Original Research Article

Performance of Different Radish (*Raphanus sativus* L.) Varieties in Black Soils of Vidharbha-Maharashtra

ABSTRACT

The present study was carried out at 'Chilli and Vegetable Research Unit', Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra during winter season of 2013-14 to investigate growth, yield and qualitative parameters of various radish varieties. The experiment was laid out in Randomized Block Design (R.B.D.) with seven treatments and three replications. Seven varieties of radish, used for the study as treatments were viz., V_1- Pusa Desi, V_2-Pusa Chetki, V_3- Pusa Reshmi, V_4- Pusa Himani,V_5- Japanese White, V_6- Arka Nishant and V_7- IHR-1-1. The plant height was supreme (28.29 cm) in Arka Nishant, maximum chlorophyll content of leaves (3.10 mg g^{-1}) recorded in Arka Nishant. The variety Arka Nishant required minimum (43 days) number of days, in weight of total fresh weight of plant (190.06 g to 226.60 g) were observed. It was maximum in variety Arka Nishant, whereas, minimum in variety Pusa Desi. The variations in fresh weight of root (122.76 g to 161.74 g) were observed. The maximum root to shoot ratio (1.37) was observed in variety Arka Nishant. The values of root diameter were maximum (3.69 cm) in variety Arka Nishant. The maximum root yield $plot^{-1}$ (32.34 kg $plot^{-1}$) and $hectare^{-1}$ (53.91 t ha^{-1}) was produced in variety Arka Nishant. The maximum moisture content of root (97.75%) was recorded in Arka Nishant variety. The ascorbic acid content was maximum (18.36 mg $100g^{-1}$), TSS (4.00 ^{0}B) was recorded in the variety Arka Nishant.

Keyword: Radish, black soil, vidharbha region, ascorbic acid content, T.S.S.

Introduction

Radish (*Raphanus sativus* L.) belongs to genus *Raphanus*, family *Brassicaceae* or *Cruciferae* originated from the Central and Western China and India. It is one of the most ancient vegetables. It was cultivated about 2700 B.C [3]. It is being cultivated in India over an area of 1, 69,000 ha with annual production of 22, 03,000 MT (N.H.B., 2015) [2]. Radish is a good source of vitamin A and vitamin C and minerals like calcium, potassium, iron and phosphorus. The most popular eating part of radish is the tuberous roots although the entire plant is edible and the tops can be used as a leafy vegetable. Radish has got several medicinal properties. It increases appetite, prevent constipation, beneficial for the patients suffering from piles, liver trouble, enlarged spleen, jaundice, gall bladder and urinary disorders. Good quality seed is one of the important means to increase productivity in any crop [24]. The vegetable intake as per the acclaimed of the dietitians must be 300 g day^{-1} capita and its obtainability is 145 g in India. Out of 300 g of vegetables, 125 g of green leafy vegetables, 100 g of roots and 75 g of other vegetables [20]. Vegetables are called as shielding food as their intake can avoid numerous diseases. Vegetables are the richest and cheapest source of natural protective food backing carbohydrates, proteins, fats, vitamins and minerals. India is the second largest producer of vegetables after China. Radish is beneficial in liver and gall bladder difficulties. In homoeopathy, it's used for neuralgic headache, sleeplessness and chronic diarrhea. Roots, leaves, flower and pod are quite effective against gram positive bacteria. Radish (*Raphanus sativus* L.) is an important root vegetable cultivated in India mainly for its tender roots, which are used as salad or cooking vegetables. Radish is grown on an area of 67,345 ha with production of 803,000 t in India [23]. Radish also has therapeutic value [23]. In Maharashtra, vegetables are grown on large scale throughout the year in areas around the big cities. The roots are said to be useful in urinary complaints, piles and in gastrodynia. A salt extracted from roots, dried and burnt to white ash is said to be used as diuretic and laxative. The seeds are said to be pectin, expectorant, diuretic and carminative [11]. Radish is grown for its young tender tuberous roots which are consumed raw as a salad or prepared as a vegetable. It is savored for its pungent flavor and is considered as an appetizer. The young leaves are also

cooked as vegetable and eaten. Radish has energizing and depurative properties. The edible portion of radish root develops from both primary root and hypocotyls. The primary root and hypocotyls develop into edible portion of radish root. There are several causes like variety, season of planting, nutrition and irrigation which plays a principal role in yield contribution and quality production. Several varieties of radish are available in the market having varying length, size, colour, taste, yield potential and quality parameters. The consumers as well as growers are demanding for the varieties having good qualities. As radish is an important salad vegetable, it is in demand throughout the year in big cities. The vegetables from this region are also sold in the big markets like Mumbai, Pune, Nagpur and Hyderabad. The varieties like Pusa Reshmi, Pusa Himani, Pusa Desi, Pusa Chetki, Japanese White, Arka Nishant, and IHR-1-1 are grown in various parts of the India. Higher yield, long sized roots and earliness are some of the characters which might be accountable for increase in the revenue of radish growing farmers.

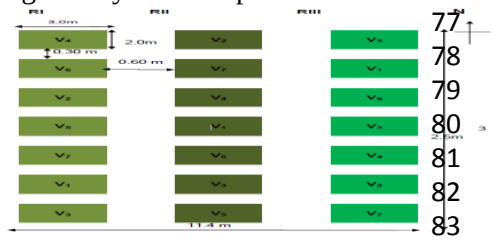
Material and Methods

The present experiment entitled "Performance of Different Radish Varieties at Akola Region of Vidharbha" was undertaken in the field of Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment was laid out in a Randomized Block Design (RBD) with three replications (Fig. 1). The treatments include seven varieties viz., Pusa Desi, Pusa Chetki, Pusa Reshmi, Pusa Himani, Japanese White, Arka Nishant, and IHR-1-1 (Table 1). The soil of the experimental block was medium black. The field was prepared by ploughing and frequent harrowing. FYM was given at the rate of 25 cart load hectare^{-1} before last harrowing and mixed well with soil. Later on sowing was done on 20th of October. The ridges and furrow was opened in a bed size 3.60 x 2.30 m. A spacing of 30 cm was kept between the ridges. The seed was dibbled at 10 cm spacing. Fertilization carried out as per recommendations and all the necessary cultural practices were adopted. The observations on length of root, diameter, weight of root, leaves, plant and yield were recorded. The analysis of variance were carried out as suggested [16].

Table 1: Source of seed used in experiment

Sr. No.	Name of varieties	Source of seed
1.	Pusa Desi	IARI New Delhi
2.	Pusa Himani	IARI New Delhi
3.	Pusa Reshmi	IARI New Delhi
4.	Pusa Chetki	Chilli and Vegetable Research Unit, Dr. PDKV, Akola.
5.	Arka Nishant	Department of Horticulture, Dr. PDKV, Akola
6.	Japanese White	Local Market
7.	I H R -1-1	IIHR Bangalore

Fig. 1: Layout of Experiment



Result and Discussion:

Growth Parameters

The growth parameters like plant height, number of leaves plant^{-1}, leaf area, and chlorophyll content of leaves were observed among different varieties at different growth stages. The plant height was maximum

(28.29 cm) in Arka Nishant, while it was minimum (22.70 cm) in Pusa Himani (Table 2, Fig. 2). The maximum plant height 24.40, 25.96, 28.29 cm was produced by Arka Nishant variety. These differences in plant height among the varieties might be due to the genetic makeup of the plant and its expression to the growing soil and environmental conditions. The variation in plant growth of different radish varieties were also observed, which confirms the results [1]. The supreme number of leaves plant^{-1} 12.33 were produced in Japanese White and it was at par with Pusa Reshmi, I H R -1-1. Whereas, the minimum number of leaves plant^{-1} 9.86 were observed in variety Pusa Chetki (Table 2, Fig. 3). The significant difference in early stages of growth is obvious, as during germination and growth initiation process, the varieties might not have expressed their genetic potential. The significant differences thereafter could be attributed to the requirement of developing plants for more quantum of carbohydrates, which might have forced the plants of these varieties to produce more number of leaves. The variation in number of leaves among different radish varieties was also reported which supports the results of present findings [8,17,13,1,18,22,6,14].The maximum leaf area 120.92 cm^2 was recorded in variety Arka Nishant, which was found to be at par with the varieties Japanese White with 117.83 cm^2, I H R-1-1 with 113.40 cm^2 and it was followed by the variety Pusa Chetki with 110.04 cm^2 (Table 2, Fig. 4). Maximum leaf area might be helpful for more photosynthesis and making food for better yield potential character of plant growth and produce maximum yield. Further, the growth characters of the plants greatly depend on the genetic makeup of the variety. Similar results were also obtained [22,15]. Also the chlorophyll content of leaves (3.10 mg g^{-1}) recorded in Arka Nishant and minimum chlorophyll content of leaves was recorded (1.61 mg g^{-1}) in variety Pusa Desi (Table 2, Fing. 5). Chlorophyll content of leaves was might be varied according to leaf area and types of leaves and genotypic character. Similar results has been reported in Pusa Chetki cultivar of radish [15].

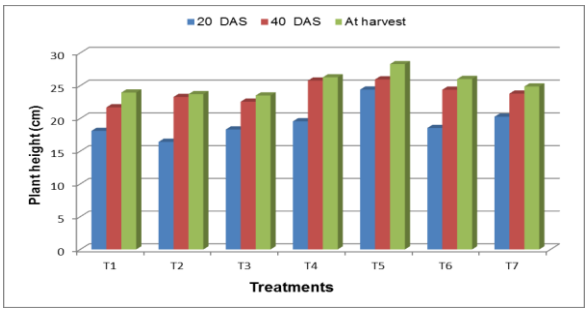


Fig. 2: Plant Height

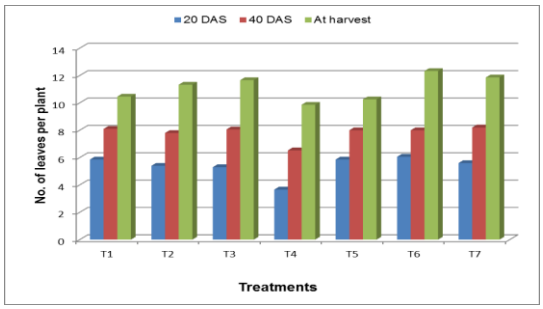


Fig. 3: No. of leaves plant^{-1}

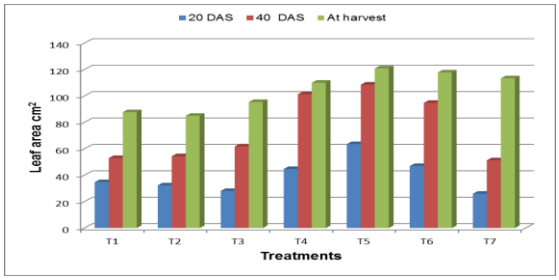


Fig. 4: Leaf area (cm^2)

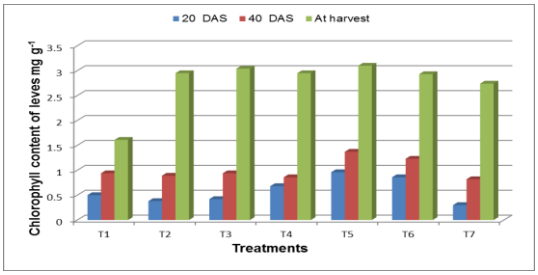


Fig. 5: Chlorophyll content of leaves (mg g^{-1})

Table 2: Performance of different radish varieties in respect of various Growth parameters

Treatment (Varieties)	Plant Height at Harvest (cm)	No. of leaves plant^{-1}	Leaf area (cm^2)	Chlorophyll content of leaves (mg g^{-1})
V1 - Pusa Desi	23.95	10.46	87.76	1.61

V2 - Pusa Himani	23.70	11.33	85.04	2.95
V3 - Pusa Reshmi	23.50	11.66	95.46	3.04
V4 - Pusa Chetki	26.28	9.86	110.04	2.95
V5 - Arka Nishant	28.29	10.26	120.92	3.10
V6 - Japanese White	26.02	12.33	117.83	2.93
V7 - I H R-1-1	24.88	11.86	113.40	2.74
"F" test	Sig.	Sig.	Sig.	Sig.
SEm±	1.02	0.29	2.53	0.16
CD at 5 %	3.15	0.90	7.82	0.49

Yield Parameters:

Days required to harvest

The variety Arka Nishant required minimum (43) number of days that is 43 days for edible size and it was closely followed by varieties Pusa Chetki (46 days), Japanese White, Pusa Himani (49 days), Pusa Reshmi (50 days) and Pusa Desi (52 days). However, the maximum numbers of days that is 58 days were taken by variety I H R -1-1 for obtaining edible size of roots (Table 3). The data in respect to number of days required to harvesting and to attend edible size, indicated that, it was varied from 43-58 days. The differences in maturity period can be attributed to genetic differences among the cultivars and ecological as well as climatic condition, as climate during growth and development of plant plays a dominant role in growth, yield and quality of radish. Similar trend of result was also observed [19,5,15].

Table 3: Performance of different radish varieties in respect of yield parameters

Treatment (Varieties)	Days require to harvest	Fresh weight of leaves (g)	Fresh weight of root (g)	Total fresh weight of plant (g)
V1 - Pusa Desi	52	67.48	122.76	190.06
V2 - Pusa Himani	49	72.64	133.66	204.22
V3 - Pusa Reshmi	50	74.70	140.88	214.74
V4 - Pusa Chetki	46	64.85	154.80	218.10
V5 - Arka Nishant	43	66.02	161.74	226.60
V6 - Japanese White	49	68.12	153.38	223.75
V7 - I H R-1-1	58	70.99	133.25	216.10
"F" test	**Sig.**	**Sig**.	**Sig.**	**Sig**.
SEm±	0.52	1.54	1.22	4.40
CD at 5 %	1.63	4.77	3.75	13.58

Fresh weight of leaves (g)

The data presented in Table 8 revealed that, the fresh weight of leaves were significantly influenced by the different varieties of radish. The variety Pusa Reshmi recorded 74.70 g, expressively maximum fresh weight of leaves, which was statistically at par with Pusa Himani (72.64g) and I H R -1-1 with 70.99 g. Whereas, the minimum weight of leaves 64.85 g was recorded in variety Pusa Chetki (Table 3). The similar variations in fresh weight of leaves among different varieties have reported [15].

Fresh weight of root (g)

The weight of roots influenced significantly among the different varieties. It was observed that, the maximum fresh weight of root was 161.74 g recorded in variety Arka Nishant. However, the minimum weight of root was 122.76 g recorded in variety Pusa Desi. The varieties Pusa Himani (133.66 g) and IHR-1-1 (133.25g) were found statistically at par with each other (Table 3). The variation in the weight of root might be due to the genetic variation. Increase in leaf area, root diameter, plant height might be reflected in the increases in the root weight. The present findings are in conformity with the work done [8,5,7] on radish crop.

Total fresh weight of plant (g)

The variety Arka Nishant recorded highest total fresh weight of plant 226.60 g which was statistically at par with variety Japanese White which was 223.75 g, Pusa Reshmi, Pusa Chetki, Japanese White, IHR -1-1. While, the minimum total fresh weight of plant was 190.06 g recorded in variety Pusa Desi (Table 3). The variations in total fresh weight of plant among different radish varieties might be due to the varietal difference. The results of the present investigation are similar [15,7] in radish.

Root yield hectare^{-1} (t ha^{-1})

The variety Arka Nishant recorded maximum root yield of 53.91 t ha^{-1} and it was significantly superior over rest of varieties and followed by Japanese White with 50. 86 t ha^{-1} and Pusa Chetki with 50.78 t ha^{-1}. Whereas, the minimum root yield was 40.90 t ha^{-1} recorded in variety Pusa Desi (Table 4). It is obivious that, the varieties which performed better in a unit area are likely to perform better on large scale as the yield hectare^{-1} was calculated by multiplying yield plot^{-1} with hectare factor. The yield is the result of interaction of the genotype to a given agro climatic and management factors. Further, yield is supposed to be reflections of the yield components. The yield variations among these seven varieties may be considered as varietal difference, as all these varieties are tested under same soil, management and similar agro climatic conditions. The variations in yield among the radish varieties were also reported by several workers [19,21,8,5,10].

Table 4: Performance of different radish varieties in respect of Root yield hectare^{-1} (t ha^{-1}) and Root to shoot ratio

Treatment (Varieties)	Root yield hectare^{-1} (t ha^{-1})	Root to shoot ratio
V1 - Pusa Desi	40.90	0.94
V2 - Pusa Himani	44.52	0.89
V3 - Pusa Reshmi	46.95	0.94
V4 - Pusa Chetki	50.76	0.86
V5 - Arka Nishant	53.91	1.37
V6 - Japanese White	50.86	1.23
V7 - I H R -1-1	44.40	0.82
“F” test	Sig.	Sig.
SEm±	0.41	0.09
CD at 5 %	1.27	0.18

Root to shoot ratio

The data related to root to shoot ratio in radish as influenced by varieties of radish are presented in Table 4 shows the significantly maximum root to shoot ratio produced by variety Arka Nishant was 1.37 and it was superior over rest of the varieties and followed by Japanese White (1.23), Pusa Chetki (0.86), respectively . The minimum root to shoot ratio recorded in variety IHR-1-1 was 0.82 (Table 4). The root to shoot ratio indicated significant differences among the different radish varieties. The variations in root to shoot ratio among different radish varieties were also observed [1,4] which supports the results of the present investigation.

Quality parameters:

Ascorbic acid content of root (mg 100 g^{-1})

The ascorbic acid content of root was significantly influenced by different radish varieties. The maximum ascorbic acid content of root recorded in variety Arka Nishant and Pusa Chetki was 18.36 mg $100g^{-1}$, which was followed by Japanese White (18.28 mg $100g^{-1}$). Whereas, the minimum (13.59 mg $100g^{-1}$) ascorbic acid content of root was recorded in variety Pusa Desi (Table 5). It might be due to the fact that, genetic cause or responses of the particular genotype to the soil and climatic conditions might be reflected in such characters. Similar results were also reported [9,15,12]. It is interesting to state that, more content of ascorbic acid in root of radish would be responsible for longer preservation of the produce during storage.

Table 5: Performance of different radish varieties in respect of Ascorbic acid content of root (mg 100 g^{-1}) and TSS of root (^{0} Brix)

Treatment (Varieties)	Ascorbic acid content of root (mg $100g^{-1}$)	TSS of root (^{0} Brix)
V1 - Pusa Desi	13.59	3.82
V2 - Pusa Himani	16.58	3.49
V3 - Pusa Reshmi	17.11	3.48
V4 - Pusa Chetki	18.36	3.89
V5 - Arka Nishant	18.36	4.00
V6 - Japanese White	18.24	3.74
V7 - I H R-1-1	18.12	3.02
"F" test	Sig.	**Sig**.
SEm±	0.84	0.10
CD at 5 %	2.58	0.32

Total soluble solids (TSS) of root (^{0}Brix)

From the data presented in Table 5, it was observed that, the maximum 4.00 TSS content in the root was recorded in variety Arka Nishant which was at par with varieties Pusa Chetki (3.89 ^{0}Brix), Japanese White (3.74 ^{0}Brix) and Pusa Desi (3.82 ^{0}Brix). The minimum (3.02 ^{0}Brix) TSS content in the root was recorded in variety I H R-1-1 and remaining varieties were at par with each other (Table 5). The variation in the TSS content in root, might be due to the indivisual character of variety and it also might be due to the effect of soil and climatic conditions wherein that variety grown. These results are in conformity with the finding [9] in radish crop.

Pithiness in root

The data regarding scores obtained after the evaluation of radish plants of different radish varieties, for pithiness in root regarding different quality characters like diameter of root and fiber content in it as vegetable, by different outcomes are presented in Table 6.

Table 6: Performance of different radish varieties in respect of Pithiness in root

Treatment (Varieties)	Different harvesting dates and pithiness status						
	43 Days after Sowing	46 Days after Sowing	49 Days after Sowing	52 Days after Sowing	55 Days after Sowing	58 Days after Sowing	60 Days after Sowing
V1 - Pusa Desi	NP	NP	NP	NP	NP	P	P
V2 - Pusa Himani	NP	NP	NP	NP	P	P	P
V3 - Pusa Reshmi	NP	NP	NP	NP	P	P	P

V4 - Pusa Chetki	NP	NP	NP	NP	NP	NP	P
V5 - Arka Nishant	NP	NP	NP	NP	NP	NP	P
V6 - Japanese White	NP	NP	NP	NP	NP	NP	P
V7 - I H R - 1-1	NP	NP	NP	NP	NP	NP	P

*NP= Non pithy root
*P = Pithy root

Conclusion:

The plant height was supreme (28.29 cm) in Arka Nishant, maximum chlorophyll content of leaves (3.10 mg g^{-1}) recorded in Arka Nishant. The variety Arka Nishant required minimum (43 days) number of days, in weight of total fresh weight of plant (190.06 g to 226.60 g) were observed. It was maximum in variety Arka Nishant, whereas, minimum in variety Pusa Desi. The variations in fresh weight of root (122.76 g to 161.74 g) were observed. The maximum root to shoot ratio (1.37) was observed in variety Arka Nishant. The values of root diameter were maximum (3.69 cm) in variety Arka Nishant. The maximum root yield $plot^{-1}$ (32.34 kg $plot^{-1}$) and $hectare^{-1}$ (53.91 t ha^{-1}) was produced in variety Arka Nishant. The maximum moisture content of root (97.75%) was recorded in Arka Nishant variety. The ascorbic acid content was maximum (18.36 mg $100g^{-1}$), TSS (4.00 ^{0}B) was recorded in the variety Arka Nishant. In nutshell, the radish varieties Arka Nishant, Japanese White and Pusa Chetki had shown the significantly superior performance with respect to most of the growth, yield and quality attributes. Hence, these varieties are suitable for agro-climatic conditions of Akola. Among seven varieties, the variety Arka Nishant performed better.

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