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Fruiting behaviour of table and wine grape varieties under North Indian conditions

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Abstract

Grape vines, trained on Y-trellis system were evaluated for their fruiting behaviour during the fruiting season of 2011-12 in Punjab conditions (North India). The maximum number of bunches per vine were recorded in variety Punjab Purple (H-516) and the maximum berries per bunch were recorded in variety Chardonnay. While, the variety Cardinal was promising in other berry characteristics such as berry weight, length, breadth and firmness, juice recovery was higher in variety Merlot. Varieties Himrod, Punjab Purple (H-516) and Pusa Navrang performed better as compared to other varieties with respect to physico- chemical parameters. Based on the overall performance, variety Punjab Purple (H-516) was found to be the most promising under North Indian conditions.

Key words: Grapes, Cardinal, Punjab Purple (H-516), Merlot, fruiting behaviour.

Introduction

The grape (*Vitis vinifera* L.) is an important and economic proposition for the farmers among the horticultural crops grown in the world. The important grape growing countries are Italy, Spain, France, U.S.A, South Africa, Iran, Bulgaria, Hungary and Romania. It is one of the commercially important fruit crops of India and is cultivated in Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu in South India and Punjab, Haryana, Uttar Pradesh in Northern India.

Grapes have multiple usage, such as for table, juice, wines and raisin making. The grape seeds have high nutraceutical potential, while the grape skins can be used for food coloring. Drying causes grapes to lose their water, but they retain their minerals, vitamins, fiber and about 324 calories per 100 g. In India, grape is grown on a variety of soil and climatic conditions in three distinct agro-climatic zones, namely, sub-tropical, hot tropical and mild temperate regions. Grape productivity varies from region to region and the best orchards of Maharashtra and Karnataka yield 24-29 tonnes per hectare. Of the total production, about 94 per cent is contributed by Maharashtra and Karnataka. In Punjab the grape cultivation is spread in the districts of Bathinda, Ferozepur, Muktsar, Sangrur and Mansa covering an area of about 400 hectares with total production of 1.25 lakh mt (NHB, 2011). Perlette is the commercial variety of the region. However, the bunch being compact in this cultivar, are highly prone to damage due to pre monsoon rains. Thus, there is an urgent need to identify a suitable multipurpose variety for this North Indian region. The present investigation was planned to evaluate fruiting behavior of new grape varieties for their suitability for this region.

Materials and methods

The present experiment was carried out at Department of Fruit Science, Punjab Agricultural University, Ludhiana, Punjab. A total of sixteen different grape (*Vitis vinifera* L.) varieties with age of five years and trained on Y-system of training were evaluated for field performance during fruiting season of 2011-12. The varieties included A 18-3, A 47-1, A 47-2, A 48-1, Beauty Seedless, Cardinal, Chardonnay, E 12-2, H 27, H 144, Himrod, Merlot, Muscat Hamburg, Punjab Purple (H-516), Pusa Navrang and Tannat. The varieties namely H 27, H 144 and H 516 were obtained from Agarkar Research Institute, Pune, while others were obtained from National Research Centre for Grapes, Pune under All India Coordinated Research Project trials.

All the cultural practices like fertilization, irrigation, weeding, plant protection, etc. were carried out uniformly to all the varieties as per recommended package of practices of Punjab Agricultural University for cultivation of fruits. The experiment was laid out in Randomized Block Design (RBD) and analysed as suggested by Gomez and Gomez, (1984). The fruiting characters were recorded at the time of harvest in the month of May-June. Physico-chemical characters were recorded as per the standard procedures (AOAC, 2000).

Observations were recorded on twelve physical and chemical characters, *viz.*, number of bunches per vine, berries per bunch by calculating total number of berries from randomly selected ten bunches. Berry length and berry breadth was recorded with the help of vernier scale, berry weight by digital weighing balance and berry firmness with the help of texture analyzer. The pressure required to force a stainless steel probe of 20 mm diameter on berry was recorded. It was measured in terms of gram force. Juice recovery percent was recorded by extracting juice of ten berries in the juice extractor. The juice was strained through a muslin cloth and weighed. The juice percentage was calculated on the basis of total fruit weight. Total soluble solids (TSS) was measured using an Erma hand refractrometer at room temperature. Acidity was measured by titrating juice against 0.1 N NaOH solution. TSS/Acid ratio was calculated by dividing the value of TSS with that of the corresponding titratable juice acidity. The pH of the juice was determined by glass electrode pH meter. Anthocyanin content based upon the principle that it is extracted with ethanolic-hydrochloride and the intensity of the colour appeared was measured colorimetrically. From the reading, the amount of the pigment present was determined.

Results and discussion

The data of different grape varieties with respect to fruiting characteristics is detailed below and presented in Table 1.

Yield per vine: The data pertaining to yield per vine ranged from 0.82 to 10.51 kg. Among table varieties, the maximum yield per vine (8.63 kg) was recorded in variety Cardinal. Among wine varieties the maximum yield per vine (10.51 kg) was obtained in variety Punjab Purple (H 516), followed by Merlot (9.55 kg).

Number of berries per bunch: The data pertaining to total number of berries per bunch of different grape varieties was found to be significant and ranged from 25.10 to 123.10 berries per bunch. The maximum number of berries per bunch was recorded in variety Chardonnay (123.10) which was significantly better from all other varieties while, minimum number of berries per bunch was recorded in variety E 12-2 (25.10).

Berry length: The data related to average berry length of different varieties presented in Table 1 exhibited a significant variation in berry length among different varieties. The average berry length ranged from 1.36 to 2.33 cm. The maximum berry length was observed in variety Cardinal (2.33 cm) which was significantly more than all other varieties followed by A 47-2 (2.11 cm) and Muscat Hamburg (2.06 cm). The minimum berry length was observed in Chardonnay (1.36 cm). The variation in berry length might be due to genetic variability and their interactions with the environment.

Berry breadth: Berry breadth ranged from 1.32 to 2.67 cm and significant variation was found among different varieties. The maximum berry breadth was observed in variety Cardinal (2.67 cm) which was significantly higher than other varieties. Varieties, A 47-2 and Muscat Hamburg showed berry breadth values 1.96 and 1.80 cm, respectively. The minimum berry breadth was noticed in variety Chardonnay (1.32 cm). Leao and Pereira (2001) evaluated six seedless grape cultivars and found that average berry diameter ranged from 1.57 cm to 1.80 cm.

Berry weight: A significant variation in berry weight was observed among different grape varieties, with the average ranging from 151.02 g to 491.47 g (Table 1). The maximum berry weight was found in variety Cardinal (491.47 g) which was followed by variety A 47-2 (426.60 g), and Muscat Hamburg (386.75 g). Minimum berry weight was found in variety Chardonnay (151.02 g). Abbal *et al.* (1992) reported that cv. Merlot had the smallest and lightest berries while cv. Cinsaut had the heaviest berries.

Berry firmness: The pressure required to force a stainless steel probe of 20 mm (diameter) on grapes was recorded. It was measured in terms of gram force and data on berry firmness in different varieties is presented in Table 1. The highest value was recorded in variety Cardinal (826.13 g force) which was significantly higher than all other varieties followed by varieties Merlot, A 47-1 and A 18-3 (689.83, 665.82 643.56 g force, respectively). The minimum value was observed in variety Beauty Seedless (523.65 g force) followed by Chardonnay (526.57 g force).

Berry colour: The data pertaining to berry colour of different grape varieties is presented in Table 2 which show a significant variation among different varieties. The black (202-A) colour was showed by varieties H-27, Pusa Navrang and Beauty Seedless. Variety A 47-2 and H-516 had black (203-D) colour while, Merlot showed blue (103-A) colour. The varieties Muscat Hamburg, Tannat, A 47-1, A 47-2, H-144, A 18-3 and Cardinal showed red colour group (59-A, 49-A, 43-D, 59-A, 53-B, 51-C, 47-C, respectively). Variety E 12-2 showed Purple (58-A) while, Chardonnay and Himrod showed green (142-A and 149-A respectively) colour.

Number of seeds per berry: Significant variations were found among different varieties of grape for number of seeds per berry (Fig. 1). The number of seeds per berry ranged from 1.36 to 3.15.

Table 1. Fruiting characteristics of different grape varieties under Punjab conditions

Variety	Yield per vine (kg)	Berries per bunch	Berry length (cm)	Berry breadth (cm)	Berry weight (g /100 berries)	Berry firmness (g force)
Punjab Purple (H-516)	10.51	84.10	1.57	1.36	169.57	556.36
H-27	4.61	76.50	1.65	1.58	224.20	605.14
Pusa Navrang	6.59	100.25	1.41	1.35	153.85	576.45
Muscat Hamburg	7.11	69.75	2.06	1.80	386.75	619.71
Chardonnay	7.37	123.10	1.36	1.32	151.02	526.57
Merlot	9.55	72.80	1.95	1.66	308.57	689.83
Tannat	9.12	64.05	1.65	1.40	225.77	634.86
A 48-1	7.23	104.50	1.52	1.45	177.82	579.18
E 12-2	0.82	25.10	1.64	1.44	249.42	538.46
A 47-1	7.68	63.20	1.69	1.38	244.22	665.82
A 47-2	5.18	57.60	2.11	1.96	426.60	638.80
H-144	8.09	107.80	1.71	1.51	205.55	578.57
A 18-3	5.71	72.10	1.77	1.64	276.25	643.56
Beauty Seedless	2.98	62.80	1.46	1.35	178.20	523.65
Cardinal	8.63	39.10	2.33	2.67	491.47	826.13
Himrod	4.80	95.20	1.74	1.55	200.07	566.68
LSD (P=0.05)	1.97	8.37	0.10	0.05	7.91	19.43

Table 2. Chemical characteristics of different grape varieties under Punjab conditions

Variety	Water berries (%)	Berry colour (RHCC*)	Juice recovery (%)	Juice pH	TSS/ Acid ratio	Anthocyanin content (mg/100g)
Punjab Purple (H-516)	8.42	Black (203-D)	66.85	3.39	29.33	34.01
H-27	3.50	Black (202-A)	71.05	3.72	16.53	29.63
Pusa Navrang	5.28	Black (202-A)	69.22	3.43	30.96	49.38
Muscat Hamburg	3.69	Red (59-A)	70.50	3.45	28.46	22.09
Chardonnay	4.14	Green (142-A)	64.45	3.43	33.33	0.00
Merlot	3.40	Blue (103-A)	84.15	3.18	28.75	27.39
Tannat	3.98	Red (49-A)	68.10	3.31	19.60	5.90
A 48-1	3.28	Black (203-D)	68.40	3.09	26.15	25.35
E 12-2	1.60	Purple (58-A)	69.12	3.32	26.42	18.43
A 47-1	3.27	Red (43-D)	70.40	3.18	18.80	4.98
A 47-2	1.26	Red (59-A)	77.90	3.22	21.83	19.55
H-144	2.84	Red (53-B)	68.10	3.03	29.28	22.30
A 18-3	8.27	Red (51-C)	72.57	3.40	27.50	15.78
Beauty Seedless	19.49	Black (202-A)	51.90	3.31	32.29	33.29
Cardinal	3.81	Red (47-C)	75.00	3.26	25.40	3.25
Himrod	1.93	Green (149-A)	74.60	3.28	37.50	0.00
LSD (P=0.05)	1.58	-	0.65	0.10	0.18	2.07

*Royal Horticultural Colour Chart (Wilson, 1938).

The highest number of seeds per berry was observed in variety E 12-2 (3.15), which was at par with variety Chardonnay (2.95), followed by H-27 (2.84). The lowest number of seeds per berry was observed in variety Himrod (1.36), followed by H-516 (1.37) and Beauty Seedless (1.38).

Seed weight: Data related to seed weight (Fig. 1) showed significant variation among different grape varieties. Maximum seed weight (100 seeds) was observed in variety A 47-2 (5.87 g) which was significantly higher than all other varieties, followed by Cardinal (5.55 g) and H-27 (5.52 g). The minimum value of seed weight was observed in variety Himrod (1.32 g), Beauty Seedless (1.42 g) and A 18-3 (1.62 g).

Water berries: The data on water berries showed significant variations (Table 2). The water berries percentage varied from 1.26 percent to 19.49 percent. The maximum water berries percentage was recorded in variety Beauty Seedless (19.49 %) which was significantly higher than all other varieties. The minimum water berries percent was recorded in variety A 47-2 (1.26), followed by E 12-2 (1.60) and Himrod (1.93).

Juice recovery: The juice recovery per cent ranged from 51.90 per cent to 84.15 per cent (Table 2). The maximum juice was

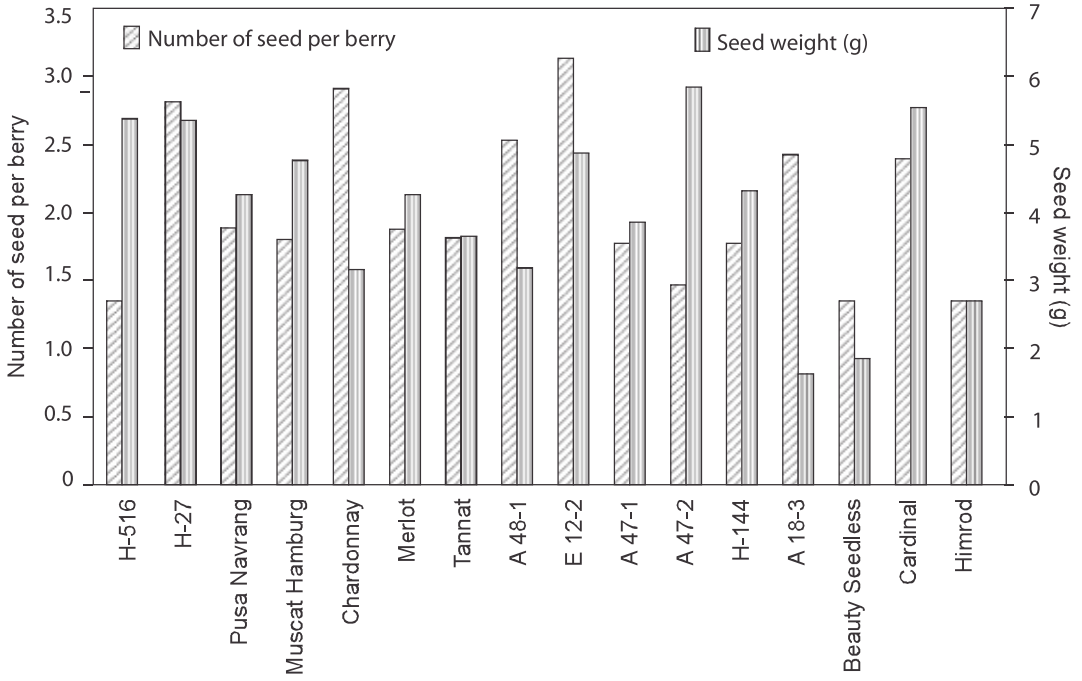

Fig. 1. Number of seeds per berry and seed weight of different grape varieties under North Indian conditions

recovered from variety Merlot (84.15 %) which was significantly higher than all other varieties. The minimum juice recovery per cent was observed in variety Beauty Seedless (51.90 %) followed by Chardonnay (64.45 %) and Punjab Purple (H-516) (66.85 %). Maljevic (2008) recorded the juice recovery ranging from 146-196 mL per 100 berries. Similar results were found with variety Punjab Purple (H- 516) which had good juice yield (62.38 %) and recommended for Punjab conditions (Aggarwal and Gill, 2010).

TSS/Acid ratio: The perusal of data in Table 2 revealed that TSS/acid ratio among different grape varieties varied significantly. The range varied from 16.53 to 37.50 with maximum ratio in variety Himrod (37.50) followed by variety Chardonnay (33.33), Beauty Seedless (32.29), Pusa Navrang (30.96) and minimum in variety H-27 (16.53). Gill and Arora (2009) reported that the TSS/Acid ratio was maximum (33.8) in Portan, which was significantly at par with Punjab Purple.

Juice pH: The different grape varieties under study showed variability in pH of the juice (Table 2). The higher value of pH was found in variety H-27 (3.72) which was significantly higher than all other varieties. The minimum pH of the juice was recorded in variety H-144 (3.03) closely followed by A 48-1 (3.09). Tambe *et al.* (2008) observed that the wines of Cabernet Sauvignon, Merlot and Pinot Noir recorded maximum pH (3.90), whereas, juice Sauvignon Blanc had the minimum pH of (3.03).

Anthocyanin content: Siginficant differences were found in anthocyanin content of different grape varieties (Table 2). The higher value of anthocyanin content was in variety Pusa Navrang (49.38 mg) which was significantly higher than all other varieties. The minimum value was recorded for variety Cardinal (3.25 mg) followed by A 47-1 (4.98 mg) and Tannat (5.90 mg). The varieties, Chardonnay and Himrod are green in colour, hence no value was calculated for these varieties. Similar results were found by Gill *et al.* (2008) that variety H-516 had the maximum anthocyanins of 5.47 mg/100 grams.

Sixteen grape varieties including table and wine purpose were studied for their fruiting and quality under Punjab conditions. The study revealed that among table varieties, maximum yield was obtained in Cardinal. Among the wine purpose varieties, Punjab Purple (H 516) was most productive having maximum yield per vine, while Merlot had maximum juice recovery.

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