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Yield Gap Analysis and Impact of Front Line Demonstrations on Productivity of Carrot in Tirap District of Arunachal Pradesh

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The carrot is an important crop in Tirap district of Arunachal Pradesh. Farmers uses old varieties for cultivation so their productivity is lower than potential. So, an demonstration of high yielding variety of carrot- Pusa Rudhira was under taken during Rabi season of 2017-18 and 2018-19 respectively in Tirap district of Arunachal Pradesh to demonstrate the scientific carrot cultivation practices. Total 20 farmers were selected from five villages during the both years of demonstration. Before the demonstration a field survey was conducted in selected villages to know in details about farmers

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practices of carrot. As per findings of survey, there was huge technological gap. There was potential of Pusa Rudhira variety of carrot in district 230 q/ha. Meanwhile demonstration yields were recorded at 190 and 178 q/ha while control was 128 and 116 q/ha respectively. Extension gap was 63 & 62 q/ha respectively. The benefit- Cost (B:C) ratio was 4.39 and 3:20 and 3.63 and 2.54 respectively during the both year of demonstration.

Keywords: Carrot; demonstration; Pusa Rudhira; benefit cost ratio; extension gap; field survery; yield/ha.

1. INTRODUCTION

Carrot (*Daucus carota* L.) is one of the most important cool weather root crops is grown all over the world. In India, the important carrot growing states are Uttar Pradesh, Assam, Karnataka, Andhra Pradesh, Punjab and Haryana. It is the second and third most important vegetable in England and Australia, respectively [1]. It can be grown also in mild climate of the tropics. Carrot had 0.064 million ha area with the production of 0.968 million tons during 2017-18 [2]. Being a rich source of beta carotene, a precursor of vitamin-A. Also possesses anti-oxidant properties, fix up harmful free radicals and prevent heart diseases [3]. It is generally consumed as a vegetable after cooking but also consumed fresh in salad, juice and served as an ingredient in soups and sauces. Tender roots are processed to make pickles, jam, candy and jellies. It is also used as an additive in poultry feed to intensify skin and egg yolk colour. The carrot variety Pusa Rudhira suits to this region. Front Line Demonstration was carried out at the twenty farmer's field at Tirap district of Arunachal Pradesh. Here generally in winter's period's minimum temperature goes to 8- 9°C and in summer maximum temperature reaches to 36°C. Annual rainfall is 1500-2000 mm per year.

2. MATERIALS AND METHODS

In Arunachal Pradesh three types of Agro-climatic zones are prevails. The Tirap district falls under Eastern Himalayan Region (Zone II), Sub region-: Per Humid Hyper Thermic Foothills; where hot and humidity is very common characteristics. The rains start from End of February and continue up to September. The intermediatory dry spells often occurs which are very heat and humid.

Table 1. The weather during the research period

Month	Rainfall(mm)		Temperature ^{0}C				Relative Humidity (%)			
	2017	2018	2017		2018		2017		2018	
			Max.	Min.	Max.	Min.	M	E	M	E
April- 2017	247	186.0	34.4	12.2	35.2	13.2	82	67	81	65
May- 2017	327	117.5	35.6	14.6	36.7	15.1	86	73	89	75
June-2017	241	433.4	36.8	16.5	37.7	17.2	91	80	93	82
July-2017	347	336.6	34.2	18.4	35.4	18.9	93	83	95	81
August-2017	493	277.3	33	19.1	34.2	20.1	87	85	89	87
September-2017	371	186.2	32.3	18.8	33.6	20.1	88	84	91	86
October-2017	162	118.0	26.5	17.2	27.4	18.4	89	90	92	92
November-2017	7.6	15.4	25.1	12.3	25.9	14.1	87	82	89	88
December-2017	0	0	25.8	9.4	26.2	10.2	85	83	86	87
January-2018	12.2	12.7	25.4	8.6	26.2	9.1	85.7	88	84.9	88
February-2018	69.6	69.0	26.1	7.9	26.9	8.3	88	90	83	92
March-2018	138.2	123.0	28.7	8.8	29.1	9.2	85	81	82	83

Where Max. denotes maximum, min. denotes minimum, M denotes Morning, E denotes evening

Table 2. Package and farmers' practices demonstrated in carrot field

Particular	Technological intervention	Existing practices	Gap
Variety	Pusa Rudhira	Local or unknown variety	Full gap
Seed rate	6 kg/ha	10 kg /ha	Full gap
Seed treatment	Seed was treated	Not treated	Full gap
Sowing method	Line sowing	Broadcasting	Full gap
Spacing	20 cm x 4 cm	Not maintained	Full gap
Application of recommended dose of manure	5 kg/ meter^2	Nil/without recommendation	Partial gap
Application of Bio fertilizer	Soil application of Azospirillum & PSB @ 2 kg/ha mix with FYM	No application	Full gap
Harvesting	Manual	Manual	No Gap

The present study was conducted in Tirap district of Arunachal Pradesh during rabi season of 2017-18 and 2018-19 respectively. The twenty farmers were selected for demonstration; from Chomoithung, Thingsa, Kheti, Lapnan and Dadam villages in Tirap district of Arunachal Pradesh. Each farmers had 0.05 ha area of plot size. The good quality seeds of carrot cv. Pusa Rudhira were procured and distributed to twenty selected farmers. All the selected farmers were trained on various aspects of carrot production technologies before conducting of demonstration through training. The field was prepared by ploughing and harrowing after kharif crops and manure at 5kg.meter^2 and biofertilizers were applied during last ploughing. The seeds were sown in well prepared field during second week of November. The 6 kg/ha seeds were sown at 20 cm line to line and 4 cm plant to plant distance. All the recommended practices were followed in demonstration plots while farmers practices were grown as per the farmers practices (mentioned in Table 2). The data related to cost of cultivation, production, productivity, total return and net return were collected in both treatments as per schedule from all selected farmers. An average of cost of cultivation, yield and net returns of different farmers was analyzed by the givenformula-

Average = [F1+ F2+F3 Fn]/NF1 = Farmer

N = No. of Farmers

In the present investigation, technology index was operationally defined as the technical feasibility obtained due to implementation of Frontline Demonstrations in Carrot. To find the technology gap, extension gap and technology index following formula used by [3] have been used.

Technology Gap = Pi (Potential Yield) – Di (Demonstration Yield)

Extension Gap = Di (Demonstration Yield) – Fi(Farmers yield)

Technology index – [(Potential Yield – Demonstration yield) × 100]/ Potential yield

3. RESULTS

A comparative study of productivity levels between demonstrated variety and local check is shown in Table 3. During the period of Study, it was observed that demonstration plots recorded the higher yield during the both years (190 and 178 q/ha) as compared local check (128 and 116 q/ha). In percentage; 48 and 53 higher over local check.

As per the parameter of technology gap, there were 40 & 52 q/ha recorded; during the both years of study while the extension gap was also had huge margins e.g. 63 and 62 q/ha respectively. And the technology index was recorded 18 and 23 % respectively.

Under economic parameters all parameters had recorded good results. The cost of cultivation during the 2017 -18 was Rs.88,000 and 76,000 respectively (demonstration and control) while it was little bit increased during the next year of demonstration (2018-19) as Rs. 96,000 and 82,000 respectively (Table 4). The gross return was calculated during the first year of study was Rs. 4,75,000 and 3,20,000 as compared Rs. 4,45,000 and 2,90,000, net return was Rs.

3,87,000 and 2,44,000 as compared to Rs. 3,49,000 and 2,08,000 respectively. The benefit cost ratio of demonstration plots was also recorded superior over control (4.39 and 3.20 as compared 3.63 and 2.54 respectively).

4. DISCUSSION

These findings are proving that improved varieties performance reported better over the local check under similar environmental conditions. The other farmers were motivated by seeing the results in term of productivity. The yield of the frontline demonstrations and potential yield of the crop was compared to estimate the yield gaps which were further categorized into technology index (Dawuda, [4], Adem Seid et al. [5] has described that different dose of fertilizers enhanced the yield of carrot. The Biratu et al. [1] and Villeneuve [6] have proven that sowing time of carrot played crucial role for its production meanwhile Reid et al. [7] and Singh et al. [8] emphasized under their findings that nutrients play important role in carrot production.

The technology gap shows the difference between potential yields over demonstration yield of the technology. The potential yield of the technology (variety Pusa Rudhira) is 230 q/ha; in soil and climatic conditions of Arunachal Pradesh. The technology gap of 40 and 52 q/ha recorded during the study has raised a special concern among the development agencies like-department of Horticulture, Agriculture, KVK etc. for making a strategy for minimizing the same. Though several efforts have been done under the supervision of KVK specialist at the farmers' field; but there are existing a gap between the potential yield and demonstration yield. The better yield of demonstration plots recorded due to scientific management practices of carrot. This finding has also supported by different researchers – Chebotev, [9], Da Silva.[10], De Carvelho. [11], D'Hooghe. [12], Kabir. [13] etc. The similar findings have also reported by Kassa M. et al. [14]. Bender, I. et al. [15] and Umlong R.M., [16] have mentioned that fertility level of soil and weather condition are important factor for carrot yield. Kharsan et al. [17], Shiberu [18] and Tagen [19] reported that plant spacing played vital role under carrot cropping while Kovacik [20] emphases that application of vermicompost during last ploughing under carrot farming was the key factor for better production. The Raginaldo [21] demonstrated the carrot demonstration in Latin America and concluded that weed management is the pivotal factor for its good yield. The Tewari et al. [22] reported that seed treatment had saved the carrot crop against different seed and soil borned diseased; which ultimately resulted better crop growth and development; by which the yield was superior as compared to without seed treatment crop of carrot.

Technology index shows the feasibility of the variety at the farmer's field. The lower value of technology index indicates the more feasibility of the particular technology. The result of study depicted in Table 3 revealed that the technology index value was 18 during first year of demonstration; which resulted into 23 after second year's demonstration at farmer's field. This proved that this type of demonstrations can play a vital role for improving the productivity of carrot in Arunachal Pradesh. Pandey et al. [23] has also confirmed that under scientific package and practices farmers income can be enhanced.

Table 3. Yield, technology gap and technology index of demonstration

Year	Fruit yield (q/ha)			(%) Increase in productivity	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
	Potential	Demonstration	Control				
2017- 18		190	128	48	40	63	18
2018-19	230	178	116	53	52	62	23

Table 4. Economics of Carrot

	Cost of Cultivation (Rs/ha)		Gross Return (Rs/ha)		Net Return (Rs/ha)		Benefit Cost ratio B:C Ratio	
Year	D	C	D	C	D	C	D	C
2017-18	88,000	76,000	4,75,000	3,20.000	3,87,000	2,44,000	4:39	3:20
2018-19	96,000	82,000	4,45,000	2,90,000	3,49,000	2,08,000	3.63	2.54

Where D denotes: Demonstration and C denotes: Control

During the both years of demonstration; net return was superior over control (Rs. 1,43,000 and 1,41,000 respectively) with better Benefit cost ration (4.39 and 3.63). The higher profitability and economic viability of the demonstration can enhance the farmers productivity as well as economy.

5. CONCLUSION

The results of demonstration were 48 % and 53 % higher yield over farmers practices during the both years of study respectively. This higher result came by adoption of good variety, scientific package and practices at farmer's field. Thus, the farmers of Tirap district can learn by this result for higher productivity, profitability as well as economic prosperity.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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