

Spring maize: A high-yielding and water demanding crop- Scenario and alternatives

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Introduction

Maize (*Zea mays* L.), also known as corn and 'Makka' locally, is the 3rd most important cereal crop in India. It is also known as "Queen of cereals" because of its high genetic yield potential. It holds significance in economic and nutritional value across the country. Maize can be cultivated in a wide variety of climatic regions, from cooler northern parts of the country to the tropical areas in the southern part. Unlike conventional maize growing seasons which are Kharif and rabi, spring maize is grown in the northern parts of the country mainly in Punjab during Spring season between 15th January to 15th February. According to the Punjab Agriculture University (PAU), in 2023, the cultivated area under Spring maize was 1.5 lakh hectares with the production of 14 lakh quintals and productivity of 38 q/acre. Farmers are favouring the cultivation of Spring maize over conventional kharif maize, as it improved production and net income due to lower temperatures during spring resulting in enhanced vegetative growth, lower weed infestation and insect-pest attack.

Why farmers choosing Spring maize

Spring maize is preferred especially by the farmers of Punjab especially in the districts of Jalandhar, Hoshiarpur, Ropar, Nawanshahr, Ludhiana and Kapurthala (Sharma *et al.*, 2014). It gives higher yield accompanied by enhanced vegetative growth, lower insect-pest attack and weed infestation due to the low temperatures (Mid. Jan. to mid. March) during the vegetative phase of crop. Insect pests are cold blooded; thus, the temperature of environment in which they sustain has a direct impact on their activity and metabolism. When temperatures are low, the activity of the insect is reduced (Saha *et al.*, 2023).

Spring maize has a potential yield capacity up to 40 q/acre. The popularity of spring maize has surged in the past 4-5 years, driven by rising demand for cattle feed and favourable market prices. Farmers receive between Rs. 2200 to Rs. 2300 per quintal for maize, slightly above the minimum support price (MSP) of Rs. 2090 per quintal (Anonymous, 2024). Minimum and maximum temperatures during cultivation of Spring maize and Kharif maize in the state of Punjab is given below.

Table 1: Mean monthly temperatures (in Celsius) of Punjab state during 2023

Crop	Jan		Feb		March		April		May	
Spring maize	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
	6 ⁰ C	18 ⁰ C	9 ⁰ C	22 ⁰ C	12 ⁰ C	32 ⁰ C	22 ⁰ C	42 ⁰ C	27 ⁰ C	46 ⁰ C
Kharif maize	July		Aug		Sep		Oct		Nov	
	24 ⁰ C	41 ⁰ C	23 ⁰ C	37 ⁰ C	21 ⁰ C	35 ⁰ C	19 ⁰ C	32 ⁰ C	10 ⁰ C	29 ⁰ C

Table 1 reveals that the Spring maize benefits from cooler temperatures during its vegetative phase (Jan-March), while Kharif maize is grown during hotter months (July-Nov), requiring more heat tolerance and have the heavier risk of insect pest attack.



Fig 1: Hybrid Spring maize (P1899)



Apart from the above benefits, Spring maize has an excellent demand to produce ethanol, as Punjab has a dozen ethanol manufacturing plants, which have a production capacity of 30 lakh litres every day and 100 silage units which use green fodder (Hindustan Times, 13th May 2024).

Table 2: Comparison of yield of Spring maize and Kharif maize varieties in Punjab state

S. No.	Spring maize			Kharif maize		
	Varieties/ Hybrids	Year of Release	Avg. yield (q/ha)	Varieties/ Hybrids	Year of Release	Avg. yield (q/ha)
1	P1844/1899	2019	32.0	DKC 9144	2024	24.6
2	PMH 10	2015	31.5	Bioseed 9788	2024	24.3
3	DKC 9108	2015	32.0	PMH 14	2023	24.8
4	PMH 8	2014	31.0	PMH 13	2021	24.0
5	PMH 7	2013	30.0	ADV 9293	2021	24.5
6	PMH 1	2005	27.6	PMH 11	2019	22.0

Source: Punjab Agricultural University, Package of Practices 2024-25

From Table 2, we can conclude that the average yield of the spring maize varieties is 20-25% more than the kharif maize varieties.

Also, special thrust on ethanol blend petrol by the central government to reduce the air pollution by the vehicles under the National Biofuels Policy, 2018 added a cause to elevate maize markets. Restrictions on the use of sugarcane in the production of Biofuel is also one of the important reasons to the increased demand of maize in the Bio-fuel Production.

Higher Water Needs

Generally, in kharif season maize requires an average water need about 500-550 mm, in which partial water needs are met by rainfall, which can be satisfied by 3-4 irrigations. But in case of spring maize due to dry months during the crops period i.e. March to May, it needs more water to sustain than normal. An average of 15-16 irrigation cycles is required to meet the high evaporative demands during these dry months (March-May).

Challenges

In a state like Punjab with fast-depleting ground water table, usually cannot accommodate the high-water requirement crops like spring maize. The on-ground research conducted by Gobinder Singh *et al.*, (2018) reveals that out of 145 water blocks (areas which uses ground water for irrigation), 110 were already declared the dark zones (areas with depleted water ground water level) by Punjab Government. As farmers of the Punjab state were not aware about the upcoming consequences like ground water table depletion, as this crop needs more irrigation cycles due to higher temperatures during the April and May. As a result, farmers increasing the depth of the submersible pumps which is a high risk and great cause for ground water depletion. Currently Spring maize has a production area about 1.50 lakh hectares when compared to 90,000 hectares of Kharif maize, which has minimal of 3-4 irrigation cycles. The article published in The tribune: News (12th June 2024) says that the farmers who has previously engaged in potato and pea farming has shifted to Spring maize for higher profitability. Not only other crops but this high profitability attracted wheat farmers as a result wheat residue burning incidence with over 11,000 cases reported during the year 2023-24, which contributes a significant share in environment pollution.

Solutions/ Alternatives

By considering the current scenario, instead of water guzzling Spring maize, growing of summer moong and sunflower crops are the best alternative. As summer moong is a short duration (70 days) crop that requires few irrigations than spring maize. Also growing of summer moong is more economical and productive when compared to spring maize. Not only economically beneficial but also climate resilient as it improves soil health by fixing the atmospheric nitrogen and adding organic matter when the dry matter is incorporated into soil after picking the dried pods, reduced the nitrogen requirement of succeeding crop by 20-25% and increases the phosphorus availability to the succeeding rice crop.

Use of alternative cropping systems like wheat-soyabean, wheat-millet/moong bean will be beneficial in terms of both economics and sustainability. Use of conservative tillage, drip irrigation and mulching practices helps in improving soil water storage and greatly reduces the usage of irrigation water.



Singh *et al.*, (2015) conducted field experiments on spring maize for two years using paddy straw mulch and their pooled results revealed that water use efficiency of spring maize significantly increased when paddy straw mulch (8.67 kg/ha/mm) is used over no mulch (7.64 kg/ha/mm). Talukdar *et al.*, (2023) conducted experiments of maize intercropped with French bean and Soyabean, the findings revealed that Maize + Soyabean intercropping system significantly increases the yield over sole maize. The intercropping system in Maize with any legume significantly reduces the water needs of maize as the legume intercrop acts as mulch crop and use of legume as intercrop will reduce the nitrogen requirement of succeeding crop by 20-25%.

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY):

The department of Agriculture and Farmers Welfare implemented the Central Scheme with the slogan “Per Drop More Crop” in the country from 2015-16 to 2022-23 as a component of PMKSY. From 2022-23, this scheme is being implemented under the Rashtriya Krishi Vikas Yojana (RKVY). This Scheme is mainly focusing on the improvement water use efficiency at farm level by the installation of micro irrigation i.e., Drip and Sprinkler irrigation. Financial assistance of 55% for small and marginal farmers and 45% for other farmers is providing Central Government for the installation of Micro irrigation under this scheme. In addition to this state governments also providing some incentives to encourage the farmers to adopt the micro irrigation systems.

To facilitate this scheme the Central Government has initiated Micro Irrigation Fund (MIF) with the NABARD with initial corpus of Rs. 5000 crores. An area of 83.46 lakh hectares has been covered under this scheme from 2016-16 to 2023-24. In Punjab state, 15173 hectares has been covered under this scheme from 2015-16 to 2023-24, which is only 0.18% of total country's coverage. As a state of having fast ground water depleting areas, Punjab needs to increase the area under micro irrigation systems to increase the water use efficiency. Also, usage of drip irrigation system increases the water use efficiency in Spring maize significantly when compared to the conventional irrigation system.



Summary/ Conclusion

Spring maize farming in Punjab has grown in popularity because of its better yield and optimal growth circumstances, which provide farmers with increased income and lower biotic stress. However, increased water demand for Spring maize, particularly during the dry months, poses substantial hazards to the region's already depleted groundwater reserves. To address this, alternative crops such as summer moong and sunflower, which are more water-efficient and climate adaptable. Furthermore, using sustainable methods such as drip irrigation, mulching, conservative tillage and intercropping practices can help conserve water and improve soil health. Balancing crop profitability with water conservation is needed to Punjab agriculture's long-term success.

