



Vegetable varieties with multiple attributes spread at faster rate - A case study in popularizing carrot variety Pusa Rudhira in NCR Region

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ABSTRACT

Improved vegetable varieties with additional attributes other than yield may have greater chances for acceptance by the farmers. This hypothesis was tested by designing the on-farm action research in Soodna village of Hapur district to assess the carrot variety Pusa Rudhira during the year 2011-14 and also to analyze farmers' feedback and horizontal expansion of the same as compared to the prevailing popular variety (Desi Red) from private sector. Findings showed that though the duration of both the varieties was comparable but the yield advantage from variety Pusa Rudhira was 10 q/ha higher than the private sector variety Desi Red (384 q/ha). Farmers and consumers preferred Pusa Rudhira for its long red fleshed roots with high juice content, sweetness and self coloured core of roots. The market price for this variety fetched higher price (17.76%) than the Desi Red variety (Rs. 788/q). As a result, the net return was computed considerably higher (38.17%) for variety Pusa Rudhira (Rs 222690/ha) over Desi Red (Rs 161169/ha). Farmers also accorded superior score to Pusa Rudhira in terms of colour (9 out of 10), marketability (9 out of 10) and taste (8 out of 10).

Key words: *Daucus carota*, technology dissemination, diffusion, impact, quality attributes.

INTRODUCTION

Vegetables play an important role in nutritional security, economic viability and fit well into the predominant cereal based cropping systems prevailing in different parts of our country. More than 60 kinds of vegetables are grown in India in tropical, subtropical and temperate agro-climates. During 2015-16, India produced 167.02 million tonnes of vegetables and vegetable export from our country was worth Rs. 121.1 billion (Anon, 1).

Carrot (*Daucus carota* L.) is a widely grown root vegetable of the Apiaceae family. Carrots probably originated in Asia around northwest India. Cultivation of carrots for medicinal purpose began 2000 to 3000 years ago and for consumption dates back to 600 A.D. when purple root types were grown in the area currently known as Afghanistan (Kelly *et al.*, 6). Red carrots are food source of lycopene which is a very very powerful anticancerous carotenoid. Carrots were used for a myriad of medicinal purposes including stomach ulcers, abscesses, bladder, liver and kidney problems, to aid in childbirth and even as aphrodisiacs (Kelley *et al.*, 6). Carrot is grown as an annual for its fleshy root, but is a biennial crop as it complete its seed to seed cycle in two seasons. Carrots are produced for a variety of uses both as fresh and in processed form.

As per the attributes of this variety (Pusa Rudhira), it holds immense potential to replace the prevailing popular cultivars developed by many private seed producing organizations, thereby saving the seed cost in addition to increase in nutritional security. The present effort was made to assess and disseminate an improved carrot variety to enhance the income and nutrition of farm families. In this paper we discussed the on-farm assessment and experiences gained in dissemination and upscaling of improved carrot variety Pusa Rudhira.

MATERIALS AND METHODS

The research was conducted in one of the villages, namely Soodna in Hapur district of Uttar Pradesh adopted by ICAR-IARI during the year 2011-14. As the project envisaged for integrated development of agriculture and horticulture in integrated crop management (ICM) mode, carrot variety (Pusa Rudhira) was introduced in the year 2011 for assessing its performance. The variety was released in 2008 and recommended for Delhi and NCR. The potential yield of the variety is 30 t/ha. The important characteristics of the variety are long red roots with self coloured core, oblong shape, suitable for sowing from mid-September to October. The roots are ready for harvest from middle of December onwards. On-farm assessment was made on the parameters of duration (days), yield (q/ha), market

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rate (Rs/q), profitability and farmers' perception. These parameters were compared with prevailing carrot variety Desi Red of Sungro Seeds Ltd. Apart from these indicators; the laboratory based qualitative analysis on the selected nutritional parameters was also done to prove the relative superiority of either of the variety. Farmers' perception for both carrot varieties were ascertained mainly on the parameters of yield, colour, taste, marketability, shelf life, profitability and duration on 5-points rating scale using structured questionnaire and through focused group interview from a the purposively drawn sample of 10 focused groups of farmers and farm women. The horizontal expansion and the rate of spread of this variety were also analyzed both quantitatively as well as graphically.

RESULTS AND DISCUSSION

Soodna village, located on the outskirts of newly carved Hapur district of western Uttar Pradesh is one of the four villages adopted by IARI, New Delhi in the year 2010 for improving farm production and profitability in an integrated manner and to develop it into a 'model' village. Conventional cropping pattern of wheat-rice-sugarcane-vegetables was prevalent there. Farmers of this village were growing carrot besides many other vegetables. However, carrot cultivation was not much remunerative as only varieties of private seed companies were available in the area and farmers had to purchase seed every season. Majority of farmers were having marginal size of land; the average land size was 0.52 ha. Keeping in view the potential of carrot cultivation in the village, the ICAR-IARI, New Delhi in 2011-12 introduced *Pusa Rudhira*, an open pollinated variety on a small area of 1.75 acres area in the village. Regular advisories were provided to the farmers for optimizing the use of farm inputs in the crop. As evident from the Table 2, a bumper crop of *Pusa Rudhira* was harvested yielding 393.75 q/ha, which was about 10 q/ha higher than the prevailing variety. It provided a net return of Rs 3,65,400.00/ha, which was 37% higher than that of Desi Red variety (Rs. 3,03,774.00/ha) (Table 1).

Superior quality traits of the newly introduced variety led to 17.76% higher price in the local market. *Pusa Rudhira* fetched higher price of Rs 928.00/q which was Rs 140.00/q higher than prevalent variety (Rs.788/q), due to its attractive long and deep red roots, red coloured core, uniformity in shape and size and more sweetness having TSS value of 9.5°Brix. Navazio (6) emphasized that among most important traits that are universally selected for any particular carrot type or carrot was the shape of a carrot variety

Table 1. Comparative economic advantage of *Pusa Rudhira* carrot variety

Particulars	<i>Pusa Rudhira</i>	Desi Red (Sungro Seeds Ltd.)	Advantage (%)
Market Price (Rs/q)	928.00	788.00	140 (17.76%)
Gross income (Rs/ha)	365400	303774	61626 (37%)
Cost of cultivation (Rs/ha)	142710	142605	105 (0.1%)
Net Income (Rs./ha)	222690	161169	61521 (38.17%)

Table 2. Comparative yield performance of *Pusa Rudhira* carrot variety over Desi Red

Particulars	<i>Pusa Rudhira</i>	Desi Red (Sungro Seeds Ltd.)	Advantage	
			Absolute (unit)	Relative (%)
Duration (Days)	090	092	02	02.22
Average Yield (q/ha)	394	384	10	02.64

which was probably the most recognizable feature of that carrot. The shape, relative size, degree of taper and the extent of blunting of the tip determine the characteristic shape of each carrot variety. Similar observations have also been reported in case of potato (Sah *et al.*, 9), pigeon pea (Singh *et al.*, 10), chickpea (Dubey *et al.*, 3) and paddy (Sharma *et al.*, 7) where farmers accorded favourable response to the additional attributes of these crop varieties and preferred them. Evaluation of similar kind was also advocated by Sharma *et al.* (8). The comparative yield related attributes showed that variety *Pusa Rudhira* gave an advantage of 2.22% in duration and 2.64% in average yield over the variety Desi Red (Table 2).

Pusa Rudhira is also nutritionally rich as compared to other carrot variety. The variety was tested to have higher levels of carotenoid (7.41 mg) and phenols (45.15 mg) per 100 g. The primary benefit of these substances lies in their antioxidant property that guards against certain types of cancer, apparently by limiting the abnormal growth of cells (Tables 3).

To study how farmers perceived and rated *Pusa Rudhira* and Desi Red variety of carrot on certain traits and the response was ascertained on a scale of 1-10 (with 10 as the most favourable score) and the results have been presented in Table 4. Variety *Pusa Rudhira* of carrot was accorded higher scores for all the criteria. The highest rating for the *Pusa Rudhira* was given for its marketability (9) and attractive blood red colour (9). The red coloured core

Table 3. Comparative nutritive advantage of *Pusa Rudhira* carrot variety

Particulars	<i>Pusa Rudhira</i>	Desi Red (Sungro Seeds Ltd.)	Advantage	
			Absolute	Relative (%)
TSS (°Brix)	9.5	8.4	1.1	13.9
Total carotenoid (mg/100g)	7.41	4.55	2.86	62.85
Total Sugars (%)	5.55	4.00	1.55	38.75
Total Phenols (mg/100g)	45.15	28.45	16.7	58.69

of variety is preferred since it is mark of freshness, softness and tenderness thus making it more market friendly. It was also reported that the carrot variety *Pusa Rudhira* is first choice of juice makers. Comparing both varieties, maximum advantage was found in terms of taste (60%) followed by colour and marketability (50%). However, there was no much difference in crop duration in both the varieties. Truong Thi Ngoc Chi *et al.* (11) also concluded that men and women have certain common criteria for varietal selection as high yield and high price. However, men have some criteria, which are different to those of women. Men are more concerned to physical conditions and abiotic conditions for the plant being grown. Women are more concerned to the post harvest traits as eating quality.

Based on the positive results and feedback of the farmer for the performance of *Pusa Rudhira* in terms of higher productivity, profitability, physical traits, and

marketability etc, other farmers of the village also showed interest. As a result, during winters 2012, another group of 20 farmers requested the seed of *Pusa Rudhira* and 200 kg seed was provided on cost basis. Consequently, *Pusa Rudhira* spread in about 60% area (90 acres) under carrot cultivation in the village within a couple of years of its introduction (Table 5). Higher productivity of *Pusa Rudhira* supported with premium price in the next season provided farmers with an impressive net income of Rs 2,22,690.00/ha. Popularity of variety *Pusa Rudhira* spread to different markets in Delhi and NCR. In Rabi season of 2013-14, 120 acres (75%) of carrot area was under this variety. It is expected that in years to come, variety *Pusa Rudhira* may cover more and more area and remain dominant variety in the district. BIRTHAL *et al.* (2) reported that up scaling of high value agriculture was constrained by lack of infrastructure for production, marketing and processing.

Since farmers were demanding more seed for the carrot variety *Pusa Rudhira*, interventions on seed production as entrepreneurial activity was taken up under the technical guidance and support of the IARI scientists. An extra income of Rs. 58000.00 was obtained from sale of Rs 145 kg of carrot seed, which was produced in next year (Fig. 1). The carrot farmers adopted mechanized cleaning of carrots by procuring three cleaning machines on community sharing basis, which facilitated faster washing and minimizing damage to carrots because of the enthusiasm with the profits from variety *Pusa Rudhira*.

A promising carrot variety *Pusa Rudhira* which has been released in 2008 was taken to the farmers' fields, where its potential to the farmers was

Table 4. Perceptual advantages of carrot variety *Pusa Rudhira*

Varieties	Perception Parameters (scores out of 10)						
	Yield	Colour	Taste	Marketability	Shelf life	Profitability	Duration
<i>Pusa Rudhira</i>	08	09	08	09	08	08	09
Desi Red (Sungro Seeds Ltd.)	06	05	05	06	06	06	08
Advantage (%)	33.33	50.00	60.00	50.00	33.33	33.33	12.50

Table 5. Horizontal expansion and impact of *Pusa Rudhira* carrot

Parameters	Unit	Value
Baseline area (i.e. area under sungro)	acre	160.00
Introductory area of <i>Pusa Rudhira</i>	acre	1.75
Second year area substitution/expansion	acre, %	90.00 (60%)
Third year area substitution/ expansion	acre, %	120.00 (75%)
Seed produced by farmers	Kg	145.00
Extra income generated through seeds	Rs.	58,000/-

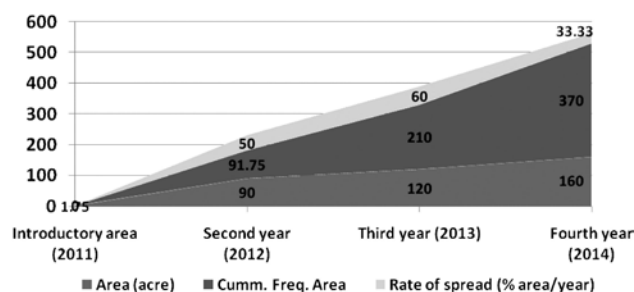


Fig. 1. Impact of *Pusa Rudhira* carrot variety in terms of rate of its spread

demonstrated initially at 4.5 acres of land. Owing to its remunerative price, it has covered 90 acres (60%) of the total area in 1 year replacing prevailing variety Desi Red in the area in village Soodna (Hapur). Farmers got more preferences for *Pusa Rudhira* in market than prevailing variety Desi Red because of deep red colour inside, more sweetness and better rate in market. The carrot variety *Pusa Rudhira*, thus has become a premium variety in National Capital region. The impact was more discernible in the area as the price for its seed had quantum jump from Rs. 400/- per kg (2011) to current price of Rs. 1200/- per kg in 2014-15. Thus, this variety has also opened the opportunity for seed production enterprise in the area.

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