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Subhashree Dihingia
Subject Matter Specialist, Department of Horticulture, Krishi Vigyan Kendra, AAU, Sivasagar,Assam, India

Prodip Handique
Senior Scientist and Head, Krishi Vigyan Kendra, AAU, Sivasagar,Assam, India

Manoranjan Neog
Associate Director of Extension Education, Directorate of Extension Education, AAU, Jorhat, Assam, India

Prasanna Kr. Pathak
Director of Extension Education, Directorate of Extension Education, AAU, Jorhat, Assam, India

Corresponding Author:
Subhashree Dihingia
Subject Matter Specialist, Department of Horticulture, Krishi Vigyan Kendra, AAU, Sivasagar,Assam, India

Impact of demonstration on cultivation of pumpkin var. Arjuna F1 (*Cucurbita moschata*) and its adoption in Sivasagar district of Assam

Subhashree Dihingia, Prodip Handique, Manoranjan Neog and Prasanna Kr. Pathak

Abstract
Pumpkin is one of the important rabi season crop in Sivasagar district. The climatic conditions of the region are very much suitable for its growth and development. The practices of using hybrid varieties are rising at an alarming rate among the farmers in the district which is bringing a great market linkage to the community of farmers. Front Line Demonstration (FLD) is a mandated activity of Krishi Vigyan Kendra with an objective to establish Production Potential of technologies in Farmers filed under the supervision of KVK Scientist. Under such circumstances, Krishi Vigyan Kendra, Sivasagar conducted frontline demonstration programme on high yielding pumpkin var. Arjuna F1 for 3 consecutive year i,e. 2018-19 (1.0 ha area), 2019-20 (1.0 ha area) and 2020-21 (1.0 ha area) which gives a higher production of 182q/ha, 187 q/ha and 189q/ha against the yield of farmers practices i.e.130q/ha, 142 q/ha and 137q/ha, respectively. The average weight of the pumkin was 3.75 kg, 4.50 kg and 4.0 kg against weight of farmers practices 2.50kg, 2.60kg and 2.45 kg, respectively for the mentioned period. From this study , it may be inferred that cultivation of Pumpkin Arjuna F1 fetch more net return due to higher yield as well as high market price of the crop. The horizontal spread of this technology was much higher within few years it goes upto 26 villages and 170 farm families and converted area into 15 ha in the assessment year 2020-21. Finally, from the study it was concluded that the farmers of Sivasagar district can go for the cultivation of hybrid pumkin Arjuna F1 in place of their existing practice to obtain higher yields and returns in terms of money.

Keywords: Rabi, Pumkin, Sivasagar, FLD, KVK etc.

Introduction
Vegetables are an integral part of a healthy daily diet. Fresh vegetables are very much needed to our body and that too when pandemic situation is prevailing in the country it is badly desired. They contain varieties of micronutrients useful for physical and mental function (Kaplan *et al*., 2007) [11]. The per capita consumption of vegetables in India around 130g/capita/per day as against the requirement of 300g recommended by Indian council of Medical Research (ICMR) (Bharali *et al*., 2019) [4]. Such an important crop in today's discussion is Pumpkin. Pumpkin (*Cucurbita moschata*) originated in Central Mexico and is cultivated in the tropical and subtropical regions of the world. It is an important cucurbitaceous vegetable crop of India having rich in beta carotene next to carrot (Kumer *et al.*, 2018) [13], constituting a principal ingredient in several Indian dishes. Pumpkin has received little attention in crop improvement compared to other cucurbitaceous vegetables.
Pumpkin is mainly grown as an annual vegetable and also grown as off season commercial cultivation for its edible portion of plants such as leaves, stems, roots, bulbs, flowers, and tubers. Because pumpkins are less sweet and more savory from a culinary perspective, so categorize them as a vegetable. The optimum temperature for its growth and development ranges from 18°C to 30°C.It can be grown on a wide range of soils but it performs well on loamy soils with good moisture percentage, rich in organic matter and proper drainage facilities. The ideal soil pH ranges from 5.5 to 6.8 (Handbook of Horticulture, ICAR, 2016). Pumpkin (*Cucurbita pepo*) has received considerable attention in recent years because of the nutritional and health protective values of the seeds.
Therefore, the present programme was carried out to popularize the effect of hybrid pumpkin against the local cultivar on growth and yield and adoption of this technology by the farmers in Sivasagar district.

Materials and Methods

The investigation were conducted by Krishi Vigyan Kendra, Sivasagar, Assam at farmers' field during the period 2018-19, 2019-20 and 2020-21 under the Frontline demonstration (FLD) programme to disseminate and popularize the Hybrid Pumpkin Arjuna F1, covering an area of 1 ha with randomly selected 15 nos. of farmers who had the experiences of cultivating local variety of pumpkin for each consecutive year. The villages selected for the study Gaurisagar (26.9420.N,94.5367.E), Demow (27.127361N,94.739922E), Amguri (26.485335N,94.313410E) and Nazira (26.5512N,94.4348E) of Sivasagar district, Assam, India.

Demonstrations at farmers' field were regularly monitored by Scientist of Krishi vigyan Kendra, Sivasagar from sowing to harvesting. The soil selected under the treatments was a sandy loam soil with proper drainage facilities. The land was duly ploughed and harrowed to obtain a fine tilth. The seed was sown in the main field in the month of mid September with a spacing of 2.5 m in rows to row and 1.5 m from seed to seed. The demonstrations were laid out on farmer's field according to recommended package of practices. All critical inputs *viz*., seed, fertilizer, chemicals for plant protection were supplied to the farmers under this programme. The management practices of the technology demonstrated in the farmers' field are elucidated in Table 1. The demonstrations plot was timely monitored and the required data were collected on regular interval and used to assess the impact on yield. However, data about adoption and horizontal spread of technologies were collected from the farmers with help of interview schedule (Islam and Nath, 2015) [9]. Some of the parameters were taken from the study to determine the final yield of the technology demonstration plot against the famers' practice *viz*., vine length, number of fruit per vine, fruit weight, duration of crop and economic parameters like Gross cost, Gross return, Net return and benefit cost ratio (B:C ratio). Moreover to find the gap analysis some exercise have been worked out to calculate certain parameters like technology gap, extension gap and technology index by using the formula as given below (Samui *et al*., 2000) [19].

Technology gap=Potential yield-Demonstration yield

Extension gap = Demonstration yield - Farmers yield

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

Table 1: Management practices of the technology in the demonstration plot in farmer's field

Particulars	Technology demonstrated	Farmers practices
Time of sowing	Mid September	Mid October & November
Variety	Arjuna F1	Non descript seed
Spacing	2.5mx1.5m	1mx1m(no specific spacing followed)
Fertilizer dose	3q FYM, 20 kg Urea, 70kg SSP, 15 kg MOP	Non judicious use of fertilizer
Irrigations	3 life saving irrigation	Rainfed
Plant protection	Neem based insecticide	Do not use any chemicals
Time of harvesting	Jan -Feb	Feb-March

Result and Discussion

The result obtained from the present investigation as well as the relevant discussion has been summarized as bellow:

The data obtained from the present study were utilized to calculate the technology gap, extension gap and technology index were calculated as per the formula and economic analysis was done as per procedure and data were presented in the table 2, 3 and 4.

Days to first flowering: Variations in appearance of first female flowers between the Arjuna F1 and local varieties have been observed in present study. The data in result showed that the average days for appearance of first female flower was recorded in Arjuna F1 as 52 days whereas, average maximum number of days taken to flowering in traditional varieties was recorded as 58 days. These findings of the seen results may occur because of following proper package of practice in the demo varieties. Similar findings were also reported by Saikia *et al.*, 2021 [18].

Vine length at harvest: During the period of present study, variations in vine length at the time of harvesting were also observed between Arjuna F1 and traditional varieties. Maximum vine length8.25m, 9.27m and 9.50m was recorded in Arjuna F1 for the year 2018-19, 2019-20, 2020-21, respectively with mean vine length of 9.00m as compared to indigenous/local type 6.35m, 7.25m and 6.75m for the above mentioned periods respectively with mean vine length 6.78m (Table 2.0). This was might be due to the proper spacing given to the demonstration while less spacing given to the farmers practice. It was also reported that hybrid or improved varieties has capacity to perform well in growth and production compared to traditional varieties when cultivated in a favourable environment with proper package of practices. The present findings were in agreement with the observation of Saikia *et al.*, 2021 [18].

Number of fruits per vine: Maximum number of fruits per plant was found in Arjuna F1 as 8 nos. (2018-19), 8 nos (2019-20) and 9 nos (2020-21) with a mean value of 8.33 and minimum number of fruits per plant was found in farmer's practice 6 nos. (2018-19), 8 nos. (2019-20), and 7 nos. (2020-21) with a mean value of 7.00 (Table 2.0). The reason might be due to the decreasing sex ratio of hybrid variety which leads to greater potential of fruit yield because of the increase in the number of female flowers per plant which develops into fruits. Minimum sex ratio was also reported by Jamal Uddin *et al*., 2014 [10] in their study.

Fruit weight: Single fruit weight varied between the Hybrid Arjuna F1 and Farmers practice. The average fruit weight were recorded as 3.75kg for the year 2018-19, 4.50kg for the year 2019-20 and 4.00kg for the year 2020-21 with a mean value of 4.08kg in Arjuna F1 where as minimum average fruit weight was recorded in Farmers Practice as 2.50kg for the year 2018-19, 2.60kg for the year 2019-20 and 2.45kg for the year 2020-21 with a mean value of 2.51kg. It was seen that the traditional varieties has smaller size compared to hybrid ones.

Table 2: Yearwise observation of different parameters under study

Treatments	Parameters year wise															
	Vine length at harvest(m)				Number of fruit per vine (Numbers)				Fruit weight (in kgs)				Duration of crop in days			
	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean
Technology	8.25	9.27	9.50	9.00	8.00	8.00	9.00	8.33	3.75	4.50	4	4.08	82	80	75	79
Farmers practice	6.35	7.25	6.75	6.78	6.00	8.00	7.00	7.00	2.50	2.6	2.45	2.51	115	110	95	106.66

Table 3: Economics of study

Treatments	Parameters year wise															
	GC				GR				NR				B:C			
	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean	2018-19	2019-20	2020-21	Mean
Technology	59000	62000	65000	62000	273000	280500	283500	279000	214000	218000	218000	216666	4.62	4.52	4.36	4.5
Farmers practice	55000	57000	60000	57333	195000	213000	205500	204500	140000	156000	145000	147000	3.54	3.73	3.42	3.56

Table 4: Yearwise production parameters, Technology gap, extension gap and Technology index.

Treatments	Area	Number of farmers	Yield (q/ha)			Percentage increase over control	Tech gap	Extension gap	Tech index (%)
			Potential	Demo	Farmers practice				
2018-19	1	15	200	182	130	82%	18	52	109
2019-20	1	15	200	187	142	87%	13	45	106.5
2020-21	1	15	200	189	137	83%	17	46	108.5
Average	1	15	200	186	136.33	84%	16	47.66	108

Duration of crop in days: Maximum average crop duration was observed in traditional practices with a mean value of 106.66 days which was minimum in Hybrid variety Arjuna F1 with a mean value of 79 days. This might be due to the fact that traditional crops are more adapted to local growing conditions and this may be also due to the reason that warmer temperature shortens the developmental stage of crop.

Fruit yield: Highest yield in almost every year was found in Arjuna F1 ie 182q/ha, 187q/ha, 189q/ha in 2018-19, 2019-20, 2020-21, respectively with a mean value of 186q/ha. On the other hand lowest yield was recorded as 130q/ha, 142q/ha and 137q/ha in the above mentioned periods respectively with a mean value of 136.33 q/ha in Farmers practices. Similar findings were reported by Misra *et al*., (2019) [15], that maximum yield in demonstration was recorded 605.80 q/ha was obtained in demonstrated plot of tomato over control 505.30 q/ha with an extra yield of 100.50 q/ha and the rising the common tomato productivity by (19.88%). Matharu and Tanwar (2018) [14] reported the moong variety SML 668 gave the maximum yield 11.08 q/ha and 11.15 q/ha as compare to the farmers cultivated variety which gave 9.80 q/ha and 9.75 q/ha yield in the year 2016 and 2017.

Economics of cultivation

Cost of cultivation (per ha): Costs incurred on various inputs and input services were considered for calculating cost of cultivation of pumpkin cultivars under study. The total costs included both fixed costs and variable costs incurred. Cost of cultivation was different for both the cultivars. Average cost for cultivation in Arjuna F1, which was (Rs. 62000.00/ha) due to high cost of seed in Arjuna F1 and difference was seen in Farmers practice that is (Rs.57333.00/ha).

Gross returns (per ha): Average maximum gross returns were realized from the cultivation of Arjuna F1 (Rs. 279000.00 per ha) and the average minimum was recorded Farmers variety (Rs. 204500.00 per ha).

Net returns (per ha): Average maximum net returns were recorded in Arjuna F1 (Rs. 216666.00 per ha) and the average minimum net returns were recorded in Farmers variety (Rs. 147000.00 per ha).

Benefit: cost ratio: Average maximum benefit: cost ratio was recorded in Arjuna F1 (4.5) and the average minimum benefit: cost ratios were recorded in Farmers variety (3.65). Singh *et al*., (2021) [21] reported that adoption of better package of practices reported superior B:C ratio (1.92) as compared to FP (1.63) in wheat growing area.

Technology gap: The average technology gap in the demonstration yield over potential yield was 16q per ha. The technological gap may be attributed to the dissimilarity in the soil fertility status and weather conditions (Vikram *et al*., 2018, Anuja *et al*., 2014, Balai, 2012, Berjesha *et al*., 2013) [2].

The extension gap: The average extension gap was calculated as 47.66 q/ha. This emphasized the need to educate the farmers through various means for the adoption of superior agricultural technologies to reverse this inclination of ample extension gap. More and more use of up to date production technologies with high yielding variety will consequently change this alarming trend of galloping extension gap (Rupesh, 2015). The new technologies will eventually lead to the farmers to discontinue the old technology and to adopt new technology.

Technology index %: The technology index illustrate the viability of the advanced technology at the farmer's fields and lower value of technology index more is the viability of the technology. The technology indexwas recorded in this demonstration as 108 percent which indicates proper adoption of improved technologies. Similar results were also recorded by Mitra (2017) [16], Eduardo *et al*., (2016) [8], Raju *et al*.; (2015), Bisht *et al*.; (2010) [7] in papaya, Keshavareddy *et al*., (2018) [12] in mango, Shalini *et al*., (2016) [20] in tomato,

Renbomo Ngullie and Pijush (2016) [17] in chilli.

Impact of Front Line Demonstrations (FLDs) on Horizontal Spread of Variety

In present study, efforts were made to study the impact of FLDs on horizontal spread of this technology in entire Sivasagar district. The data indicated that FLD on Pumpkin crops facilitated to boost their area under recommended variety ie. Arjuna F1 (Table 5 and Figure 1). There was considerable increase in area horizontally from 0.5 ha (2015-16) to 15ha (2020-21) under *Arjuna F1* variety of Pumpkin due to FLD.The FLDs made optimistic impact on horizantal spread of Arjuna F1which leads to conclude that FLDs organized by KVK, Sivasagar made significant impact on horizantal spread of technlogies.

Table 5: Horizontal spread of pumpkin var. Arjuna F1 from 2015-16 to 2020-21

	Area covered (ha)	No of village	Number of farm families
2015-16	0.5	3	3
2016-17	2	4	5
2017-18	2.5	5	15
2018-19	5	12	50
2019-20	9	18	75
2020-21	15	26	170

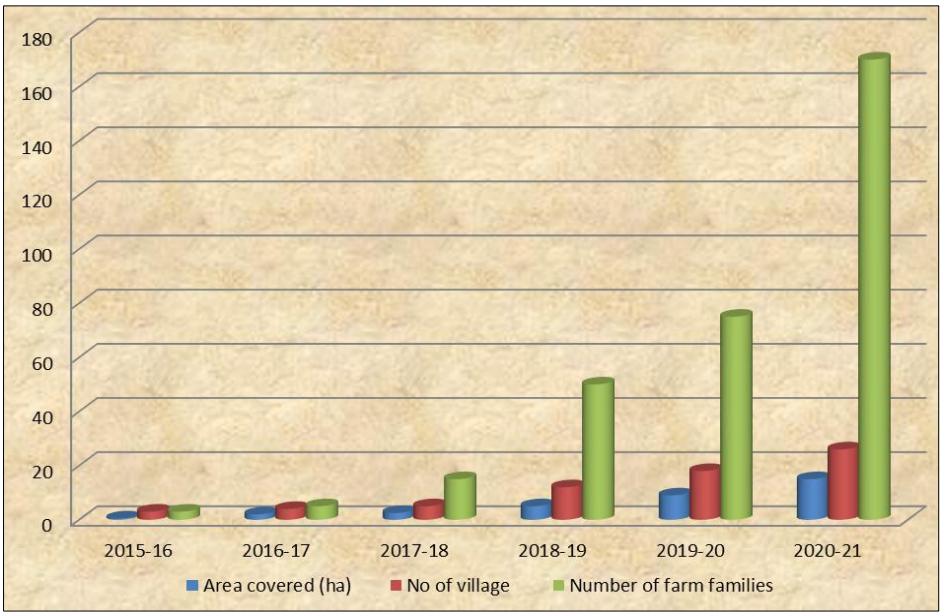

Fig 1: Graphical presentation of horizontal spread of pumpkin var. Arjuna F1

Conclusion

From the above findings, it could be concluded that the pumpkin variety Arjuna F1 and its scientific cultivation practice provided to the farmers by KVK, Sivasagar through FLD programme was able to give higher production at farmers field which result higher income to the farming community. The programmes backed by the field demonstrations conducted by KVK, Sivasagar with the apparent objective of popularizing Pumpkin var. Arjuna F1in the district have proved to be the most effective and come up as an effective tool in the result oriented speedy dissemination of knowledge and technical skills to the farmers. Krishi Vigyan Kendras situated in different districts of Assam are very much instrumental in disseminating knowledge and popularizing such variety among farming community. Further efforts are being made by organising different extension activities to motivate the farmers for further popularization and adoption of different hybrid and high yielding varieties which help in the farming community.

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