



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(6): 989-992
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www.thepharmajournal.com
Received: 05-02-2022
Accepted: 10-05-2022

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Varietal evaluation of Red cabbage [*Brassica oleraceae* var. *capitata* f. *rubra*] under Prayagraj Agro-climatic conditions

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Abstract

An experiment was conducted to find out the best suitable varieties of Red Cabbage for Prayagraj Agro-climatic conditions in the Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences (SHUATS), Prayagraj (U.P.), during Rabi season of the year 2021-2022. Eight varieties including two check varieties are evaluated and the experiment was laid out in randomized block design with three replications. The observations were recorded on growth, yield and quality parameters. In terms of earliness, minimum days to maturity was recorded in the variety AVT-11 2019/CABRVAR-1 (83.73), followed by AVT-11 2019/CABRVAR-6 (85.33) and maximum days to maturity was recorded in the variety RED BALL (108.67). In terms of yield, Maximum marketable head weight & marketable head yield/hectare was recorded in the variety RED CABBAGE HAIRLOOM (1.73kg & 519.22q/ha), followed by RED BALL (1.49kg & 445.50q/ha) and minimum marketable head weight & marketable head yield/hectare was recorded in the variety AVT-11 2019/CABRVAR-2 (0.99kg & 297.61q/ha).

Keywords: Red cabbage, Agro-climatic, *Brassica oleraceae* var. *capitata* f. *rubra*

Introduction

Red cabbage (*Brassica oleracea* var. *capitata* f. *rubra*) is an important cole crop grown worldwide both in temperate and tropical regions of the world. Red cabbage is also called as purple cabbage, red kraut or purple kraut after preparations. It is a diploid plant ($2n=2x=18$) and a member of family Brassicaceae. It is an herbaceous, biennial, dicotyledonous flowering plant distinguished by purplish leaves which are tightly arranged forming a headed cabbage, having a flat-topped, cylindrical, spherical or oval shape. Commercially it is grown in the European, African as well as in Asian continents.

Red cabbage is used as raw for salad, fermented for sauerkraut or liquid products as juices, soups, curries and other cooking purposes like pickles, boiled and steamed purposes (Sarkar *et al.*, 2017) [9]. Red cabbage contain purple or red colour due to the presence of pigment known as anthocyanin, which is predominant over other 10 flavonoids.

Red cabbage having the strongest antioxidant capacity to anthocyanins which has a power of 150 flavonoids (Fernandis *et al.* 2019). Anthocyanin concentration in red cabbage is 322mg/100 gm (Singh *et al.*, 2015) [15]. Red and white cabbage having antioxidants are antiulcer, antidiabetic and anticancerous properties which reduce the risk of diseases and contain abundant source of health promoting substances which protects us from cancer, premature aging, diabetes, ulcer and Alzheimer's diseases. Also the red cabbage helps in weight loss, immune system booster and detoxification of body (Sarkar *et al.*, 2017) [9].

Diversity in cultivars of vegetables and other crops developed by various research institutes is a considerable importance in any crop improvement programme. Given that, it is also important to research on the adaptability and its overall performance like the growth parameters, the yield produced or pest and disease resistance quality which can vary from different regions. So this necessitates to research on the new varieties of Red Cabbage for a suitable variety in Prayagraj climatic conditions.

Materials and Methods

The present investigation was carried out with 8 varieties of Red cabbage collected from different sources. The experiment was conducted in randomized block design with three.

replications during Rabi season of 2021-2022, at Vegetable Research Farm, Department of Horticulture, SHUATS, Prayagraj (U.P.), India. Observation was recorded on five randomly selected plants of each genotype from each replication for the thirteen quantitative characters i.e., plant height (cm), number of leaves, number of days to maturity, head polar diameter (cm), head equatorial diameter (cm), head compactness (g/cm³), gross plant weight (kg), net head weight (kg), marketable head weight (kg), marketable head yield per plot (kg), marketable head yield per hectare (quintals), harvest index and total soluble solids (TSS).

Table 1: Name of Varieties and their sources

| S. No. | Varieties | Source |
|--------|------------------------------|--------------------------|
| 1 | AVT-II 2019/ CABRVAR-1 | IIVR, Varanasi |
| 2 | AVT-II 2019/ CABRVAR-2 | IIVR, Varanasi |
| 3 | AVT-II 2019/ CABRVAR-3 | IIVR, Varanasi |
| 4 | AVT-II 2019/ CABRVAR-4 | IIVR, Varanasi |
| 5 | AVT-II 2019/ CABRVAR-5 | IIVR, Varanasi |
| 6 | AVT-II 2019/ CABRVAR-6 | IIVR, Varanasi |
| 7 | Red Cabbage Hairloom (Check) | KRAFT SEEDS, |
| 8 | Red Ball (Check) | Urja Agriculture Company |

Results and Discussion

Plant height at 30 days (cm)

The maximum plant height at 30 days was recorded in the variety RED BALL (25.37cm), followed by AVT-11 2019/CABRVAR-5 (24.53cm) and minimum plant height at 30 days was recorded in the variety AVT-11 2019/CABRVAR- 4 (18.07cm).

Plant height at 45 days (cm)

The maximum plant height at 45 days was recorded in the variety AVT-11 2019/CABRVAR- 3 (34.67cm), followed by AVT-11 2019/CABRVAR-1 (33.60cm) and minimum plant height at 45 days was recorded in the variety AVT-11 2019/CABRVAR- 4 (23.53cm).

Plant height at 60 days (cm)

The maximum plant height at 60 days was recorded in the variety AVT-11 2019/CABRVAR- 1 (44.13cm), followed by AVT-11 2019/CABRVAR-3 (43.00cm) and minimum plant height at 60 days was recorded in the variety AVT-11 2019/CABRVAR- 4 (29.57cm). This finding is in close proximity with the findings of kundu *et al.*, (2018)^[5] and Eva *et al.*, (2020)^[2] in Cabbage and PC. Chaurasiya *et al.*, (2020)^[7] and Kour Ravneet. (2020)^[4] in Broccoli.

Number of Leaves at 30 days

The maximum number of leaves at 30 days was recorded in the variety AVT-11 2019/CABRVAR-1 & AVT-11 2019/CABRVAR- 6 (10.67), followed by AVT-11 2019/CABRVAR- 3 (10.40) and minimum number of leaves at 30 days was recorded in the variety AVT-11 2019/CABRVAR- 4 & RED CABBAGE HAIRLOOM (8.00).

Number of Leaves at 45 days

The maximum number of leaves at 45 days was recorded in the variety AVT-11 2019/CABRVAR- 6 (15.60), followed by AVT-11 2019/CABRVAR- 3 (15.20) and minimum number of leaves at 45 days was recorded in the variety AVT-11 2019/CABRVAR- 4 (11.47).

Number of Leaves at 60 days

The maximum number of leaves at 60 days was recorded in the variety RED CABBAGE HAIRLOOM (17.13), followed by RED BALL (16.93) and minimum number of leaves at 60 days was recorded in the variety AVT-11 2019/CABRVAR-5 (13.67). Similar findings previously also reported by Eva *et al.*, (2020)^[2] in Cabbage and PC. Chaurasiya *et al.*, (2020)^[7] and Kour Ravneet. (2020)^[4] in Broccoli.

Number of days to Maturity

Minimum days to maturity was recorded in the variety AVT-11 2019/CABRVAR-1 (83.73), followed by AVT-11 2019/CABRVAR-6 (85.33) and maximum days to maturity was recorded in the variety RED BALL (108.67). Similar results were obtained by Eva *et al.*, (2020)^[2], Adeniji *et al.*, (2010)^[1], and Kundu *et al.*, (2018)^[5].

Gross Plant Weight (kg)

Maximum gross plant weight was recorded in the variety RED CABBAGE HAIRLOOM (3.26kg), followed by RED BALL (2.85kg) and minimum gross plant weight was recorded in the variety AVT-11 2019/CABRVAR-2 (1.61kg). Similar results were obtained by Singh *et al.*, (2011)^[14].

Net Head Weight (kg)

Maximum net head weight was recorded in the variety RED CABBAGE HAIRLOOM (1.45kg), followed by RED BALL (1.22kg) and minimum net head weight was recorded in the variety AVT-11 2019/CABRVAR-2 (0.80kg). Similar findings previously also reported by Eva *et al.*, (2020)^[2], Adeniji *et al.*, (2010)^[1], and Singh *et al.*, (2011)^[14].

Head Polar Diameter (cm)

Maximum head polar diameter was recorded in the variety RED CABBAGE HAIRLOOM (16.37cm), followed by RED BALL (15.40cm) and minimum head polar diameter was recorded in the variety AVT-11 2019/CABRVAR-2 (12.65cm). Similar results were obtained by Adeniji *et al.*, (2010)^[1], Singh *et al.*, (2011)^[14] and Kundu *et al.*, (2018)^[5].

Head Equatorial Diameter (cm)

Maximum head equatorial diameter was recorded in the variety RED CABBAGE HAIRLOOM (15.46cm), followed by AVT-11 2019/CABRVAR-6 (15.41cm) and minimum head equatorial diameter was recorded in the variety AVT-11 2019/CABRVAR-2 (13.87cm). Similar results were obtained by Adeniji *et al.*, (2010)^[1], Singh *et al.*, (2011)^[14] and Kundu *et al.*, (2018)^[5].

Marketable Head Weight (kg)

Maximum marketable head weight was recorded in the variety RED CABBAGE HAIRLOOM (1.73kg), followed by RED BALL (1.49kg) and minimum marketable head weight was recorded in the variety AVT-11 2019/CABRVAR-2 (0.99kg). Similar findings previously also reported by Adeniji *et al.*, (2010)^[1].

Marketable Head Yield/Plot (kg)

Maximum marketable head yield/plot was recorded in the variety RED CABBAGE HAIRLOOM (84.81kg), followed by RED BALL (72.77kg) and minimum marketable head yield/plot was recorded in the variety AVT-11 2019/CABRVAR-2 (48.61kg). Similar results were obtained

by PC. Chaurasiya *et al.*, (2020)^[7] and Eva *et al.*, (2020)^[2].

Marketable Head Yield/Hectare (q/ha)

Maximum marketable head yield/hectare was recorded in the variety RED CABBAGE HAIRLOOM (519.22q/ha), followed by RED BALL (445.50q/ha) and minimum marketable head yield/hectare was recorded in the variety AVT-11 2019/CABRVAR-2 (297.61q/ha). Similar findings were obtained by Kundu *et al.*, (2018)^[5] and Eva *et al.*, (2020)^[2] in Cabbage and PC. Chaurasiya *et al.*, (2020)^[7] and Kour Ravneet. (2020)^[4] in Broccoli.

Harvest Index (%)

Maximum harvest index was recorded in the variety AVT-11 2019/CABRVAR-4 (71.01%), followed by AVT-11 2019/CABRVAR-3 (68.91%) and minimum harvest index was recorded in the variety RED BALL (52.22%). Similar

results were obtained by Singh *et al.*, (2011)^[14].

Head Compactness (g/cm³)

Maximum head compactness was recorded in the variety RED BALL (37.86g/cm³), followed by AVT-11 2019/CABRVAR-3 (36.33g/cm³) and minimum head compactness was recorded in the variety AVT-11 2019/CABRVAR-2 (29.70g/cm³). Similar results were obtained by Singh *et al.*, (2011)^[14].

TSS (°Brix)

Maximum TSS was recorded in the variety RED BALL (9.27°Brix), followed by AVT-11 2019/CABRVAR-4 & RED CABBAGE HAIRLOOM (7.70°Brix) and minimum TSS was recorded in the variety AVT-11 2019/CABRVAR-1 (4.40°Brix). Similar findings previously also reported by Thapa *et al.*, (2012)^[17].

Table 2: Varietal evaluation of Red cabbage with respect to plant height, number of leaves, days to maturity and gross plant weight.

| S.NO. | VARIETIES | PH 30 | PH 45 | PH 60 | NL 30 | NL 45 | NL 60 | DM | GPW |
|-------|--------------------------------|--------|-------|-------|--------|-------|-------|--------|--------|
| V1 | AVT II 2019/ CABRVAR- 1 | 23.20 | 33.60 | 44.13 | 10.67 | 14.40 | 16.20 | 83.73 | 2.23 |
| V2 | AVT II 2019/ CABRVAR- 2 | 19.30 | 25.83 | 32.80 | 9.93 | 15.07 | 16.00 | 88.73 | 1.61 |
| V3 | AVT II 2019/ CABRVAR- 3 | 22.40 | 34.67 | 43.00 | 10.40 | 15.20 | 15.53 | 86.73 | 1.89 |
| V4 | AVT II 2019/ CABRVAR- 4 | 18.07 | 23.53 | 29.57 | 8.00 | 11.47 | 14.67 | 110.80 | 1.61 |
| V5 | AVT II 2019/ CABRVAR- 5 | 24.53 | 24.77 | 32.17 | 8.40 | 11.60 | 13.67 | 91.60 | 1.89 |
| V6 | AVT II 2019/ CABRVAR- 6 | 20.73 | 30.87 | 39.93 | 10.67 | 15.60 | 16.80 | 85.33 | 2.02 |
| V7 | RED CABBAGE HAIRLOOM (CHECK-1) | 22.20 | 27.93 | 38.87 | 8.00 | 11.87 | 17.13 | 106.33 | 3.26 |
| V8 | RED BALL (CHECK-2) | 25.37 | 32.73 | 41.40 | 8.53 | 12.80 | 16.93 | 108.67 | 2.85 |
| | F | S | S | S | S | S | S | S | S |
| | SE(d) | 2.09 | 1.73 | 1.70 | 0.87 | 0.78 | 0.76 | 1.02 | 0.18 |
| | CD at 5% | 4.33 | 3.57 | 3.53 | 1.80 | 1.62 | 1.57 | 2.11 | 0.37 |
| | CV | 11.67% | 7.23% | 5.53% | 11.42% | 7.09% | 5.86% | 1.31% | 10.22% |

PH 30 = PLANT HEIGHT AT 30 DAYS, PH 45 = PLANT HEIGHT AT 45 DAYS, PH 60 = PLANT HEIGHT AT 60 DAYS, NL 30 = NUMBER OF LEAVES AT 30 DAYS, NL 45 = NUMBER OF LEAVES AT 45 DAYS, NL 60 = NUMBER OF LEAVES AT 60 DAYS, DM = DAYS TO MATURITY, GPW = GROSS PLANT WEIGHT

Table 3: Varietal evaluation of Red cabbage in different yield and quality parameters.

| SL.NO | VARIETIES | NHW | HPD | HED | MHW | MHY/PLOT | MHY/HA | HI | HC | TSS |
|-------|------------------------------|--------|-------|-------|--------|----------|--------|-------|-------|-------|
| V1 | AVT II 2019/ CABRVAR- 1 | 1.02 | 13.96 | 14.87 | 1.27 | 62.47 | 382.46 | 57.52 | 34.05 | 4.40 |
| V2 | AVT II 2019/ CABRVAR- 2 | 0.80 | 12.65 | 13.87 | 0.99 | 48.61 | 297.61 | 62.10 | 34.19 | 5.10 |
| V3 | AVT II 2019/ CABRVAR- 3 | 0.96 | 13.28 | 14.33 | 1.28 | 62.57 | 383.08 | 68.91 | 36.33 | 5.37 |
| V4 | AVT II 2019/ CABRVAR- 4 | 1.00 | 14.61 | 14.03 | 1.15 | 56.11 | 343.54 | 71.01 | 34.04 | 7.70 |
| V5 | AVT II 2019/ CABRVAR- 5 | 0.95 | 14.77 | 14.70 | 1.17 | 57.35 | 351.10 | 62.05 | 29.70 | 5.13 |
| V6 | AVT II 2019/ CABRVAR- 6 | 1.14 | 14.35 | 15.41 | 1.19 | 58.13 | 355.90 | 59.41 | 34.85 | 4.67 |
| V7 | Red cabbage hairloom (check) | 1.45 | 16.37 | 15.46 | 1.73 | 84.81 | 519.22 | 53.11 | 35.49 | 7.70 |
| V8 | Red ball (check) | 1.22 | 15.40 | 14.01 | 1.49 | 72.77 | 445.50 | 52.22 | 37.86 | 9.27 |
| | F | S | S | S | S | S | S | S | S | S |
| | SE(d) | 0.11 | 0.41 | 0.45 | 0.12 | 5.97 | 36.57 | 2.92 | 1.64 | 0.21 |
| | CD at 5% | 0.24 | 0.85 | 0.93 | 0.25 | 12.36 | 75.66 | 6.04 | 3.40 | 0.42 |
| | CV | 13.13% | 3.48% | 3.77% | 11.64% | 11.64% | 11.64% | 5.88% | 5.83% | 4.07% |

NHW = NET HEAD WEIGHT, HPD = HEAD POLAR DIAMETER, HED = HEAD EQUATORIAL DIAMETER, MHW = MARKETABLE HEAD WEIGHT, MHY/PLOT = MARKETABLE HEAD YIELD/PLOT, MHY/HA = MARKETABLE HEAD YIELD/HECTARE, HI = HARVEST INDEX, HC = HEAD COMPACTNESS, TSS= TOTAL SOLUBLE SOLIDS

Conclusion

The results from the present investigation concluded that AVT II 2019/ CABRVAR- 1 was identified as the earliest variety and RED CABAGGE HAIRLOOM was found to be superior for marketable head yield and other yield contributing traits.

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