

Original Research Article

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Impact of Varietal Replacement Demonstration on the Yield and Economics of Elephant Foot Yam (*Amorphophallus paeoniifolius*) cv. Gajendra in Bhagalpur District of Bihar

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ABSTRACT

Elephant foot yam (*Amorphophallus paeoniifolius*) is one of the important tuber crops grown for fresh and processing purpose all over the India due to its wider adaptability under various agro-climatic conditions, which plays a major role in supplementing the income of small and marginal farmer of the Bhagalpur district of Bihar state. The present study was carried out at Bhagalpur district during *kharif* 2017-18 and 2018-19. Varietal replacement through Farmer FIRST Project were conducted on elephant foot yam by the active participation of the farmers with the objective of improved technologies of elephant foot yam production potential. The improved technologies consist improved variety (Gajendra), balanced fertilizers (Soil test based) application and integrated pest and disease management, etc. The development of the agriculture is primarily depends on the application of the scientific technologies by making the best use of available resources. One of the major constraints of traditional elephant foot yam farming is low productivity because of non-adoption of advanced technologies like improved varieties. To increase the production, productivity and quality of agricultural produce, varietal replacement are being conducted at various farmer's field. All the recommended practices were provided to the selected farmers. The data related to the cost of cultivation, production, productivity, gross return and net return were collected as per schedule and analysed. Result of the present study revealed the higher average yield in the varietal replacement demonstration was recorded (595.5 q/ha) as compared to farmers practice (288.40 q/ha) traditional adopted by the farmers. The percentage increase in the yield over farmer's 106.48 was recorded. The technology gap and extension gap were computed 159.35 and 307.10 q/ha respectively, along with 48.11 percent of technology index. The varietal replacement demonstration field gave higher average net return Rs. 587630.00 and B:C ratio is 1:5.22. The result of the study indicated the gap existed in the potential yield and demonstration yield is due to soil fertility and weather conditions. Present result clearly show that the yield and economics of elephant foot yam can be boost up by adopting recommended technologies.

Keywords

Amorphophallus paeoniifolius
balanced fertilizers
yam farming

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Introduction

Elephant Foot Yam (*Amorphophallus paeoniifolius*) is a traditional crop with a long history of cultivation in Asia and the Pacific. It is widely used as a tuber vegetable in India, whereas, it is very closely associated with culture in many of the South Pacific Islands. It ranks fourth after cassava and yam, in terms of total production, area and consumption (Poonia and Pithia 2011).

Elephant foot yam also known as Zimikand or Oel is a tropical tuber crop belong to the monocotyledonous family “Araceae” of the order “Arales” whose members are known as “aroids” (Henry, 2001) and Van Wyk, 2005).

Elephant foot yam is believed to have originated in South Central Asia, perhaps in Eastern India or Malaysia (Sturlevant, 1919). All parts of the plant including corm, cormels, leaves and flowers are edible and contain abundant starch (Bose *et al.*, 2012). Elephant foot yam is a rich source of major components of the diet viz. proteins, minerals and vitamins.

The nutritional value of a food depends upon its nutritional contents, digestibility and the presence or absence of anti-nutrients or toxic factors. Several authors have evaluated the chemical composition of whole corms and cormels of elephant foot yam (Surjit and Tarafdar, 2015).

It has been observed that in spite of the fact that elephant foot yam are neglected crops, their nutritional value is high. Apart from the low fat content, the crop is nutritionally superior to other root and root crops in protein, mineral and vitamin contents (Onwueme, 1978).

Investigation have shown that elephant foot yam contains digestible starch, protein of

good quality, vitamin C, thiamine, riboflavin, niacin and high scores of proteins and essential amino acids. The crop is also very rich in dietary fibre, thus, it could be employed in the treatment of diseases such as obesity, diabetes, cancer and gastrointestinal disorders (Mukherjee *et al.*, 2016).

Elephant foot yam is cultivated in an area of around 30 m ha with an annual production of 774MT (NHB Database, 2018) and the major elephant foot yam growing states are Assam, Bihar, Nagaland, Manipur, Orissa, Maharashtra, Kerala, Andhra Pradesh, Meghalaya, West Bengal, Uttar Pradesh, Gujarat and Tamil Nadu.

In Bihar state total share under elephant foot yam is 4.94 with a production of 36.20 metric tonnes (NHB Database, 2016). Elephant foot yam is mainly grown as a major tuber crop in north Bihar areas like Muzaffarpur, Samastipur, Vaishali, East Chaparan, Madhubani, Shitamarhi, Bhagalpur and Begusarai districts in Bihar.

Despite of the importance of this crop, its cultivation anywhere in India is generally a subsistent to semi-commercial crop due to low productivity because of non-adoption of advanced technologies like improved varieties. To increase the production, productivity and quality of agricultural produce, varietal replacement demonstrations are being conducted at project area various farmers' field.

Materials and Methods

The varietal replacement demonstration is an applied approach to accelerate the dissemination of proven technologies at project area farmer's fields in a full package and practice mode with an objective to explore the maximum available resources of crop production and also to bridge the

productivity gaps by enhancing the production in national basket (Choudhary *et al.*, 2018). To overcome the problems faced by the farmers in cultivation of elephant foot yam, integrated crop management in elephant foot yam was conducted by Farmers FIRST Project, Bihar Agricultural University, Sabour, Bhagalpur during *Kharif* 2017-18 and 2018-19 in five farmers of Bhagalpur district. In the demonstration, improved variety Gajendra was grown in 0.5 ha area each farmer with integrated crop management practices and the farmers practice traditionally in 0.5 ha area for comparison. The integrated crop management practices consisting the conjoint use 20 t/ha FYM with a balanced fertilization of 120:60:80 NPK kg/ha.

Improved variety of elephant foot yam i.e. Gajendra introduced under demonstration was released from a local selection from Kovvur area of Andhra Pradesh is able to yield 50-60 t/ ha. The tubers are non-acrid, well-shaped and generally devoid of cormels or propagules. Treated with fungicide namely, Diathan M-45 and integrated pest management strategies were demonstration as per need.

Selection from local collections of Kovvur, West Godavari district, Average yield of 42.00 t/ha, potential yield Andhra Pradesh, released from Vegetable Research Station, of 55.00 t/ha, matures by 180-210 days Rajendra Nagar, under the aegis of All India Co-Ordinated Research Project (AICRP) on Tuber Crops.

The Gajendra variety was a local selection. Salient features of technology are plant height upto 80 – 90 cm, canopy spread upto 85 – 92 cm, pseudostem girth upto 11 – 15 cm, growth habit is erected, corm type stem, corm size 500 – 700 gm suitable for culinary purpose due softness and non-acrid which make it easy to cook.

Responsive to recommended dose of fertilizer at both rain fed and irrigated conditions situation in *Kharif* and spring –summer season and field tolerant to pest and leaf blight disease with average yield of 595.50 q/ha elephant foot yam (Gajendra) may progressively commercialized in Bihar as well as in Jharkhand.

The technological interventions followed in farmers practice and demonstration is given in table 1. Before initiating the demonstration, the beneficiary farmers were given with skill training on various technological interventions to be followed in elephant foot yam cultivation.

The performance of crop was periodically observed by the scientists of Farmers FIRST Project, Bihar Agricultural University, Sabour, Bhagalpur and advisory recommendations were followed. During harvest, yield data was collected from both the demonstration and farmers practice.

At the end, cost of cultivation, net income and cost benefit ratio were worked out. An average of cost of cultivation, yield and net returns of different farmers was analysed by the formula.

$$\text{Average} = \frac{(F_1+F_2+F_3+\dots+F_n)}{N}$$

Where,

F= Farmer (s)

N= No. of farmers

In the present study, technology index was operationally defined as the technical feasibility obtained due to implementation of varietal replacement demonstrations in elephant foot yam. To estimate the technology gap, extension gap and technology index following formula used as given by Samui *et al.*, 2000.

Technology Gap = P₁ (Potential yield) – D₁ (Demonstration yield)

Extension Gap = D₁ (Demonstration yield) – F₁ (Farmers yield)

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} \times 100$$

$$\text{B: C ratio} = \frac{\text{Net income (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

Percent increase over farmer's practices

$$= \frac{\text{Improved practices} - \text{Farmers practices}}{\text{Farmers Practices}} \times 100$$

Results and Discussion

The economic indices depicted in table 2 showed that the average yield of elephant foot yam variety (Gajendra) were 595.50 q/ah and 597.40 q/ha during kharif 2017-18 and 2018-19 respectively under demonstrated technology however, under farmer's practices the average yield were found to be 288.40 q/ha and 285.80 q/ha during respective years. The average percent increases over local yield were 106.48.

The results clearly indicated the positive effect of varietal replacement demonstration over the existing practices toward enhancing the yield of elephant foot yam in the study area due to use of high yielding variety, timely sowing, balance dose of fertilizers, proper and timely irrigation, need based plant protection etc.

The result is in conformity with the finding of Markam *et al.*, (2019), Tiwari and Saxena (2001) and Tiwari *et al.*, (2003). Yield of the varietal replacement demonstration and potential yield of the crop was compared to estimate the yield gaps which were further categorized into technology and extension

gap. The data of table 3 depicted the technology gap in the demonstration yield against potential yield which is 188.92 q/ah during both the year and reflects the farmer's cooperation in carrying out such demonstrations with encouraging results in subsequent years.

The technology gap observed may be attributing to the dissimilarity in soil fertility status, timely sowing and weather conditions. Similar finding was recorded by Mitra and Samjdar (2010). Further, the higher extension gap was observed. The extension gap ranged from 307.10 q/ha during the period of study that emphasizes the need to educate the farmers through various means for adoption of improved production technologies to mitigate the extension gap.

The data of table 2 reveals that as far as average economics of elephant foot yam is concerned; gross cost, net income and benefit cost ration were Rs. 1789350.00 /ha, Rs. 1445235.00 /ha and 1:4.23, respectively during 2017-18 and Rs. 1792200.00 /ha, Rs. 1449036 /ha and 1:4.22, respectively during 2018-19 under demonstration plot. However, Rs.869910.00 /ha gross cost, Rs.583958.00 /ha net return with 1:2.07. benefit cost ration during 2017-18 and Rs.874650.00 /ha gross cost, Rs.591302.00 /ha net return with 1: 2.08 Benefit cost ratio observed during 2018-19 under farmer's practice.

The superiority of recommended package of practices under varietal replacement demonstration over farmer's practice was also reported by Mitra and Samajdar (2010) and Balai *et al.*, (2012). From the finding of present study, it can be concluded that use of above prescribed technologies of elephant foot yam cultivation can reduce the technology gap to a considerable extent resulting in to increased productivity as well as quality in Bihar.

Table.1

S.No.	Package of practices (Technology intervention)	Varietal replacement demonstration (Recommended package of practices)	Farmers practice (Local/check)	Gap
01.	Selection of variety	Improved variety (Gajendra)	Age old variety	Partial gap
02.	Soil testing	Have been done in all the location	Not in practice	Full gap
03.	Seed rate	90 q/ha	90 q/ha	Partial gap
04.	Seed treatment	Seed treated with fungicide Dithan M-45	Not done	Full gap
05.	Spacing	70 cm x 60 cm	60 cm x 50 cm	Partial gap
06.	Application of recommended dose of fertilizer	120 kg N + 60 kg P ₂ O ₅ + 80 kg K ₂ O per ha (50% N+ 100% P K at the time of planting and remaining 50% N applied at 40 days and 80 days after planting)	Imbalance and inadequate	Partial gap
07.	Application of vegetable special (micro-nutritional) Irrigation	Foliar spray of vegetable special (micro-nutrients) 75 g + 15 lit water + lemon + 1 shampoo (Rs. 1).	Not applied any micro-nutrient	Full gap
08.	Irrigation	Drip or furrow method of irrigation at once in a 7-11 days interval depend upon soil condition	Twice in a month	Partial gap
09.	Weed management	Pre-emergence herbicide pendimethalin @ 1.5 kg a.i/ha, followed by hand weeding depend upon weed intensity.	Weeding is not common	Partial gap
10.	Plant protection measures for control of insect pest and diseases	Need based application for control: Aphid and sucking pest-spraying with diamethoate (30 EC) 1.5 ml/L of water. Leaf eating caterpillar: spray NPV (250 LE/ha). Blight, pythium rot & leaf blight – Spraying of (COC) blitox 50 – 3 g/L of water	Plant protection is not common	Partial gap
11.	Harvesting	Manual	Manual	No gap

Table.2 Economics of varietal replacement demonstration of year 2017-18 and 2018-19

Variables	Yield (q/ha)			Cost of cultivation (Rs./ha)			Gross return (Rs./ha)			Net return (Rs./ha)			Benefit: Cost ratio		
	2017-18	2018-19	Average	2017-18	2018-19	Average	2017-18	2018-19	Average	2017-18	2018-19	Average	2017-18	2018-19	Average
Farmers practice	288.40	291.55	289.97	281242.00	283348.00	282295.00	865200.00	874650.00	869910.00	583958.00	591302.00	587630.00	1:2.07	1:2.08	1:2.08
Recommended practices (Gajendra)	595.50	597.40	596.45	341265.00	343164.00	342215.00	1786500.00	1792200.00	1789350.00	1445235.00	1449036.00	1447135.00	1:4.23	1:4.22	1:4.22

Table.3 Yield technology gap and technology index of varietal replacement demonstration

Variables	Yield (q/ha)	Increase (%) over farmers Practice	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
Farmers Practice	289.97	-	-	-	-
Recommended practices (Gajendra)	596.45	106.48	159.35	307.10	48.11

It requires collaborative extension efforts to enhance adoption level of location and crop specific technologies among of the farmers for bridging these gaps. Therefore, extension agencies in the district need to provide proper technical support to the farmers through various educational and extension methods for better elephant foot yam production in

Bhagalpur districts of Bihar.

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