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Popularization of quality protein maize shaktiman-5 in Muzaffarpur and East Champaran district of Bihar under front line demonstration programme

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Abstract
A front line demonstration programme of quality protein maize was conducted in order to evaluate the scientific method of QPM cultivation and farmer practices in the important maize growing districts i.e Muzaffarpur and East Champaran of Bihar. The scientific method of QPM cultivation for QPM includes sowing of seeds at a distance of 60 X 25 cm, application of fertiliser at the rate of N: P_2O_5:K_2O:: 150:70:60 kg/ha, irrigation at knee height, pre-flowering and grain filling stages and application of Chlorantraniliprole 18.5 SC @ 0.4 ml/L at fortnight interval during initial growth stages. The framer practices include broad casting method of sowing, application of higher doses of fertiliser particularly urea at the time of sowing and irrigation depending upon the soil moisture content irrespective of critical stages. In each districts, 10 progressive farmers were selected for recording the observation regarding grain yield. Based on the results, it was found that QPM variety with front line demonstration practices records higher yield in fields of all the farmers in both the districts. The FLD practices also showed lesser damage by the Fall Armyworm (*Spodoptera frugiperda*) and stem borer (*Chilo partellus*) as compared to farmer practices.

Keywords: FLD, farmer practices, QPM, yield

Introduction
Maize is the most widely distributed crops of the world. It is cultivated in tropics, sub-tropics and temperate regions unto 50^0 and from sea level to 4000 m. altitude under irrigated to Semi-arid conditions. This represents 24% of the total cereal production as compared to 27% for wheat and 25% for rice. It is an important cereal in many developed and developing countries of the world. It is widely used for animal feed and industrial raw material in the developed countries where as the developing countries use it in general for feed. In Indian agriculture, it occupies a prominent position and each part of the maize plant is put to one or the other use and nothing goes as waste. Among the cereal crops in India, maize with annual production of around 10 million tones covering 6 million hectares ranks fifth in area being next to rice, wheat, jowar and bajra, fourth in production whereas in productivity it ranks at third position. Maize production in country is fully utilized domestically for food and exports are negligible. Even with the spectacular increase during the recent years in production of the finer cereals i.e., rice, wheat or also of jowar coarse grain, there is no problem of surplus of maize. It is, therefore, inferred that, with the increasing demand for, food grains relative population growth maize will hold its share as an important cereal food grain.
Maize is among the most important cereal crops across the world. The role of maize as a staple crop in Africa is comparable with wheat and rice in Asia (Nuss & Tanumihardjo, 2011) [7]. Maize along with wheat and rice providing around 30% of food calories to more than 4.5 billion people in 94 developing countries. Among these consumers, about 900 million belong to poor families. Role of maize in terms of calorie share for human consumption is significantly variable across the regions (Shiferaw *et al*., 2011) [10].
Maize and its products comprised 30% of food supply for Americas, 38% for Africans and 6.5% for Asian. Maize is also important part of livestock and poultry industry across the world (Tanumihardjo *et al*., 2019) [11]. Different food habits are prevailing in different countries and different dishes with different types of morpho-physiological processing are prepared from maize (Nuss & Tanumihardjo, 2010, 2011) [6, 7]. Limited diversification in dietary food and higher per capita maize consumption in several Latin American, African and Asian countries

indicating that great proportion of population in these regions are lacking in essential nutrients like micronutrients, amino acids (lysine and tryptophan). Essential amino acids like lysine and tryptophan are serving as important neurotransmitters besides their basic function to act as protein building blocks. Deficiency of these amino acids may become reason of reduced appetite, impaired skeleton development, delayed growth and aberrant behaviour (Tome & Bos, 2007) [12].

Eggs, dairy products, meat and legumes, which are also called high quality protein sources, provides essential amino acids which are absent in maize. But consumption of these high-quality protein sources is limited due to availability and affordability issues in rural areas. This disease increases the susceptibility against different diseases like gastroenteritis and tuberculosis (Rolfes *et al*., 2009) [9]. Infants feeding on non-QPM maize are more likely to suffer from malnutrition and become victim of diseases such as Kwashiorkor (Badu-Apraku *et al*., 2015) [1]. Protein intake and dietary energy intake from protein are different for various countries. As proteins are accounting for significant proportion of dietary intake, however, biological value of these proteins can be doubled by using the quality protein maize (QPM) as dietary source. QPM is also important to overcome pellagra disease. Pellagra is basically comprised of three main diseases viz. diarrhea, dermatitis and dementia. There are many other symptoms like, aggression, edema, tongue inflammation, skin lesions, insomnia, weakness, paralysis of extremities, nerve damage, dilated cardiomyopathy and dementia are also associated with pellagra (Hegyi *et al*., 2004) [4]. QPM is very important type of maize to ensure the nutritional security of maize dependent communities. International Maize and Wheat Improvement Center (CIMMYT) and the International Institute of Tropical Agriculture (IITA) are working on development of QPM germplasm which may contain twice the amount of essential amino acids that is lysine (>4.0%) and tryptophan (>0.8%) than normal maize (Krivanek *et al*., 2007) [5].

A grain of modern maize comprised of about 73% starch, 9% proteins, 4% oil and 14% other contents including fibre. Endosperm and germ are two main parts of the maize grain and comprising about 80% and 10% of grain dry weight, respectively. The endosperm is about 90% starch, whereas germ contains about 30% oil and 18% protein. Among protein contents, endosperm is comprised of about 80% protein and rest is present in germ. Germ protein is of superior quality but endosperm protein is of poor quality due to deficiency of essential amino acids that is lysine and tryptophan (Prasanna *et al*., 2001) [8].

Nutritional value of maize is poor for monogastric animals including humans due to absence of essential amino acids like lysine and tryptophan. Lysine is comprised of only 2% of total protein contents in normal maize (NM) which is even less than half of the amount recommended by Food and Agricultural Organization (Food & Agricultural Organization, 2008) [3]. Biological value (absorption and utilization of protein by body) of QPM is about 80%, whereas for NM it ranges from 40% to 57% and highest known for egg is 86% (Bressani, 1992) [2]. United Nations Children's Fund (UNICEF) reported that the inclusion of QPM in daily life proved to be effective for combating malnutrition (Vasal, 2001) [8]. QPM has higher lysine, tryptophan and leucine contents along with higher biological value and higher protein intake (Mertz *et al*., 1964). QPM also has higher contents of non-zein protein (albumin, globulin and glutelin fractions), which are rich in lysine and tryptophan (Vivek *et al*., 2008) [14].

Keeping in view the above point, a frontline demonstration involving quality protein maize was undertaken to popularise the quality protein maize among rural areas of different district of Bihar.

Materials and Methods

A front line demonstration programme of quality protein maize variety Shaktiman 5 was conducted in order to evaluate the scientific method of QPM cultivation and farmer practices during 2021-22 in the important maize growing districts i.e Muzaffarpur and East Champaran of Bihar. The scientific method of QPM cultivation for QPM includes sowing of seeds at a distance of 60 X 20 cm, application of fertiliser at the rate of N: P_2O_5:K_2O:: 150:70:60 kg/ha, irrigation at knee height, pre-flowering and grain filling stages and application of Chlorantraniliprole 18.5 SC @0.4 ml/L at fortnight interval during initial growth stages. The framer practices include broad casting method of sowing, application of higher doses of fertiliser at the time of sowing and irrigation depending upon the soil moisture content irrespective of critical stages. In each district, 10 progressive farmers were selected for recording the observation regarding grain yield.

Results

The QPM variety Shaktiman-5 under front line demonstration programme was compared with local variety KSP5391 under farmer practice scenario in Muzaffarpur district where as that of compared with local variety NK 6802 under farmer practice scenario in East Champaran district. It was found that the QPM variety with front line demonstration practices records higher yield in fields of all the farmers in both the districts. The QPM variety under front line demonstration practices recorded on an average of 57.3±2.45 q yield per ha whereas the variety KSP5391 recorded on an average of 40.8±2.65 q yield per ha in muzaffarpur district (Table 1). Similarly in East Champaran district, the QPM variety under front line demonstration practices recorded on an average of 54.4±3.20 q yield per ha whereas the variety NK 6802 recorded on an average of 45.2±3.82 q yield per ha (Table 2). It was observed that QPM variety under front line demonstration practices recorded 28.79±3.47% & 16.67±5.67% extra yield as compared to normal variety KSP5391 & NK6802 in Muzaffarpur and East Champaran district (Table 1 & Table 2). It was also observed that the front line demonstration practices recorded lesser infestation by fall armyworm and stem borer as compared to farmer practices (Fig 1 & Fig 2).

Fig 1:% Fall Army Infestation

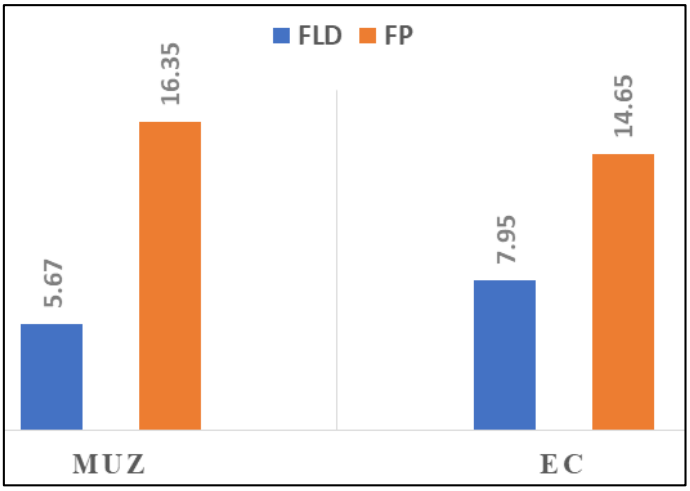

Fig 2:% Stem Borer Infestation

Table 1: A comparative study between quality protein maize under front line demonstration and normal variety under farmer practices in Muzaffarpur district

S. No.	Name of the farmer	Address (name of village, sub-division, district)	FLD technology details	Area (ha)	Check / Farmer practice details (FP)	Yield (q/ha)		Yield gains (%)
						FP	FLD	
1	Mr. Raghvendra Kumar Singh	Vill:- Hasna Post:- Hasna Dist- Muzaffarpur	Shaktiman-5 (QPM Hybrid)	0.4 ha	KSP5391	39.00	57.00	31.57
2	Mr. Navin Kumar	Vill: Bhushra Post. Hasna Dist- Muzaffapur	Shaktiman-5 (QPM Hybrid)	0.4 ha	KSP5391	43.00	55.00	21.81
3	Mr. Manoj kunwar	Vill:- Bhushra Post. Hasna Dist. Muzaffapur	Shaktiman-5 (QPM Hybrid)	0.4 ha	KSP5391	37.00	53.00	30.18
4	Mr. Upendra Kunwar	Vill:- Bhushra Post. Hasna Dist Muzaffapur	Shaktiman-5 (QPM Hybrid)	0.4 ha	KSP5391	39.00	58.00	32.75
5	Mr. Sachhidanand Jha	Vill:- Bhushra Post. Hasna Dist Muzaffapur	Shaktiman-5 (QPM Hybrid)	0.4 ha	KSP5391	44.00	61.00	27.86
6	Mr. Madhumangal Kumar	Vill:- Bhushra Post. Hasna Dist. Muzaffapur	Shaktiman-5 (QPM Hybrid)	0.4 ha	KSP5391	42.00	60.00	30.00
7	Mr. Sanoj Kumar	Vill:- Bhushra Post. Hasna Dist. Muzaffapur	Shaktiman-5 (QPM Hybrid)	0.4 ha	KSP5391	44.00	59.00	25.42
8	Mr. Nilesh Kumar	Vill:- Bhushra Post. Hasna Dist. Muzaffapur	Shaktiman-5 (QPM Hybrid)	0.4 ha	KSP5391	43.00	58.00	25.86
9	Mr. Shashi Bhushan Kumar	Vill:- Bhushra Post. Hasna Dist. Muzaffapur	Shaktiman-5 (QPM Hybrid)	0.4 ha	KSP5391	39.00	57.00	31.57
10	Miss. Amlesh devi	Vill:- Bhushra Post. Hasna Dist. Muzaffapur	Shaktiman-5 (QPM Hybrid)	0.4 ha	KSP5391	38.00	55.00	30.90
						40.8±2.65	57.3±2.45	28.79±3.47

Table 2: A comparative study between quality protein maize under front line demonstration and normal variety under farmer practices in East Champaran district

Sl. No	Name of the Farmers	New Technology Demonstrated in FLDs	Hybrid/ QPM	Area (ha.)	Local check/ Farmer practice details	Yield (q/ha)		Gain Yield (%)
						Farmers Practices	FLD (q)	
1	Md. Ajad Alam Vill:- Jaishinghpur, Sharda Tola Post:- Turkulia Dist. East Champaran	QPM Hybrid	Shaktiman-5	0.4	NK 6802	39.00	55.00	29.09
2	Mr. Hari Kishor Singh Vill:- Sarisaka Post:- Murapur Dist. East Champaran	QPM Hybrid	Shaktiman-5	0.4	NK 6802	43.00	51.00	13.72
3	Mr. Basir Ansari Vill:- Jaishinghpur, Bandraha Post:- Turkulia Dist. East Champaran	QPM Hybrid	Shaktiman-5	0.4	NK 6802	42.00	54.00	22.22
4	Mr. Ganesh Prasad Vill:- Piparia, Post:- Saphi, Turkulia Dist. East Champaran	QPM Hybrid	Shaktiman-5	0.4	NK 6802	44.00	49.00	10.20
5	Mr. Gopal Singh Vill:- Jaishinghpur, Mauje Post:- Khirua, Turkulia Dist. East Champaran	QPM Hybrid	Shaktiman-5	0.4	NK 6802	47.00	53.00	11.32
6	Mr. Bigul Shah Vill+Post:- Turkulia Dist. East Champaran	QPM Hybrid	Shaktiman-5	0.4	NK 6802	49.00	58.00	15.51
7	Mr. Chandan Kumar Vill:- Sarsiva Post:- Murapur Dist. East Champaran	QPM Hybrid	Shaktiman-5	0.4	NK 6802	42.00	52.00	19.23
8	Mr. Raj Kishor Prasad Vill+Post:- Turkulia Dist. East Champaran	QPM Hybrid	Shaktiman-5	0.4	NK 6802	46.00	56.00	17.85
9	Mr. Kaushal Kumar Vill+Post:- Turkulia Dist. East Champaran	QPM Hybrid	Shaktiman-5	0.4	NK 6802	51.00	59.00	13.55
10	Mr. Karan Singh Vill+Post:- Turkulia Dist. East Champaran	QPM Hybrid	Shaktiman-5	0.4	NK 6802	49.00	57.00	14.03

Conclusion

From the above results we can say that the scientific method of cultivation of quality protein maize maize as compared to normal maize enhances the yield as well as economic of maize growers. Besides enhancing the economy, it also helps in providing nutritional security to the children as well as old age peoples in the rural areas.

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