disease mainly occurs in Jammu and Kashmir, Himachal Pradesh, Sikkim, etc. At appearance of the disease, white lesions develops on leaves and sheath. Pratap Kanchan 2, Pratap Makka 3, Pratap Makka 5, Shaktiman 1 and Shaktiman 3 have tolerance to this disease. Seed treatment with peat based formulation @ 16 g/kg of *Pseudomonas fluorescence* or as soil application @ g/liter of water, carbendazim, thiophanate-methyl and 12 captan and foliar spray (30-40 days old crop) of tolcofos-methyl @ 1g/ litre or validamycin @ 2.7mL/liter of water.

vi. Pre-flowering Stalk Rots (*Pythium aphanidermatum* and *Erwinia chrysanthemi* p.v. *zeae):* The high incidence of Pythium and bacterial stalk rots favored by high temperature and high relative humidity in states of Sikkim, Himachal Pradesh, West Bengal, etc. Good field drainage (to avoid waterlogging), planting time between 10 and 20th July in North India, plant population of not more than 50,000/ha reduce the less disease. PEMH- 1, X-1280, HQPM-4, PAU 352, PEMH- 5, DKI – 9202, DKI – 9304 are having tolerance to these stalks. Application of 75% captan @ 12 g/100 liter of

water and bleaching powder (33% chlorine) @ 10 kg/ha as soil drench help in the control of these stalks.

vii. Post Flowering Stalk Rot of Maize (PFSR): The PFSR occurs mainly in Rajasthan, Uttar Pradesh, Bihar and Andhra Pradesh. Disease appears when the crop enters in senescence phase. The pathogen commonly affects the roots crown regions and lower internodes. When split open, the stalk shows pink-purple dis-colouration. For effective control of the disease, water stress at flowering should be avoided. Use balance dose of nutrients wherein potassium application helps in minimizing the disease. Use of bio-control agents (*Trichoderma* formulation) in furrows mixed with FYM @ 10g/kg at 10 days prior to its use in the field. It always advisable to practice crop rotation to minimize the disease incidence.

viii. Downy Mildews (DM): This group of the pathogens constitutes one of the most important factors limiting maize production in India. The important species causing downy mildew in maize in India are the Sorghum downy mildew (SDM; *Peronosclerospora sorghi*), Brown stripe downy mildew (BSDM; *Sclerophthora rayssiae* var. *zeae*) and Rajasthan downy mildew (RDM; *Peronosclerospora hetropogoni*). Rogue and destroy infected plants as they appear in the field. Avoid maize-sorghum crop rotation in field where disease has occurred. Avoid sowing of maize adjacent to a field of maize or sorghum to avoid the spread of secondary infection. Early planting of maize escapes RDM infection. Use resistant varieties/hybrids (PAU 352, Pratap Makka 3, Gujarat Makka 4, Shalimar KG 1, Shalimar KG 2, PEMH– 5, Bio 9636, NECH- X-1280, DMH 1, NAC 6002, COH (M) 4, COH (M) 5, Nithyashree. Seed should invariably be treated with metalaxyl @ 2.5g/kg seed and need based foliar sprays of systemic fungicide such as metalaxyl @ 2-2.5g/L is recommended at first appearance of disease symptoms (Joshi *et al*., 2000).

Maize Based Cropping Systems in India

As maize has wide adaptability and compatibility under diverse soil and climatic conditions. Maize-wheat is the 3rd most important cropping systems after rice-wheat and rice-rice that contributes about 3 % in the national food basket. The other major maize systems in India are maize-mustard, maize-chickpea, maize-maize, cotton-maize etc.

Table 5. Maize based sequential cropping systems in different ago-climatic zones of India

Agro-climatic Region	Cropping System	
Irrigated	Rainfed	
Western Himalayan Region	Maize-wheat Maize-potato-wheat Maize-wheat-greengram Maize-mustard Maize-sugarcane	Maize-mustard Maize-legumes
Eastern Himalayan Region	Summer rice-maize-mustard Maize-maize Maize-maize-legumes	Sesame-Rice+maize
Lower Gangetic Plain region	Autumn rice-maize Jute-rice-maize	Rice-maize
Middle Gangetic Plain region	Maize-early potato-wheat-mungbean Maize-wheat Maize-wheat-mungbean Maize-wheat-urdbean Maize-sugarcane-mungbean	Maize-wheat
Upper Gangetic Plain region	Maize-wheat Maize-wheat-mungbean Maize-potato-wheat Maize-potato-sunflower Maize-potato-onion Maize-potato-sugarcane-ratoon Rice-potato-maize	Maize-wheat Maize-barley Maize-safflower

Trans Gangetic Plain region	Maize-wheat Maize-wheat-mungbean Maize-potato-wheat Maize-potato-sunflower Maize-potato-onion Mungbean-maize-toria-wheat Maize-potato-mung bean	Maize-wheat
Eastern plateau & hills region	Maize-groundnut-vegetables Maize-wheat-vegetables	Rice-potato-maize Jute-maize-cowpea
Central plateau & hills region	Maize-wheat	Maize-groundnut
Western plateau & hills region	Sugarcane + Maize	
Southern plateau & hills region	Rice-maize Maize-rice	Sorghum-maize Maize-sorghum-Pulses Maize-potato-groundnut
East coast plain and hills region	Rice-maize-pearl millet Maize-rice Rice-maize Rice-rice-maize	Maize-maize-pearl millet Rice-maize + cowpea
West coast plain and hills region	Maize-pulses Rice-maize	Rice-maize Groundnut-maize
Gujrat plains and hills region	Maize-wheat	Rice-maize
Western dry region	Maize-mustard Maize-chickpea	Maize+legumes
Island region	Rice-maize	Maize-rice Rice-maize + cowpea Rice-maize-urd bean Rice-rice-maize

Table 6. Maize based Intercropping systems

Intercropping systems	Suitable area/situation
Maize + Pigeon pea Maize + Cowpea Maize + Mung bean Maize + Urd bean Maize + Sugarcane Rice + Maize Maize + Soybean	All maize growing areas
Maize + high value vegetables Maize + flowers Baby corn + vegetables Sweet corn + vegetables	Peri-urban interface

(Source: Singh *et al*., 2010)

Maize and Climate Change

Under the changing climate scenario the limitations of rising temperature during grain filling of wheat particularly in eastern India, and declining yield of boro rice in West Bengal and Orissa, water scarcity areas in peninsular India (AP and Tamil Nadu) affecting yield of *Rabi* rice, maize being a photo-insensitive crop has better options for adaptation and mitigation of these climatic changes. Peninsular India is considered to be a neutral environment for maize wherein maize can be cultivated in either of the seasons. Therefore, it is emerging as a potential driving force for diversification i.e. diversification of rice-rice with rice-maize and other maize based high value cropping systems in water scarcity/lowering of water table is a major concern in rice growing belt of India and making rice cultivation non-remunerative. Hence, maize has emerged as a potential as well as profitable crop in these areas. Wheat crop adversely affected with terminal heat due to sudden rise in temperature during crop growth and maturity but this favors maize crop positively.

Quality Protein Maize, Specialty and other Corn type Production Technology

Other than grain, maize is also cultivated for various purposes like quality protein maize and other special purposes known as 'Specialty Corn'. The various specialty corn types are quality protein maize (QPM), baby corn, sweet corn, popcorn, waxy corn, high oil corn etc. In India, QPM, baby corn and sweet corn are being popularized and cultivated by the large number of farmers. The brief summary of different type of specialty maize is as follows –

i. Quality Protein Maize

As more than 85 % of the maize is used directly for food and feed, the quality has a great role for food and nutritional security in the country. In this respect, discovery of Opaque-2 (O2) and floury-2 (F2) mutant had opened tremendous possibilities for improvement of protein quality of maize which later led to the development of "Quality Protein Maize (QPM). Quality Protein Maize has specific features of having balanced amount of amino acids with high content of lysine and tryptophan and low content of leucine& isoleucine. The production technology of QPM is same as of normal grain maize except isolation as to maintain the purity of QPM, it should be grown in isolation with normal maize.

ii. Baby corn: Baby corn is a young finger like unfertilized cobs with one to three centimeter emerged silk preferably harvested within 1-3 days of silk emergence depending upon the growing season. It can be eaten raw as salad and in preparation of different recipes such as chutney, pakora, mix vegetables, pickles, candy, murabba, kheer, halwa, raita, Chinese preparations, etc. In general, the cultivation practices of baby corn are similar to grain crop except (i) higher plant population (ii) higher dose of nitrogen application because of higher plant population (iii) preference for early maturing single cross hybrid and (iv)harvesting within 1-3 days of silk emergence.

iii. Sweet corn: Sweet corn is one of the most popular vegetables in the USA, Europe and other developed countries of the world. It is a very delicious and rich source of energy, vitamin C and A. It is eaten as raw, boiled or steamed green cobs/ grain. It is also used in preparation of soup, salad and other recipes. Generally sweet corn is early in maturity. It is harvested in 70-75 days during kharif season. Green cobs are harvested after 18-20 days of pollination during kharif but the duration may varies season to season. At the harvest time the moisture is generally 70 % in the grain and sugar content varies from 11 to more than 20%. Sweet corn is generally dull yellow and white but dull yellow color is preferred. Sweet corn with high sugar content should not be planted when temperature is below 16^{o}C (Joshi *et al*., 2000).

iv. Pop Corn: Popcorn is one of the common snack items in many parts of the world, particularly in cities and is liked because of its light, porous and crunchy texture. The popcorn flour can also be used for preparing many traditional dishes. It is consumed fresh, as it has to be protected against moisture absorption from the air. It is hard endosperm flint maize. Kernels of popcorn are very small and oval/round in shape. When heated at about 1700C, the grains swell and burst, turning inside out. Quality of popcorn depends on popping volume and minimum number of non-popcorn.

v. Waxy corn: It is originated in China but largely used in USA. Grain gives wax-like appearance and having 100 **%** amylopectin starch**.** While in normal maize, the starch is nearly 30 percent amylose and the remaining 70 % is amylopectin. Waxy corn is mainly used for food and industrial purposes.

vi. High oil corn: Most of the normal maize lines have 3- 4 % oil content. In general, lines with more than 6 % oil are considered high oil lines. 95 % of the total oil is in the germ. When the oil percent increases the starch decreases. The corn oil has low content of saturated fatty acid and is considered to be one of the best quality cooking oil.

vii. Fodder maize: Maize fodder can be used at any crop growth stage. Its quality is adversely affected after anthesis. To maintain the fodder quality the detasseling is advised to the farmers for better digestibility and palatability.

Table 7. Quality protein maize, specialty and other corn type cultivars

S. No.	Corn type	Cultivars
1.	Quality Protein Maize	H*:HQPM 1 & HQPM 5 (All States of India), HQPM 7, Vivek QPM 9 (Peninsular India), C**:Shaktiman1,2,3 and 4 (Bihar)
2.	Baby corn	H:HM-4, C: VL Baby Corn 1

3.	Sweet corn	H:HSC1 for J&K and HP C:Madhuri, Win Orange, Priya
4.	Pop corn	C: Jawahar, Amber, Pearl & VL Pop corn
5.	Fodder	C: African tall, J 1006 & Pratap chari-6

(Source: Prasad, 2012)

CONCLUSION

From the above, it can be concluded that it is necessary to study and characterize maize production systems, and future policy and technology interventions need to be formulated accordingly. The study observed that maize has potential for product diversification under a new economic regime. Demand for maize is shifting from food to feed for livestock and poultry. New opportunities need to be tapped by providing appropriate technologies to farming communities.

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