www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(4): 324-329

www.thepharmajournal.com
Received: 03-02-2023
Accepted: 09-03-2023

Kiran S Giri
Ph.D. Scholar, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

PC Haldavanekar
Associate Dean, College of Horticulture, Mulde, Sindhudurg Maharashtra, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

YR Parulekar
Assistant Professor, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

BR Salvi
Professor, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

VV Dalvi
Professor and Officer Incharge, Agricultural Research Station, Shirgaon, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

VG More
Agrometeorologist, AICRP, Department of Agronomy, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

Corresponding Author:
Kiran S Giri
Ph.D. Scholar, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

Effect of spacing and mulching on growth and yield parameters of local Chilli genotype in *kharif* season under Konkan agro-climatic conditions

Kiran S Giri, PC Haldavanekar, YR Parulekar, BR Salvi, VV Dalvi and VG More

Abstract
Chilli (*Capsicum annuum* L.) is cultivated worldwide and is an important spice cum vegetable crop cultivated extensively in India. In Konkan region, due to heavy rains and high humidity, the improved and hybrid varieties of chilli do not show better performance during *kharif* season. Some local genotypes cultivated have hardy nature which is well adapted to the soil and climatic conditions of Konkan region. The present investigation entitled "Growth and yield performance of promising local chilli genotype to different spacing and mulching under Konkan agro-climatic conditions" was undertaken at Experimental farm, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during two successive *kharif* seasons *of* 2021 and 2022 by considering the potential of promising local chilli genotype. A field experiment was conducted in split plot design consisting of three main treatments *i.e.* S_1 (30 cm x 30 cm), S_2 (45 cm x 30 cm) and S_3 (60 cm x 30 cm) and three sub treatments *i.e.* M_1 (no mulch), M_2 (polyethylene mulch) and M_3 (organic mulch *i.e.* gliricidia mulch). The observations were recorded on various growth and yield parameters. Different parameters showed significant difference with various spacing levels and mulching. The data of pooled analysis revealed that DPL CA-8 performed better with regards to various growth and yield parameters and produced higher yield as well as highest fruit length, fruit diameter and fruit weight at 60 cm x 30 cm spacing with organic mulch (gliricidia mulch) during *kharif* seasons under Konkan agro-climatic conditions.

Keywords: Local chilli genotype, *kharif* season, spacing, mulching, growth and yield parameters

Introduction
Chilli is an important vegetable crop in many countries of the world. It is the most widely used universal spice and named as wonder spice. It is one of the important and worthwhile commercial vegetable crops play a vital role in the world economy. It has numerous uses in pharmaceuticals to relief pain, anti-arthritic, antibacterial, anti-inflammatory, anti-rhinitis and analgesic properties. It has also attained a great importance because of having 'oleoresin', which permits better distribution of colour and flavour in foods (Chakrabarty *et al*., 2017) [4].
In Konkan region also, large variability in chilli genotypes has been reported and mostly grown in *kharif* season. However, due to heavy rains and high humidity, the improved and hybrid varieties of chilli do not show better performance during *kharif* season. The local genotypes are preferred and grown for their characteristic shape (Gundu type – fat chillies, round or triangular in shape with high seed content), specific taste, flavour and hardy nature which is well adapted to the soil and climatic conditions and fetching approximately 40 to 50 percent more market price as compared to regular improved or hybrid chillies (Parulekar *et al*., 2020) [21]. Considering the potential of local chilli genotypes grown in Konkan region for *kharif* season, its evaluation at different spacing and to ascertain the effect of different mulches on plant growth and yield characters of chilli for commercial cultivation is necessary.

Materials and Methods
The experiment was conducted during two successive *Kharif* seasons of 2021 and 2022 at Experimental farm, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist – Ratnagiri (M.S.). Local chilli genotype DPL CA- 8 was collected from the Goa state (Gavdongari, Cancona, Goa) for investigation from farmer's field based on their phenotypic characters with respect to growth, flowering and yield performance. Treatments were combinations of three different spacing and three mulch types.

Various spacing *viz.,* 30 cm x 30 cm (S_1), 45 cm x 30 cm (S_2) and 60 cm x 30 cm (S_3) with three different mulches *viz.,* no mulch (M_1), polyethylene mulch (M_2) and organic mulch (Gliricidia mulch) (M_3). Treatments were arranged in split plot design with four replications. Polyethylene mulch and gliricidia mulch were laid in the experimental field one day before transplanting of seedling and after 45 days of planting, seedlings were transplanted in the main field. Various intercultural operations *viz.,* nutrient management, weeding, earthing up as well as plant protection were carried out. The data were recorded on various growth and yield characters and subjected to statistical analysis using Analysis of Variance (ANOVA) technique (Panse and Sukhatme, 1985) [20].

Results and Discussion

The various growth and yield parameters *viz.,* plant height, plant spread, stem diameter, number of primary and secondary branches, leaf area and leaf area index, days required for initiation of flowering, days required for 50% flowering, days required for first harvesting, days required for last harvesting, harvesting duration, fruit length, fruit diameter, fruit weight, fruit yield (per plant, per plot and per hactare) were observed under various spacing and mulching with their interactions.

Effect of spacing on growth and yield characters of local chilli genotype

The pooled data presented in Table 1 revealed that spacing significantly influenced growth and yield characters. Among different spacing levels, the highest plant height (92.15 cm), plant spread (58.68 cm), stem diameter (20.37 mm), number of primary branches (9.92) and secondary branches (15.21) were recorded in the treatment S_3 *i.e.* at 60 cm x 30 cm spacing, however, the lowest plant height (87.90 cm) and the lowest number of secondary branches (13.88) were seen in S_2 *i.e.* at 45 cm x 30 cm spacing, while the lowest plant spread (54.36 cm), stem diameter (19.16 mm) and number of primary branches (8.50) were recorded in the treatment S_1 *i.e.* at 30 cm x 30 cm spacing,.

This might be due to availability of more space between plants in wider spacing, which helps in better development of plants. Also the plants at wider spacing able to exploit more light sources, nutrients and other resources than the plants at closer spacing. Similar variations were also reported by Mishriky and Alphonse (1994) [18], Islam *et al*. (2011) [10] and Thakur *et al.* (2018) [25] in sweet pepper.

Leaf area (6802.4 cm^2) and leaf area index (4.02) were exhibited highest at wider spacing *i.e.* at 60 cm x 30 cm spacing, while the lowest leaf area (6604.3 cm^2) was recorded in the treatment S_2 (45 cm x 30 cm) and the lowest leaf area index (3.96) was recorded in the treatment S_1 (30 cm x 30 cm).

This might be due to reduced number of plants under wider spacing undergone less inter or intra plant competition which caused an increased growth rate and enabled the plants to utilized the available energy for maximum production of larger leaf area as well as leaf area index. The results are in agreement with the report of Thakur *et al.* (2018) [25] in capsicum and Gbaraneh (2018) [7] in okra.

Similarly, the lowest days required for initiation of flowering (43.29) was registered in S_3 (60 cm x 30 cm) which was statistically at par with S_1 (30 cm x 30 cm) (44.04), the lowest days required for 50% flowering (51.83) and for first harvesting (61.96) were recorded in the same treatment S_3 *i.e.* at 60 cm x 30 cm spacing, while the highest days for last harvesting (115.38) which was statistically at par with S_1(30 cm x 30 cm) (114.83) and the longest harvesting duration (52.83) were also recorded in the same treatment S_3 (60 cm x 30 cm). Further, significantly the highest fruit length (2.90 cm), fruit diameter (17.26 mm) and fruit weight (3.66 g) which was statistically at par with S_1 (30 cm x 30 cm) (3.65 g) and the highest fruit yield per plant (367.3 g), fruit yield per plot (5.10 kg) and fruit yield per hectare (15.74 t/ha) also recorded in S_3 *i.e.* at 60 cm x 30 cm spacing, whereas, the highest days for initiation of flowering (45.75), delayed 50% flowering (54.25), the lowest days for last harvesting (109.71), the shortest harvesting duration (45.79), the lowest fruit length (2.64 cm), the lowest fruit length and fruit weight (15.89 mm and 3.40 g) were noticed in S_2 (45 cm x 30 cm), however, the lowest fruit yield per plant (270 g), fruit yield per plot (4.41 kg) and fruit yield per hectare (13.08 t/ha) was recorded in S_1 (30 cm x 30 cm).

This might be due to plants grown with wider spacing acquired better opportunity of availing maximum space, light and nutrients and extended vegetative as well as reproductive growth of the plants. Similar result agrees with the reports of Aminifard *et al.* (2010) [2] and Gilsha and Sudha (2015) [8] in chilli.

Effect of mulching on growth and yield characters of local chilli genotype

During present investigation, various mulching exhibited significant variation in various growth and yield attributing characters and organic mulch performed better with the highest plant height (94.56 cm), stem diameter (21.43 mm), highest number of primary (10.00) and secondary branches (15.79) were recorded in M_3 *i.e.* organic mulch (gliricidia mulch). The plant spread also exhibited significant variation and the highest plant spread (57.73 cm) was recorded in the same treatment M_3 *i.e.* organic mulch (Gliricidia mulch) which was at par with M_2 (polyethylene mulch) (56.84 cm), while M_1 (no mulch) recorded the lowest plant height (86.97 cm), plant spread (54.26 cm), stem diameter (18.30 mm), number of primary branches (8.38) and secondary branches (13.83). This might be due to the incorporation of gliricidia mulch, their faster decomposition and better nutrient release.

This might be associated with improved soil fertility that helps to improve plant growth and unmulched plots negatively affected growth and development of the plant. The similar results were also reported by Khurshid *et al.* (2006) [11] and Quee *et al.* (2017) [22] in maize, Zerga *et al*. (2017) [28] in hot pepper and Mahmoud *et al*. (2021) in sweet pepper.

The highest leaf area (6856.1 cm^2) and leaf area index (4.05) was also recorded in M_3 *i.e.* organic mulch (gliricidia mulch), whereas, the lowest leaf area (6520.9 cm^2) and leaf area index (3.93) was reported in M_1 (no mulch). This might be due to less weed crop competition and availability of nutrients through decomposed gliricidia leaves. Similar results have been reported by Venkanna (2008) [26], Hossen *et al*. (2017) [9] in brinjal, Kumawat *et al*. (2021) [14] in chilli.

The lowest days for initiation of flowering (41.88) was recorded in M_3 *i.e.* organic mulch (gliricidia mulch) and the highest days (45.75) was noticed in M_2 (polyethylene mulch). This might be due to the wider spacing which facilitated the plants to develop properly with less inter and intra plant

competition. The flower initiation was indirectly correlated with soil temperature and available phosphorus and weeds was directly affected by the crop growth due to crop-weed competition for space, sunlight, nutrients and soil temperature was increased by the mulching. The findings are also in agreement with the findings of Kumawat *et al.* (2021) [14] in chilli.

The same treatment M_3 *i.e.* organic mulch (gliricidia mulch) recorded the lowest days for 50% flowering (50.21) and for first harvesting (60.04), whereas the highest days for last harvesting (118.54) and the longest duration for harvesting (57.79), however, the highest days for 50% flowering (55.29), for first harvesting (64.25) were noticed in M_2 (polyethylene mulch), while the lowest days for last harvesting (109.88) and the shortest harvesting duration (45.38) was noted in M_1 (no mulch).

This might be due to the positive effect of gliricidia mulch which decompose quickly and release maximum nitrogen and creates microenvironment *i.e.* optimum moisture, optimum nutrient supply, optimum soil temperature and faster growth due to reduction in weed population which enhanced the early reproductive phase. These results are supported by the earlier findings of Maida *et al.* (2019) [17] in chilli, Bhuiya *et al.* (2020) [3] in tomato and Lodhi *et al.* (2019) [15] in bell pepper. The highest fruit length (3.23 cm), fruit diameter (18.03 mm) and fruit weight (3.80 g) was registered in organic mulched plots and the lowest fruit length (2.47 cm) and fruit weight (3.39 g) was recorded in M_1 (no mulch), whereas, M_2 (polyethylene mulch) recorded the lowest fruit diameter (15.67 mm).

This might be due to the extended retention of moisture and availability of moisture provided by organic mulch also results in increased photosynthesis and metabolic activities, higher uptake of nutrients for proper growth and development of fruits. Similar result was also recorded by Sathiyamurthy *et al.* (2017) [24] in chilli and Lodhi *et al.* (2019) [15] in bell pepper.

Table 1: Effect of spacing, mulching and their interactions on various growth characters (Pooled data 2021-2022)

Treatments	Growth characters						
	Plant height (cm)	**Plant spread (cm)**	**Stem diameter (mm)**	**Number of primary branches**	**Number of secondary branches**	**Leaf area (cm^2)**	**Leaf area index**
Effect of spacing							
S_1	89.01	54.36	19.25	8.50	14.46	6599.9	3.96
S_2	87.90	55.80	19.16	8.54	13.88	6604.3	3.97
S_3	92.15	58.68	20.37	9.92	15.21	6802.4	4.02
S.Em ±	0.27	0.40	0.28	0.17	0.27	26.06	0.008
CD at 5%	0.96	1.40	0.98	0.60	0.96	90.16	0.028
Effect of mulching							
M_1	86.97	54.26	18.30	8.38	13.92	6520.9	3.93
M_2	87.54	56.84	19.04	8.58	13.83	6629.6	3.97
M_3	94.56	57.73	21.43	10.00	15.79	6856.1	4.05
S.Em ±	0.32	0.51	0.27	0.13	0.14	19.50	0.007
CD at 5%	0.96	1.51	0.82	0.40	0.43	57.93	0.020
Interaction effects of spacing and mulching on growth characters							
S_1M_1	87.14	52.83	18.16	8.38	13.50	6465.5	3.92
S_1M_2	88.63	56.83	19.20	8.50	14.75	6608.6	3.96
S_1M_3	91.25	53.43	20.39	8.63	15.13	6725.6	4.00
S_2M_1	83.07	52.70	17.11	7.25	13.38	6341.2	3.87
S_2M_2	85.61	56.58	18.69	8.50	13.00	6574.9	3.96
S_2M_3	95.03	58.13	21.68	9.88	15.25	6896.9	4.06
S_3M_1	90.70	57.25	19.64	9.50	14.88	6755.8	3.98
S_3M_2	88.36	57.13	19.24	8.75	13.75	6705.5	3.98
S_3M_3	97.40	61.65	22.23	11.50	17.00	6946.0	4.08
S.Em ±	0.56	0.88	0.47	0.23	0.25	33.77	0.012
CD at 5%	1.66	2.62	1.42	0.70	0.75	100.34	0.036

Also, fruit yield (per plant, per plot and per hectare) reported significant variation and the same treatment M_3 and noted the highest fruit yield per plant (363.2 g), fruit yield per plot (5.14 kg) and fruit yield per hectare (15.87 t/ha). However, the lowest fruit yield per plant (297.6 g) in M_2 (polyethylene mulch) and the lowest fruit yield per plot (4.23 kg) and fruit yield per hectare (13.07 t/ha) was recorded in M_1 (no mulch).

The yield increase under organic mulch could be due to their ability to reduce soil temperature fluctuation, to add organic matter by decomposition, increased water holding capacity, smothering weed population, which led to favorable condition for plant growth and development. The positive influence of organic mulch materials on yield was also reported by Kurshid *et al*. (2006) [11] in maize, Kosterna (2014) [12] in tomato and broccoli, Daniel *et al*. (2018) [5] in carrot and Yasmin *et al*. (2020) [27] in chilli.

Interaction effects of spacing and mulching on growth and yield characters of local chilli genotype

Data presented in Table 1 and 2 showed that growth and yield characters varied significantly and the highest plant height (97.40 cm) and plant spread (61.65 cm) was recorded in S_3M_3 *i.e.* at 60 cm x 30 cm spacing with organic mulch (gliricidia mulch), while, stem diameter (22.23 mm) also exhibited highest in the same treatment combination which was statistically at par with S_2M_3 *i.e.* at 45 cm x 30 cm spacing with organic mulch (21.68 mm), number of primary branches (11.50) and secondary branches (17.00), leaf area (6946.0 cm^2) also recorded highest in S_3M_3 *i.e.* at 60 cm x 30 cm spacing which was statistically at par with S_2M_3 *i.e.* at 45 cm x

30 cm spacing with organic mulch (6896.9 cm^2), leaf area index (4.08), lowest days for initiation of flowering (39.75), lowest days for 50% flowering (47.63), highest days required for last harvesting (121.38), longest harvesting duration (61.38) were observed in the treatment combination S_3M_3 *i.e.* at 60 cm x 30 cm spacing with organic mulch (gliricidia mulch). Furthermore, the lowest plant height (83.07 cm), plant spread (52.70 cm), number of primary branches (7.25), number of secondary branches (13.00), leaf area (6341.2 cm^2), leaf area index (3.80), highest number of days required for first harvesting (65.50), lowest days required for last harvesting (102.75), shortest harvesting duration (36.63) was recorded in S_2M_1 *i.e.* at 45 cm x 30 cm spacing without mulch. However, the lowest days required for first harvesting (58.50) was recorded in S_3M_3 *i.e.* at 60 cm x 30 cm spacing which was statistically at par with S_2M_3 *i.e.* at 45 cm x 30 cm spacing with organic mulch (59.50), was recorded in the same treatment combination S_2M_1 *i.e.* at 45 cm x 30 cm spacing without mulch.

The data presented in Fig 1, 2 and 3 indicated that the fruit length, weight and diameter showed significant variation and S_3M_3 *i.e.* at 60 cm x 30 cm spacing with organic mulch (Gliricidia mulch) exhibited the highest fruit length (3.46 cm), fruit weight (3.96 g) and fruit diameter (19.19 mm) which was statistically at par with S_2M_3 *i.e.* at 45 cm x 30 cm spacing with organic mulch (Gliricidia mulch) (17.83 mm), whereas S_2M_1 *i.e.* at 45 cm x 30 cm spacing without mulch recorded the lowest fruit length (2.25 cm), fruit weight (3.14 g) and fruit diameter (14.65 mm).

Analysis of results indicated the beneficial effect of applied nutrients and mulching on the fruit characters. The role of nitrogen and phosphorus in growth and development through cell division and cell development might have influenced the fruit characters. Moreover, organic mulch improved the availability of applied nutrients through conservation of soil moisture and smothering of weeds. The experimental findings are in agreement with findings of Ahmad *et al.* (2021) [1] in sweet banana pepper and Lodhi *et al.* (2019) [15] in capsicum.

Also the fruit yield (per plant, per plot and per hectare) affected significantly and S_3M_3 *i.e.* at 60 cm x 30 cm spacing with organic mulch (Gliricidia leaves) noted the highest fruit yield per plant (416.8 g), fruit yield per plot (5.63 kg) and fruit yield per hectare (17.37 t/ha), while the lowest fruit yield per plant (243.1 g) was exhibited in S_1M_2 *i.e.* at 30 cm x 30 cm spacing with polyethylene mulch and the lowest fruit yield per plot (3.91 kg) and fruit yield per hectare (12.06 t/ha) was reported in S_2M_2 *i.e.* at 45 cm x 30 cm spacing with polyethylene mulch.

The study indicated that the highest fruit yield per plot was recorded at wider spacing with organic mulch treatment, whereas, the lowest yield was recorded in closer and medium spacing without mulch treatment. This might be due to differences in plant spacing as well as plant morphology and due to application of organic mulch (gliricidia mulch) as it has high nutritive properties and great source of nitrogen and improves soil properties after decomposition which ultimately helps in increasing fruit yield. Similar findings were also reported by Essilfie *et al.* (2017) [6] in chilli, Kumar *et al.* (2014) [13] in stevia, Santos *et al.* (2020) [23] in corn and Moniruzzaman (2006) [19] in lettuce.

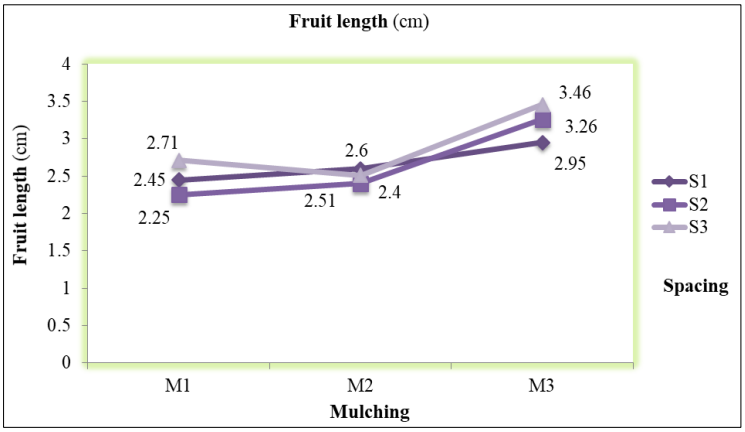

Fig 1: Effect of spacing, mulching and their interactions on fruit length (cm)

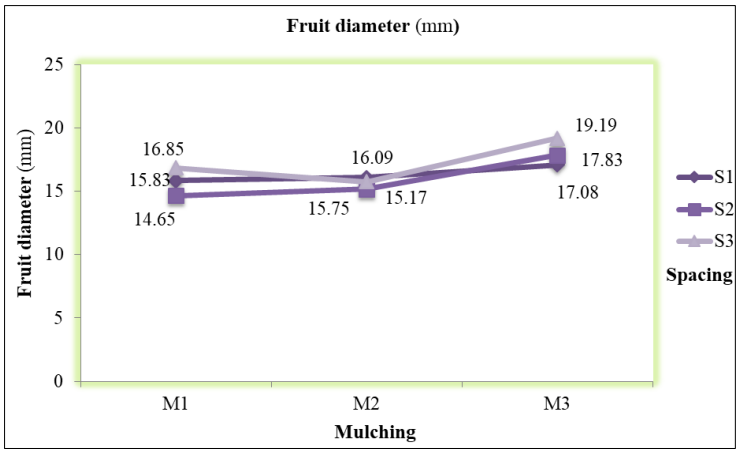

Fig 2: Effect of spacing, mulching and their interactions on fruit diameter (mm)

Table 2: Effect of spacing, mulching and their interactions on yield characters (Pooled data 2021-2022)

Treatments	Yield characters										
	Days to initiation of flowering	Days to 50% flowering	Days to first harvesting	Days to last harvesting	Harvesting duration	Fruit length (cm)	Fruit diameter (mm)	Fruit weight (g)	Fruit yield per plant (g)	Fruit yield per plot (kg)	Fruit yield (t/ha)
Effect of spacing											
S_1	44.04	54.25	63.08	114.21	51.13	2.67	16.33	3.56	270.0	4.41	13.61
S_2	45.75	54.25	63.21	109.71	45.79	2.64	15.89	3.40	348.7	4.23	13.08
S_3	43.29	51.83	61.96	115.38	52.83	2.90	17.26	3.66	367.3	5.10	15.74
S.Em ±	0.33	0.22	0.17	0.19	0.16	0.006	0.32	0.03	1.44	0.01	0.05
CD at 5%	1.17	0.79	0.61	0.65	0.55	0.024	0.96	0.11	4.34	0.04	0.19
Effect of mulching											
M_1	45.46	55.29	63.96	109.88	45.38	2.47	15.78	3.39	325.3	4.23	13.07
M_2	45.75	54.83	64.25	110.88	46.58	2.50	15.67	3.43	297.6	4.37	13.49
M_3	41.88	50.21	60.04	118.54	57.79	3.23	18.03	3.80	363.2	5.14	15.87
S.Em ±	0.22	0.23	0.21	0.42	0.47	0.024	0.31	0.02	1.64	0.01	0.05
CD at 5%	0.67	0.68	0.64	1.25	1.42	0.073	0.92	0.08	4.94	0.05	0.16
Interaction effects of spacing and mulching on growth characters											
S_1M_1	44.38	55.75	64.00	112.25	48.13	2.45	15.83	3.43	273.0	4.10	12.66
S_1M_2	44.38	53.63	63.13	114.00	50.50	2.60	16.09	3.58	243.1	4.18	12.89
S_1M_3	43.38	53.38	62.13	116.38	54.75	2.95	17.08	3.68	294.0	4.95	15.28
S_2M_1	47.88	57.88	65.50	102.75	36.63	2.25	14.65	3.14	340.5	3.93	12.20
S_2M_2	46.88	55.25	64.63	108.50	43.50	2.40	15.17	3.29	325.4	3.91	12.06
S_2M_3	42.50	49.63	59.50	117.88	57.25	3.26	17.83	3.77	380.3	4.85	14.97
S_3M_1	44.13	52.25	62.38	114.63	51.38	2.71	16.85	3.61	362.3	4.65	14.35
S_3M_2	46.00	55.63	65.00	110.13	45.75	2.51	15.75	3.41	324.6	5.03	15.50
S_3M_3	39.75	47.63	58.50	121.38	61.38	3.46	19.19	3.96	416.8	5.63	17.37
S.Em ±	0.39	0.40	0.37	0.73	0.82	0.042	0.53	0.04	2.85	0.02	0.09
CD at 5%	1.16	1.18	1.10	2.16	2.46	0.127	1.59	0.14	8.57	0.08	0.28

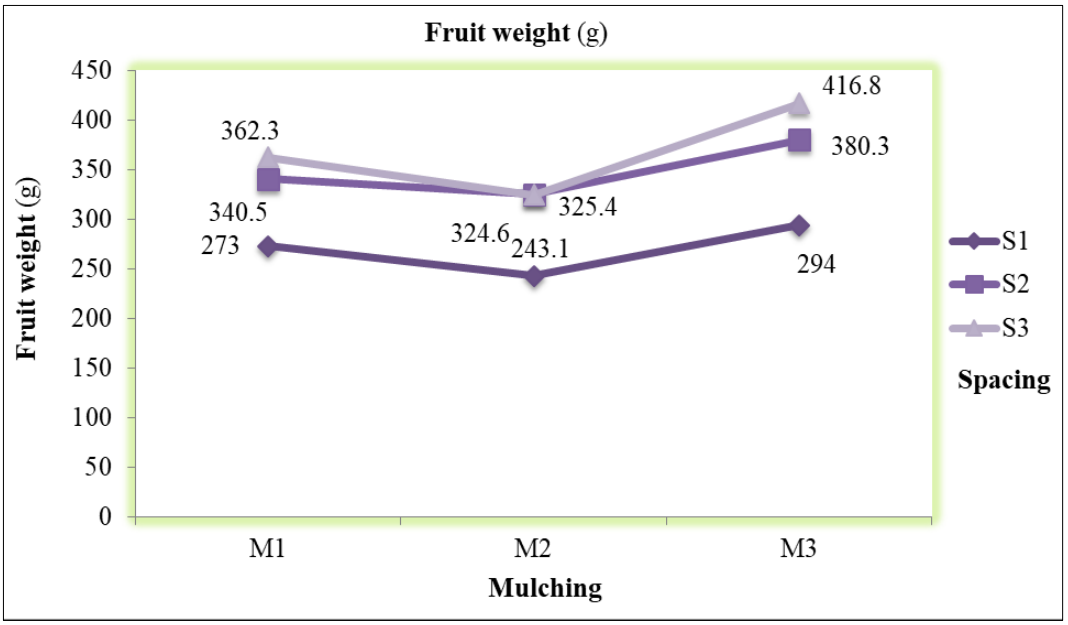

Fig 3: Effect of spacing, mulching and their interactions on fruit weight (g)

Summary

Based on the experimental results, it could be concluded that local chilli genotype DPL CA-8 planted at the spacing of 60 cm x 30 cm with organic mulch (Gliricidia mulch) showed superior performance and found profitable during *kharif* season under Konkan agro-climatic conditions.

Acknowledgment

We thank Associate Dean, College of Horticulture, Dapoli and Staff of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (M. S. India) for providing valuable insight and expertise that greatly assisted the research.

References

1. Ahmad F, Mehta DK, Verma R. Effect of mulching and planting density on production of sweet banana pepper (*Capsicum annuum* L.). Int. J of Chemical Studies. 2021;9(1):1373-1378.
2. Aminifard MH, Aroiee H, Karimpour S, Nemati H. Growth and yield characteristics of paprika pepper (*Capsicum annum* L.) in response to plant density. Asian J. of Plant Sci. 2010;9(5):276-280.
3. Bhuiya MI, Rahman A, Miah MU, Ami R, Saha SR, Miyajima I. Gliricidia tree leaf incorporation into soil and use of companion plants for safe tomato production. J

Fac. Agri. Kyushu Univ. 2020;65(1):1-7.
4. Chakrabarty S, Mominul AKM, Islam M, Islam MA. Nutritional benefits and pharmaceutical potentialities of chilli: A review. Fundam. Appl. Agric. 2017;2(2):227-232.
5. Daniel FC, Gomes DP, Oliveira Neto DH, Guerra JG, Rouws RC, Oliveira FL. Carrot yield and water-use efficiency under different mulching, organic fertilization and irrigation level. Campina Grande. 2018;22(7):445-450.
6. Essilfie ME, Dapaah HK, Boateng E, Damoah RJ. Age of transplant and row spacing effects on growth, yield and yield components of chilli pepper (*Capsicum annuum* L.). Int. J of Env. Agri. and Biotech. 2017;2(5):2406-2418.
7. Gbaraneh LD. Effect of plant spacing and harvest interval on the growth, fruit quality and yield of okra (*Abelmoschus esculentus* L.) in Port Harcourt, Nigeria. Int. J of Agri. and Earth Sci. 2018;4(4):18-28.
8. Gilsha B, Sudha B. Growth and yield of chilli as influenced by spacing under greenhouse condition. Int. J Agri. Sci. 2015;11(2):297-300.
9. Hossen MS, Shaikh MM, Ali MA. Effect of different organic and inorganic mulches on soil properties and performance of Brinjal (*Solanum melongena* L.). Asian J of Adv. in Agril. Res. 2017;3(2):1-7.
10. Islam M, Saha S, Hasanuzzaman AK, Rahim M. Effect of spacing on the growth and yield of sweet pepper (*Capsicum annuum* L.). J of Central European Agril. 2011;12(2):328-335.
11. Khurshid K, Iqbal M, Arif MS, Nawaz A. Effect of tillage and mulch on soil physical properties and growth of maize. Int. J Agril. Biol. 2006;8:593-596.
12. Kosterna E. The effect of soil mulching with straw on the yield and selected components of nutritive value in broccoli and tomatoes. Folia Horticulture. 2014;26(1):31-42.
13. Kumar R, Sooda S, Sharma S, Kasanab RCV, Pathaniaa L, Singha B, Singh RD. Effect of plant spacing and organic mulch on growth, yield and quality of natural sweetener plant Stevia and soil fertility in western Himalayas. Int. J of Plant Production. 2014;8(3):311-334.
14. Kumawat S, Kumawat A, Asati KP, Bhuriya R. Effect of different mulches on growth, yield and economics of chilli (*Capsicum annuum* L.). The Pharma Innovation J. 2021;10(7):903-906.
15. Lodhi Y, Chakravorty S, Prasad B, Chandrakar S. Influence of nutrients and mulching on fruiting and fruit characteristics of bell pepper (*Capsicum annum* L.). The Pharma Innovation J. 2019;8(6):791-794.
16. Mahmoud MI, Abuo SA. Using colored shade nets and organic mulch to improve microclimate, growth, and yield of yellow sweet pepper. Plant Archives. 2021;21(1):210-223.
17. Maida P, Bisen BP, Diwan G. Effect of plastic mulch on growth and yield of chilli (*Capsicum annuum* L.). Int. J Curr. Microbio. App. Sci. 2019;8(12):2056-2062.
18. Mishriky JF, Alphose M. Effect of nitrogen and plant spacing on growth, yield and fruit mineral composition of pepper (*Capsicum annuum* L.). BulL Fac. Agric. Cairo Univ. 1994;45(2):413-431.
19. Moniruzzaman M. Effects of plant spacing and mulching on yield and profitability of lettuce (*Lactuca sativa* L.). J Agric. Rural. Dev. 2006;4(1):107-11.
20. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research Publication; c1985. p. 87-89.
21. Parulekar YR, Haldankar PM, Haldavanekar PC, Salvi BR, Sawardekar SV, Dalvi VV, *et al*. Field evaluation of gundu chillies (*Capsicum annuum* L.) under Konkan agro-climatic conditions for growth, yield and yield attributing characters. Int. J Curr. Microbiol. App. Sci. 2020;11:1870-1883.
22. Quee DD, Mansaray A, Kanneh SM, Kamanda PJ, Conteh AR, Ndoko EJ, *et al*. Effect of Gliricidia sepium leaf mulch on weed growth and productivity of maize (*Zea mays* L.) in southern Sierra Leone. Int. J Agric. For. 2017;7(2):35-41.
23. Santos LA, Silva PS, Oliveira VR, Oliveira AK. Branches of Gliricidia sepium used as mulch for weed control in corn. Rev. Cienc. Agron. 2020;51(1):1-9.
24. Sathiyamurthy VA, Rajashree V, Shanmugasundaram T. Arumugam T. Effect of different mulching on weed intensity, yield and economics in chilli (*Capsicum annuum* L.). Int. J Curr. Microbiol. App. Sci. 2017;6(3):609-617.
25. Thakur G, Singh AK, Maurya PK, Patel P, Kumar U. Effect of plant spacing on growth, flowering, fruiting and yield of capsicum (*Capsicum annuum* L.) hybrid buffalo under natural ventilated polyhouse. J of Pharmacognosy and Phytochemistry. 2018;1:78-81.
26. Venkanna Y. Effect of mulches, organics and organic solutions on growth, yield and quality of chilli (*Capsicum annuum* L.) Cv. Byadagi Dabbi in northern transition zone of Karnataka. Thesis, University of Agricultural Science. Dharwad, Karnataka, India; c2008.
27. Yasmin M, Rahman MA, Shikha FS, Rahman MS, Rahman J, Tipu MH. Effect of mulch on soil temperature, soil moisture conservation and yield of chilli. J Clean WAS. 2020;4(1):36-39.
28. Zerga K, Alemu M, Tebasa F, Tesfaye B. Impacts of different mulching material on seedling emergence and growth performance of hot pepper (*Capsicum annuum*) at Gurage Zone, Ethiopia. Int. Multidisciplinary Res. J 2017;7:01-04.