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PB Sanap
Vegetable Specialist - Vegetable Improvement Scheme (VIS), Central Experiment Station (CES), Wakavali, DBSKKV, Dapoli, Maharashtra, India

BG Thaware
Assistant Professor, Department of Botany, College of Agriculture, DBSKKV, Dapoli, Maharashtra, India

PM Haldankar
Head of Department of Horticulture, College of Agriculture, DBSKKV, Dapoli, Maharashtra, India

TM Chikte
PhD Student – Mendel University, Brno, Czech Republic, Europe, India

Corresponding Author:
PB Sanap
Vegetable Specialist - Vegetable Improvement Scheme (VIS), Central Experiment Station (CES), Wakavali, DBSKKV, Dapoli, Maharashtra, India

Konkan Madhur (DPLSM-2): A new promising variety of snapmelon in coastal agro-climatic conditions of Maharashtra (India)

PB Sanap, BG Thaware, PM Haldankar and TM Chikte

Abstract
DPLSM-2 (Konkan Madhur), a variety of snapmelon cultivated in Konkan agro-climatic conditions of Maharashtra (India), is characterized by the potential yield of 15.31 t/ha. This variety possesses high fruit yield, attractive shape, and size and is sustainable in high rainfall areas. It also resulted in better LAB (L- Lightness, A- Redness, B- Yellowness) attributes with high Total Soluble Solids (TSS) content. Furthermore, the variety acquires better agronomic attributes and has better keeping qualities. The cracking percentage in Snapmelon cultivars is more than 65%, but the ratio in DPLSM-2 is minimal (9%). The incidence of pests and diseases is below ETL for this type and favoured by farmers for commercial cultivation.

Keywords: Snapmelon, Konkan Madhur, High yield, Pest and Diseases

1. Introduction
Snapmelon (*Cucumis melo* var. Momordica), a cucurbit vegetable, is indigenous to India with chromosome number 2n = 2x = 24 and is considered the hub of domestication for melons by some scientists (Duthie, 1905) [4]. Snapmelon is cultivated for salad fruits and raw fruits and eaten as melon when ripe, but the juice of snapmelon is gaining popularity as a refreshing drink due to its cooling effects (Pareek *et al.*, 1999) [10]. Snapmelon has a specific character of cracking (splitting) after ripening; therefore, in India, the snapmelon is locally known as 'phut' (Dhillon *et al.*, 2007) [3]. However, the snapmelon is not cultivated commercially as a vegetable crop, which is grown all over north India on a small scale and as an intercrop in pulses during the Kharif season in *the Konkan* region of western Maharashtra (Raigad and Thane Districts). It bears good potential for cultivation as it delivers more yields and requires less management cost as approached with cucurbits.
Snapmelon fruits are a rich source of nutrients such as carbohydrates (15.6 g), vitamin C (18.6 mg), energy (74.0 kcal), (Singh *et al.*, 2015) [15], and minerals like calcium phosphorus, and iron (Goyal and Sharma, 2009). The mature fruits are consumed raw with salt. The fruits are used for the medicinal purpose of first aid treatment for burns and as a natural moisturizer for the skin. Also, the fruits improve appetite and cure stomach pain and are considered a dessert (Singh *et al.*, 2015) [15]. The fruit bears light orange flesh and does sometimes used for flavouring ice cream and candy in Europe and the USA. Besides, the snapmelon does use for manufacturing squash, jams, etc. (Rana and Brar, 2017). The seeds of snapmelon are antitussive, digestive, febrifuge, and vermifuge. Moreover, the seed kernel is used in preparing bakery products and a traditional drink (Thandai).
Melons were raised in India as far back as 2300 and 1600 BC, where *momordica*, acidulous, and flexuous varieties were grown (Pitrat *et al.*, 2000; Cohen *et al.*, 2003) [11, 1]. Despite its commercial importance, limited attention has been given to the genetic characterization and diversity studies of the snapmelon (Pandey *et al.*, 2009 and 2011) [8, 9]. In the present situation, most of the genotypes with less keeping quality and cracking problems are unsuitable for commercial cultivation of snapmelon. Therefore, there was a need to evolve high-yielding and good-quality types with the low cracking character of snapmelon in India.
Because of these efforts, various varieties of snapmelon with acceptable characteristics were investigated to evolve high-yielding snapmelon type with exceptional quality fruit and suitable for agro-climatic conditions of the *konkan* region in Maharashtra (India).

2. Breeding Methods

DPLSM-2 is developed through the selection method at Central Experiment Station (CES), Wakavali, Maharashtra (India), by selecting various local genotypes and the elite types collected from Dapoli Tehsil, District Ratnagiri, India. The eight genotypes (DPLSM-6, VTR-2, DPLSM-2, DPLSM-8, Fansu local, VGLSM-1, VTR-1, and Lanja local) were evaluated during the cropping season 2010, 2011, and 2012 at VIS, CES, Wakavali. Based on its superior performance, the DPLSM-2 variety was promoted on farmer's fields in different *Konkan* regions for yield and other yield attributes. The performance of DPLSM-2 proved promising among the eight genotypes from 2010 to 2012 at the Vegetable Improvement Scheme (VIS), Central Experiment Station, Wakavali (Table 1). On the other hand, this genotype has gained an assuring yield (15.31 t ha^{-1}) at four locations: Palghar, Lanja, Awashi, and Wakawali, while the outcome at Karjat was in 2nd place (14.17 t ha^{-1}) in 2009-2010 (Table 2). DPLSM - 2 and the other seven genotypes have been screened artificially for the incidence of diseases and pests in plant growth and harvest. However, genotypes also evaluated fruit length and diameter, fruit count, fruit weight (kg), shelf life, the cracking, and organoleptic partition of fruits.

3. Performance Characteristics

3.1 Varietal characteristics: DPLSM-2 (Konkan Madhur) is a monoecious plant with a medium growth habit and ovate foliage. The flowers are yellow, and the first fruit was ready to harvest within 93 days, while the last fruit was harvested at 130 days with oblong fruits. The fruits reached a length of 18.91 cm and a diameter of 13.89 cm. The texture of the fruit skin is plain, along with ribs where the fruit skin is soft. It has a smooth, firm surface, light orange colour, and a mild, good taste similar to muskmelon.

3.2 Yield evaluation: The eight genotypes mentioned, DPLSM-2 was a prominent high-yielding variety with 19.59 t ha^{-1} from 2011 onwards (Tab I). Furthermore, these genotypes were evaluated at five places: Palghar, Karjat, Lanja, Awashi, and Wakavali, for the yield performance. DPLSSM-2 was recorded as a high-yielding variety at Palghar, Lanja, Awashi, and Wakavali, while DPLSM-8 recorded a high yield at Karjat (Tab II). Although the eight genotypes were studied at different locations in the *konkan* region, only two (DPLSM-2 and DPLSM-8) were selected to evaluate farmers' fields in Thane, Raigad, Ratnagiri, and Sindhudurg districts of Maharashtra during the year 2013. DPLSM-2 was a conspicuous high-yielding assortment with 16.37 t ha^{-1}, whereas DPLSM-8 yielded 12.62 t ha^{-1} during 2013.

3.3 Fruit attributes: Among the fruit attributes studied for eight genotypes at Palghar, Karjat, Awashi, and Wakavali, the variety DPLSM-2 was significantly higher in the number of fruits (4.11), fruit length (18.91 cm), fruit diameter (13.89 cm), and fruit weight (1.95 kg) than those of other genotypes (Tab III – VI).

3.4 Quality attributes: The mentioned genotypes of snapmelon were studied for their quality characters. Among the studied quality characters, the variety DPLSM-2 recorded better for specific gravity. The number of seeds per fruit was low in DPLSM-2 than those of other genotypes of snapmelon. Total soluble solids (TSS) were observed at maximum in DPLSM-2 (5.40), whereas the weight of the edible portion for DPLSM-2 was 77.90%. DPLSM-2 resulted in low acidity (0.107%) as well as high total sugars (2.05%) (Tab VII).

3.5 Impact of disease and pest incidence: In melons, the trouble of powdery mildew is a severe foliar disorder that affects the plant canopy and also reduces the fruit yield and quality (Jahn *et al.*, 2002) [7]. Moreover, the yellow mosaic virus (Desbiez and Lecoq, 1997) [2] and Alternaria leaf blight are considered the most crucial diseases of hot and humid conditions in southern India (Thomas, 1996) [6]. However, the eight genotypes of snapmelon were evaluated to check the incidence of pests and diseases during the crop season. DPLSM-2 reported a low incidence of pests and diseases compared to other genotypes (Tab VIII).

3.6 Keeping quality attributes: The snapmelon has a common problem of cracking; therefore, to avoid cracking problems and increase the melon's shelf life, eight genotypes were evaluated at CES, Wakavali, during the year 2013-14. Among the eight genotypes of snapmelon, DPLSM-2 has a superior keeping quality (3-4 days) and a low percentage of cracking (9%), whereas other genotypes have 1-2 days keeping quality and the percent of cracking is more than 70%.

4. Notification and seed production: Konkan Madhur (DPLSM-2), a variety of snapmelon, was released and notified by the central sub-committee on crop standards, notification, and release of varieties vide notification in the official gazette number S.O.4272 (E), dated 26th of November, 2019. The Central Experiment Station, Wakavali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli is the maintainer of this variety and the producer of the nucleus and breeder seeds of snapmelon.

Tables and Figures

Table 1: Yield (t/ha) of snapmelon genotypes at VIS, CES Wakawali

Sr. No.	Genotypes	Average yield (t/ha)			Pooled mean (t/ha)
		2010	2011	2012	
1.	DPLSM-6	15.50	19.56	12.60	15.88
2.	VTR-2	17.20	16.44	14.67	16.10
3.	DPLSM-2	16.58	20.84	21.36	19.59
4.	DPLSM-8	11.32	18.24	20.32	16.62
5.	Fansu local	9.63	10.36	9.96	9.98
6.	VGLSM-1	12.23	13.16	15.80	13.73
7.	VTR-1	12.68	14.20	19.44	15.44
8.	Lanja local	11.78	11.84	13.78	12.46
SE ±		0.89	0.93	1.24	1.87
CD @ 5%		2.61	2.79	3.76	5.74

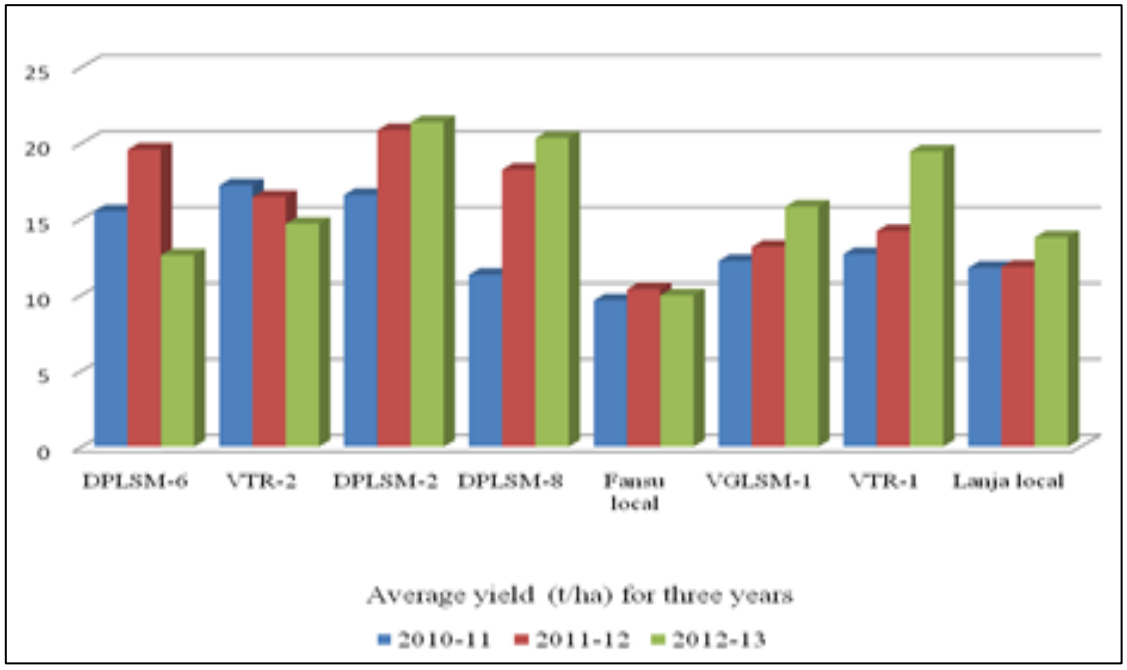

Fig 1: Yield (t/ha) of snapmelon genotypes at VIS, CES Wakawali

Table 2: The yield of snapmelon genotypes at different locations (t/ha)

Sr. No.	Genotypes	Palghar	Karjat	Lanja	Awashi	Wakawali	Pooled Mean
1.	DPLSM-6	11.88	11.60	10.06	13.98	16.08	12.72
2.	VTR-2	10.84	6.55	7.66	11.68	15.55	10.45
3.	DPLSM-2	12.67	14.17	14.08	14.54	21.10	15.31
4.	DPLSM-8	12.01	14.70	9.17	13.19	16.08	13.03
5.	Fansu local	6.68	11.02	4.56	9.96	9.99	8.44
6.	VGLSM-1	7.32	4.65	7.26	10.98	12.69	8.58
7.	VTR-1	11.00	11.55	7.93	11.38	13.44	11.06
8.	Lanja local	7.28	12.45	5.16	11.14	11.81	9.56
SE ±							0.80
CD @ 5%							2.32

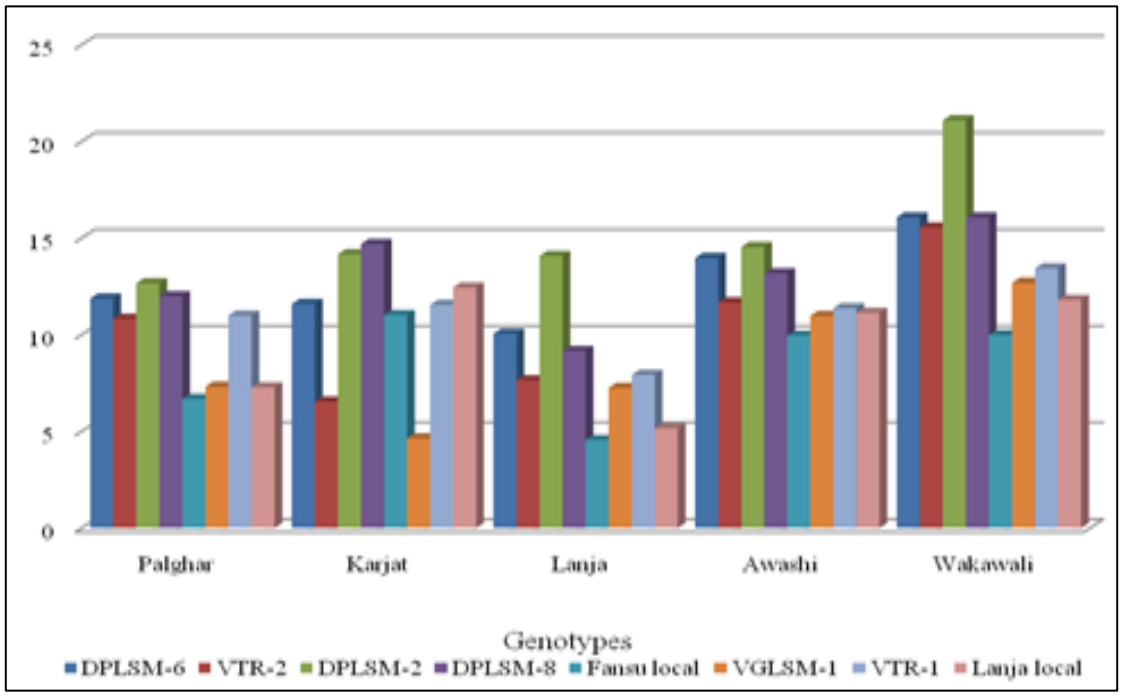

Fig 2: Yield of snapmelon genotypes at different locations (t/ha)

Tab 3: Number of fruits of snapmelon genotypes at different locations

Sr. No.	Genotypes	Palghar	Karjat	Awashi	Wakawali	Pooled Mean
1.	DPLSM-6	2.9	3.16	2.66	3.33	3.01
2.	VTR-2	3.3	1.66	3.00	3.33	2.82
3.	DPLSM-2	3.75	3.96	4.33	4.40	4.11
4.	DPLSM-8	2.33	2.66	3.33	2.33	2.66
5.	Fansu local	3.0	1.83	3.66	3.00	2.87
6.	VGLSM-1	2.5	1.83	3.00	3.00	2.58
7.	VTR-1	2.6	2.33	2.66	3.66	2.81
8.	Lanja local	2.95	2.1	3.33	3.66	3.01
SE +						0.22
CD @ 5%						0.65

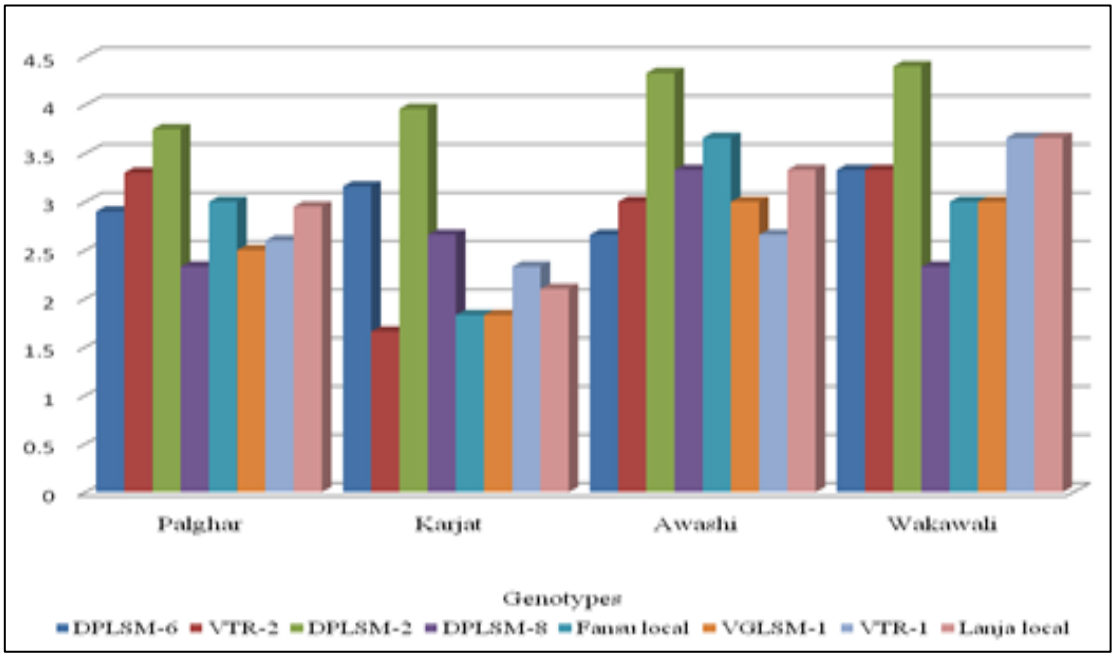

Fig 3: Number of fruits of snapmelon genotypes at different locations

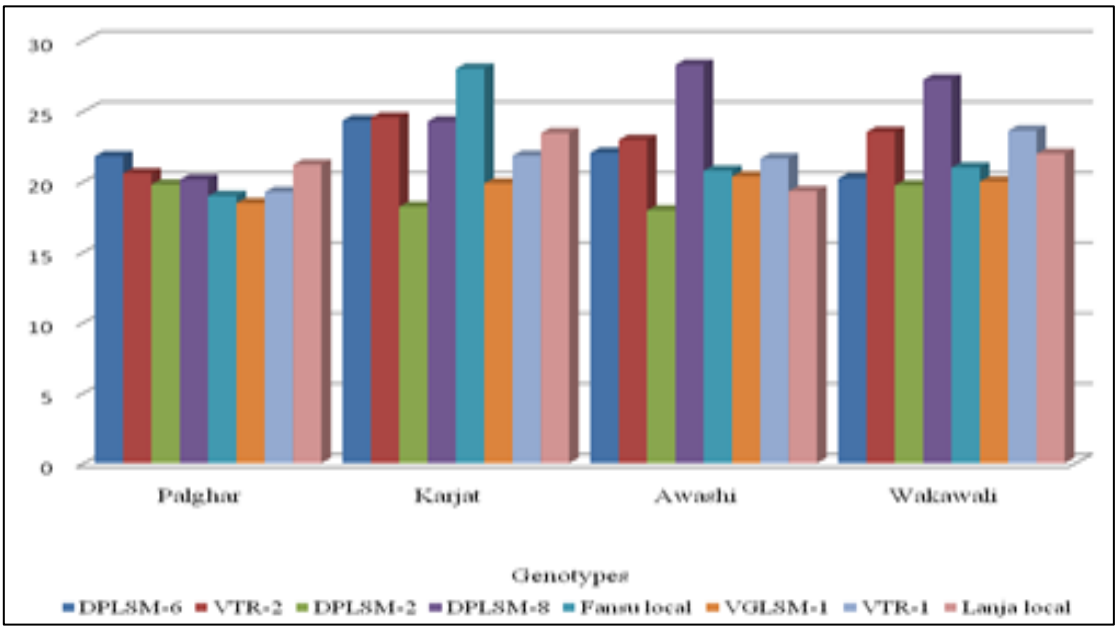

Fig 4: Mean length of fruit (cm) of snapmelon genotypes at different locations

Table 4: Mean length of fruit (cm) of Snapmelon genotypes at different locations

Sr. No.	Genotypes	Palghar	Karjat	Awashi	Wakawali	Pooled Mean
1.	DPLSM-6	21.79	24.33	22.04	20.21	22.09
2.	VTR-2	20.58	24.53	22.95	23.52	22.89
3.	DPLSM-2	19.78	18.20	17.94	19.72	18.91
4.	DPLSM-8	20.13	24.26	28.28	27.22	24.97
5.	Fansu local	18.96	28.00	20.76	20.98	22.17
6.	VGLSM-1	18.46	19.86	20.35	19.99	19.66
7.	VTR-1	19.25	21.83	21.63	23.60	21.57
8.	Lanja local	21.19	23.43	19.31	21.96	21.47
SE +						1.03
CD @ 5%						3.04

Table 5: Diameter (cm) of the fruit of Snapmelon genotypes at different locations

Sr. No.	Genotypes	Palghar	Karjat	Awashi	Wakawali	Pooled Mean
1.	DPLSM-6	10.10	13.01	11.62	12.69	11.85
2.	VTR-2	11.14	13.58	10.38	13.36	12.11
3.	DPLSM-2	11.06	15.06	13.32	16.12	13.89
4.	DPLSM-8	11.41	10.56	10.13	13.56	11.41
5.	Fansu local	6.35	9.16	9.34	8.09	8.23
6.	VGLSM-1	8.60	11.08	9.69	9.42	9.69
7.	VTR-1	9.44	12.40	9.25	10.50	10.39
8.	Lanja local	8.98	13.78	10.22	9.77	10.68
SE +						0.58
CD @ 5%						1.71

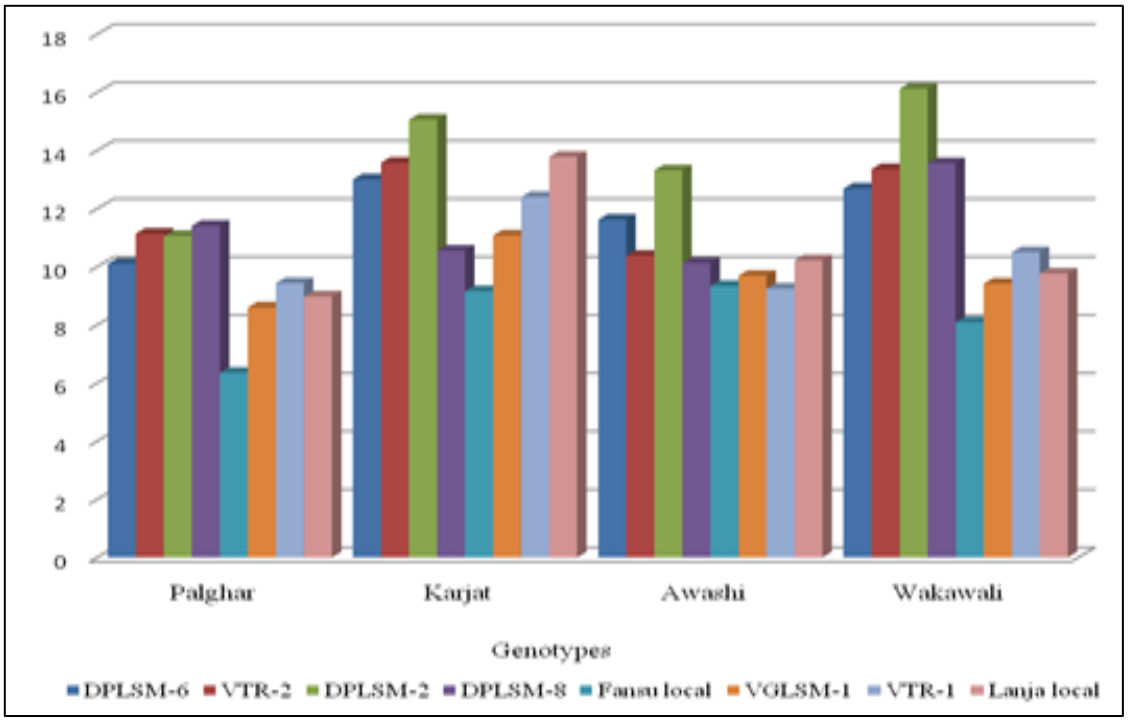

Fig 5: Diameter (cm) of fruit of Snapmelon genotypes at different locations

Table 6: Weight of fruit (kg.) of Snapmelon genotypes at different locations

Sr. No.	Genotypes	Palghar	Karjat	Awashi	Wakawali	Pooled Mean
1.	DPLSM-6	1.41	1.52	1.48	1.66	1.51
2.	VTR-2	1.56	1.31	1.40	1.36	1.40
3.	DPLSM-2	1.81	1.89	1.80	2.10	1.95
4.	DPLSM-8	1.55	1.76	2.18	2.05	1.88
5.	Fansu local	1.67	1.47	1.24	1.43	1.45
6.	VGLSM-1	1.45	1.93	1.66	1.40	1.61
7.	VTR-1	1.42	1.54	1.72	1.60	1.57
8.	Lanja local	1.66	1.66	1.55	1.70	1.64
SE +						0.088
CD @ 5%						0.262

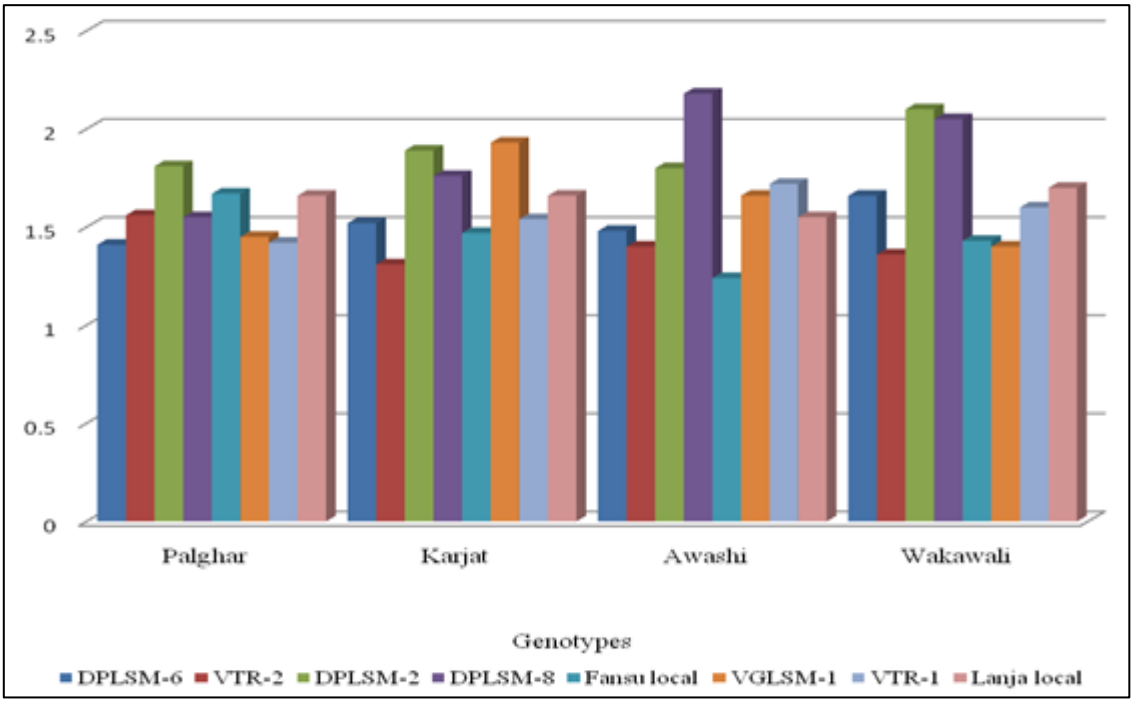

Fig 6: Weight of fruit (kg.) of Snapmelon genotypes at different locations

Table 7: Quality analysis of Snapmelon fruits

Sr. No	Quality parameters	Varieties							
		DPLSM-6	VTR-2	DPLSM-2	DPLSM-8	Fansu local	VGLSM-1	VTR-1	Lanja local
1.	Specific gravity	1.04	1.07	1.04	1.17	1.28	1.20	1.03	1.05
2.	No. of seeds/fruit	690.6	1022.3	624.00	741.66	731.3	984.00	868.3	1008.3
3.	Pulp colour L (Lightness)	35.58	32.51	30.86	32.20	31.13	31.96	30.36	28.65
4.	A (Redness)	4.81	3.31	2.96	3.15	2.78	2.40	3.65	2.96
5.	B (Yellowness)	16.00	13.40	10.43	14.56	10.06	10.41	12.30	10.66
6.	Pulp recovery %	83.39	92.50	88.33	93.07	89.38	93.52	91.86	90.70
7.	Wt. of edible portion %	71.66	74.58	77.90	76.08	80.66	79.79	88.44	82.60
8.	TSS (^{0}Brix)	3.53	3.83	5.40	4.07	4.43	4.37	3.77	4.37
9.	Reducing sugar %	2.29	2.02	1.87	1.92	1.85	1.62	1.93	1.47
10	Acidity %	0.153	0.138	0.107	0.120	0.121	0.110	0.143	0.181
11	Total sugar %	2.08	1.84	2.05	1.61	1.53	1.82	2.15	1.60
12	Ascorbic acid (mg/100gm)	5.86	3.89	3.91	3.91	3.91	7.74	4.89	2.93

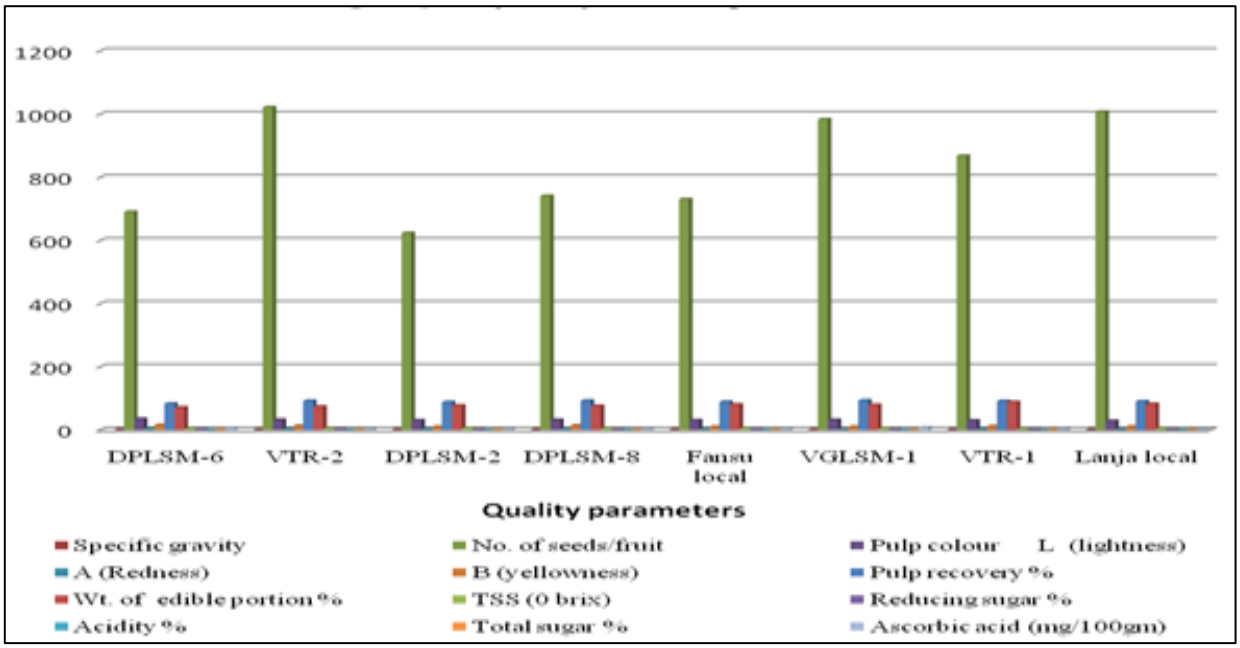

Fig 7: Quality analysis of Snapmelon fruits

Table 8: Disease and pest incidence of different snapmelon genotypes

Sr. No.	Genotypes	Downy mildew %	Fruit fly incidence %	Red pumpkin beetle/leaves
1.	DPLSM-6	7.60	6.50	1.00
2.	VTR-2	6.40	8.40	0.80
3.	DPLSM-2	4.70	1.80	0.41
4.	DPLSM-8	4.80	8.50	0.50
5.	Fansu local	5.42	6.90	1.60
6.	VGLSM-1	6.80	8.40	0.90
7.	VTR-1	7.20	7.60	1.20
8.	Lanja local	8.60	6.40	0.60

***Note:** The incidence of powdery mildew was not observed during the experiment

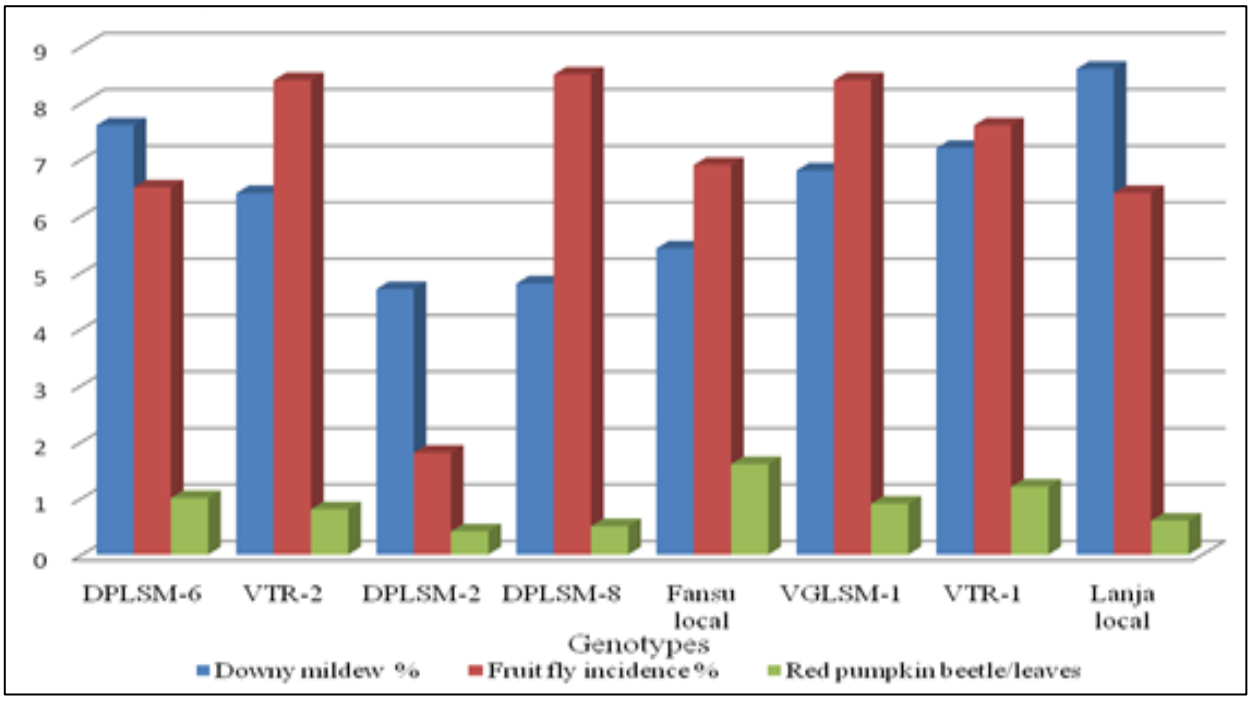

Fig 8: Disease and Pest incidence of different Snapmelon genotypes

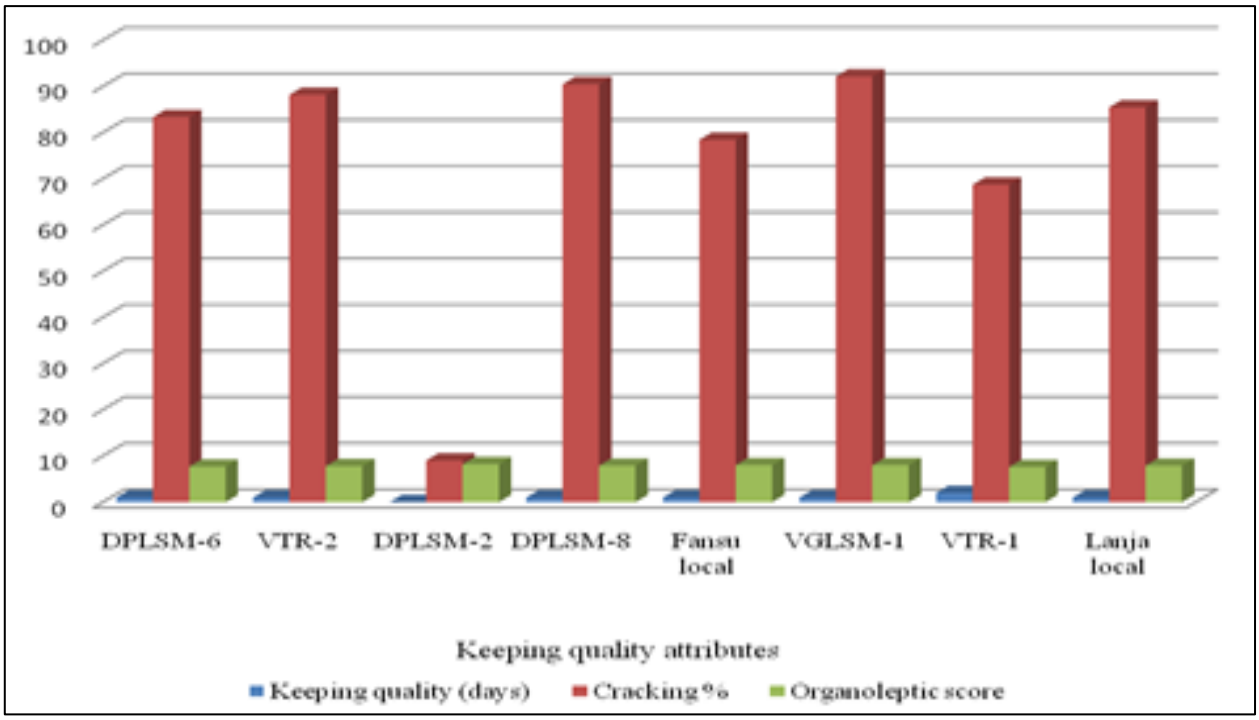

Fig 9: Shelf life, percent cracking and organoleptic evaluation of different Snapmelon genotypes

Table 9: Shelf life, percent cracking and organoleptic evaluation of different Snapmelon genotypes

Sr. No.	Genotypes	Keeping quality (days)	Cracking %	Organoleptic score
1.	DPLSM-6	1	83.36	7.7
2.	VTR-2	1	88.20	7.8
3.	DPLSM-2	3 - 4	09.00	8.2
4.	DPLSM-8	1	90.50	7.9
5.	Fansu local	1	78.44	8.0
6.	VGLSM-1	1	92.16	8.0
7.	VTR-1	2	68.72	7.6
8.	Lanja local	1	85.48	7.9

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