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Effect of Irrigation Intervals and Plastic Mulching On Flower Production of Carnation

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Declaration

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ABSTRACT

Calyx splitting is a physiological disorder that results in poor flower production and vase life in carnation. Several scientific reports and literature suggests that this physiological die back and curly tip of carnation flowers might be due to the water stress and potassium deficiency. Keeping in view these facts a field experiment was carried out to study the effect of irrigation intervals and plastic mulching on flower production and control of calyx split in carnation at Ornamental Horticulture Nursery, The University of Agriculture Peshawar, in 2020. Randomized Complete Block Design with a split plot arrangement having two factors was used. Treatments were repeated three times. The plants of carnation were irrigated at different interval (3, 6, 9 and 12 days) allotted to main plots and plastic mulches (transparent, black and green and control / no mulching) were assigned to subplots. Data pertaining to irrigation intervals revealed that least days to flowering (89.7), least calyx splitting (6.1%) and maximum vase life (11.33 days) were recorded in plants irrigated with 12 days' interval that were statistically similar to the effect of irrigation at 9 days of interval. Findings regarding plastic mulches showed that maximum chlorophyll content (62.8 SPAD), days to flowering (100.5), dry flower weight (2.4g) and vase life (10.95 days) with minimum calyx splitting (7.4%) were recorded in carnation plants of plots covered with green plastic mulch that were statistically similar to the effect of black and transparent plastic mulches. It is concluded that irrigation intervals of 9 and 12 days resulted in early flowering, least calyx splitting and extended vase life. While use of plastic (Transparent, black or green) as mulching material proved superior as compared to control/ no mulching.

INTRODUCTION

Carnation is an annual flowering plant that has a vast demand as a cut flower in the International market because of its beautiful flowers, easy transportation and marketing (Faust and Dole, 2021). Its cut flowers are in high demand especially during festivals like Mother's Day, Father's Day, Eid, wedding and other anniversaries etc. It has hermaphrodite flowers and is mainly utilized as a flowering plant in beds, pots, and containers (Singh *et al*., 2022).

In order to enhance the growth and production of quality cut flowers of carnation, it is necessary to provide the plant with optimum water supply and nutrition. The water requirement of carnation highly depends on the soil texture, temperature, air movement, and humidity. Generally carnation

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thrives well in moist soil (Jawaharlal *et al.*, 2009). Low moisture level in the soils can cause wilting and negatively affect the production and quality of the carnation flowers. If the drought conditions prevail for a longer time it can result in restricted plant growth and lowering the number and quality of the flowers (Gupta and Dubey, 2018). The cut flower production is mainly affected by the availability of moisture in the soil and timely irrigation (Singh *et al*., 2015).

Calyx splitting is a major problem affecting the flower quality in the carnation. It's mainly caused by the moisture imbalance in the soil. To resolve this problem mulching can be utilized as it can conserve moisture, and suppress weeds ultimately controlling the calyx splitting and leading to quality flower production in carnation (Faust and Dole, 2021). Mulching improves plant growth by enhancing the soil temperature and conserving the soil moisture for relatively longer period. It creates a microclimate around the plant root zone by modifying the temperature and moisture in the soil (Stigter *et al*., 2018).

Various types and colors of plastic mulches are used for trapping the amount of radiation and influencing the micro-climate around the plant (Mormile *et al*., 2017). The reflectivity and conductivity of the plastic mulch regulate the soil temperature and moisture content (Jones *et al.*, 2021). Irrigation intervals also affect the quality and production of carnation cut flowers. The optimum water availability ensures the maximum uptake of nutrients and improves plant growth, flower size, and quality. The study mainly focuses on exploring different mulching types and Irrigation intervals to control calyx splitting and enhance the production and quality of carnation flowers.

MATERIAL AND METHODS

The experiment was conducted in the Horticulture Nursery, The University of Agriculture, Peshawar in 2020. The experiment was conducted in Randomized Complete Block Design with two factors. Factor "A" was comprised of Irrigation intervals i.e. 3, 6, 9, and 12 days and Factor "B" was mulching types i.e. No mulch (control), transparent / white plastic, black plastic and green plastic. All the treatments were repeated three times. Cultural practices like weeding, ploughing, leveling and fertilizer application etc. were carried out regularly throughout the experiment when needed. Seedlings were transplanted in the last week of February 2020.

The studied parameters included the number of leaves plant^{-1}, leaf area (cm^2), chlorophyll content (SPAD), days to flowering, calyx splitting (%), flower diameter (cm), and vase Life (Days).

Number of leaves plant^{-1}: No. of leaves plant^{-1} were calculated by counting the leaves in randomly selected five plants from each treatment and replication and its average was taken.

Leaf Area (cm^2): The leaf area was calculated by measuring the leaf area with a leaf area meter in randomly selected plants from each treatment and replication and its average was calculated.

Chlorophyll Content (SPAD): Leaf chlorophyll content was determined from five plants of all treatments in each replication using SPAD (502 Plus) meter and its average was taken.

Days to flowering: Days to flowering were recorded in randomly selected five plants for all treatments in each replication from the date of transplantation up to the date of flower appearance and its average was taken.

Calyx Splitting (%): The number of split calyces was observed in randomly selected five plants from each treatment in each replication and average calyx splitting was calculated. The percent calyx splitting was calculated by using the formula;

$$Calyx\ Splitting(\%) = \frac{Number\ of\ split\ calyces}{Total\ number\ of\ calyces} \times 100$$

Flower diameter (cm): Flower diameter was calculated from the randomly selected five plants from each treatment and replication using a Vernier caliper and its average was taken.

Vase life (Days): Cut flowers of carnation were harvested early in the morning at a color showing stage in each treatment and replication and were kept in distilled water at room temperature. The vase life of these cut flowers was determined by counting the days from its placement in the vase till loss of its market value.

Statistical procedure: Data were analyzed using the statistical software Statistix 8.1. Analysis of variance (ANOVA) was obtained and the LSD test was done for the significant parameters at 1% and

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5% level of significance to separate the means where needed (Jan *et al*., 2009).

RESULTS

Mean data regarding number of leaves plant^{-1}, Leaf area (cm^2), Chlorophyll content (SPAD), and Days to flowering are shown in Table 1. Different mulching types significantly affected the number of leaves per plant, leaf area, chlorophyll content, and days to flowering in Carnation, similarly Irrigation intervals also significantly affected all these parameters except leaf area.

Maximum number of leaves per plant (354.9), Leaf Area (5.31cm^2), Chlorophyll Content (62.8 SPAD), and Days to flowering (100.5 days) were observed in green plastic mulch which was statistically at par with black and transparent plastic mulch. In contrast, the minimum number of leaves per plant (285.4), Leaf Area (2.5cm^2), Chlorophyll content (53.6 SPAD), and days to flowering (90.0 days) were recorded when no mulch was used. Different Irrigation Intervals showed that maximum number of leaves per plant (415.0), Chlorophyll Content (65.0 SPAD), and Days to flowering (103.4 days) were recorded in plants irrigated after 3 days while the minimum number of leaves per plant (272.4), Chlorophyll Content (56.3 SPAD), and days to flowering (89.7 days) were recorded in plants irrigated after 12 days.

Mean data regarding Calyx splitting (%), Flower diameter (cm), and Vase Life (Days) are shown in Table 2. Different mulching types and irrigation intervals significantly affected the Calyx splitting (%), Flower diameter (cm), and Vase Life (Days) whereas interaction was non-significant.

In case of mulching types highest calyx splitting (13.8%) was observed when no mulching was used in the carnation plants while the least calyx splitting (7.4%) was observed when the green mulch was used which was statistically similar to the black and transparent mulch. The calyx splitting was recorded maximum (12.0%) when the plants were irrigated after 3 days interval while the minimum calyx splitting (6.1%) was recorded when the plants were irrigated after 12 days interval. The maximum flower diameter (5cm) was recorded when black mulch was used which was statistically similar to green and transparent mulch, minimum flower diameter (3cm) was observed in control. In case of irrigation intervals, maximum flower diameter (6 cm) was observed when plants were irrigated after 3 days while minimum flower diameter (3.3cm) was observed when the plants were irrigated after 12 days' interval. The maximum vase life (10.95 days) was observed when green mulch was used which was statistically similar to the black and transparent mulch. The minimum vase life (6 days) was observed when no mulch was used. In case of Irrigation intervals, the maximum vase life (11.3 days) was observed when the plants were irrigated after 12 days while the minimum vase life (7.92 days) was observed when the plants were irrigated after 3 days' interval.

DISCUSSION

Mulching influences the number of leaves plant^{-1}, Leaf area (cm^2), Chlorophyll content (SPAD), and Days to flowering because it retains moisture in soils and increases the soil temperature by trapping the thermal radiation due to which the root activity is enhanced and more nutrients are absorbed with water (Du *et al*., 2022). It also suppresses the weed population and improves the microclimate as a result more root growth and more nutrient uptake occur which ultimately leads to enhanced leaf area and chlorophyll content (Kader *et al*., 2017). It also improves the absorption of nutrients from the soil which stimulates the growth and development of plants (Ngosong *et al*., 2019). Frequent irrigation resulted in enhanced attributes of the carnation as optimum moisture was available due to which the stomata remained opened and adequate gaseous exchange occurred (Meeteren and Alinjaeifard, 2016). Moreover, it enhanced the vegetative growth of carnations and contributed to more number of leaves and delayed flowering. Relatively high temperatures and reduced watering cause earliness in flowering of plants due to mild stress (Sage *et al*., 2015).

Mulching influences the soil temperature to a great extent and inhibits the weed population making it suitable for optimum nutrient uptake and creating a favorable environment in the root zone for the better development of plants (Wang *et al*., 2019). The use of plastic mulching reduced evaporation from the soil surface and suppressed weed growth hence increasing water-use efficiency and yield as well as quality (Memon *et al*., 2017). The cells become turgid with the uptake of water,

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excessive water absorption results in enhanced osmotic pressure of the cell and leads to splitting of calyx. Plastic mulch improves the nutrients uptake by improving the root system of plants. More nutrients result in the enhanced flower diameter of carnations (Singh *et al*., 2015). The supply of water with extended intervals caused a reduction in vegetative growth and biomass production. Drought stress results in significant decrease in flower diameter. Mulching retains moisture, moderates soil temperature as it acts as an insulating layer, and reduces the competition for water and nutrients by suppressing weeds leading to optimum nourishment of plants and enhancing the vase life of carnation flowers (Bar-Tal *et al*., 2019). As a result, Optimum irrigation results in stronger stem structures which enhance the vase life of carnation flowers while both over-irrigation and under-irrigation result in creating a stressful environment for the plant and are responsible for affecting the turgor and stem structures (Reid and Jiang, 2012). Optimum irrigation results in optimum turgor and enhances the vase life of carnation flowers (Ataii *et al*., 2015).

CONCLUSION

It was concluded from this study that the minimum days to flowering, least calyx splitting, and extended vase life were recorded in plants irrigated with 12 days' interval that were statistically similar to the effect of irrigation at 9 days of interval. In different plastic mulching, highest chlorophyll content, maximum days to flowering, and vase life with minimum calyx splitting were recorded in carnation plants of plots covered with green plastic mulch that were statistically at par to the effect of black and transparent plastic mulches.

Table 1

Number of leaves plant^{-1}, Leaf Area (cm^2), Chlorophyll Content (SPAD), and Days to flowering as affected by different mulching types and Irrigation Intervals.

Plastic Mulching	Number of leaves plant^{-1}	Leaf Area (cm^2)	Chlorophyll Content (SPAD)	Days to flowering
Control	285.4B	2.5B	53.6B	90.0B
Transparent	346.9A	5.6A	60.5A	95.6A
Black	360.7A	5.31A	61.8A	98.6A
Green	354.9A	5.06A	62.8A	100.5A
LSD	47.99	1.0815	4.16	4.58
Irrigation Intervals (Days)				
03	415.0A	4.50	65.0A	103.4A
06	367.7B	4.90	60.8B	97.4B
09	307.8C	4.45	56.6C	94.2B
12	272.4D	4.62	56.3C	89.7C
LSD	41.02	NS	3.16	4.87
Interaction M x I	NS	NS	NS	NS

Means having different letters are significantly different from each other at P≤ 0.01.
M = Plastic Mulching
I = Irrigation Intervals

Table 2

Calyx splitting (%), Flower diameter (cm), and Vase Life (Days) as affected by different mulching types and irrigation intervals.

Plastic Mulching	Calyx splitting (%)	Flower diameter (cm)	Vase life (Days)
Control	13.8a	3.0B	6.00B
Transparent	8.4b	4.7A	10.55A
Black	7.6b	5.0A	10.89A
Green	7.4b	4.4A	10.95A
LSD	3.00	1.08	1.29
Irrigation Intervals (Days)			
03	12.0A	6.0A	7.92C
06	10.3A	4.4B	8.61B
09	8.8B	3.5C	10.49A
12	6.1B	3.3C	11.33A
LSD	2.11	0.97	0.86

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Interaction M x I	NS	NS	NS

Means having different letters are significantly different from each other at P≤ 0.01 and P≤ 0.05.
M = Plastic Mulching
I= Irrigation Intervals

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