Biological Forum – An International Journal **14(3): 1428-1433(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Studies on Effect of Colchicine on Growth and Yield of Tuberose (*Agave amica*)

B.L. Sravani[1*], P.L. Kameswari[2], A.V.D. Dorajee Rao[3] and D.R. Salomi Suneetha[4]

[1]PG Scholar, Department of Floriculture and Landscape Architecture, College of Horticulture, Dr. Y.S.R. Horticultural University, Venkataramannagudem, West Godavari (Andhra Pradesh), India.
[2]Principal Scientist and Head (Horticulture), Krishi Vigyan Kendra, Pandirimamidi, East Godavari (Andhra Pradesh), India.
[3]Professor and Head (Horticulture), College of Horticulture, Dr. Y.S.R. Horticultural University, Venkatarammanagudem, West Godavari (Andhra Pradesh), India.
[4]Dean of student affairs, Professor and Head (Biochemistry), College of Horticulture, Dr. Y.S.R. Horticultural University, Venkataramannagudem, West Godavari (Andhra Pradesh), India.

(Corresponding author: B.L. Sravani)*
(Received 13 July 2022, Accepted 23 August, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The present investigation entitled "Studies on effect of colchicine on growth and yield of tuberose (*Agave amica*)" was conducted at College of Horticulture, Venkataramannagudem, West Godavari district of Andhra Pradesh during October 2021 - June 2022 with the objective of finding out the best concentration of colchicine and dipping time for improving the performance of the plant. The experiment was carried out in a factorial randomized block design comprising eighteen treatment combinations with two replications from two factors *i.e.*, concentration of colchicine at six levels *viz.*, colchicine (0, 100, 200, 300, 400 and 500 ppm). The second factor was dipping time at three levels (3, 6 and 9 h). The study revealed significant differences among colchicine concentrations, dipping times and their interactions for different growth and yield characters. Bulbs treated with colchicine @ 500 ppm for a dipping time of 9 h performed best with respect to plant height, number of leaves per plant, leaf length, leaf width, leaf chlorophyll content and number of bulbs per plant. Days taken for sprouting of bulbs and number of florets per spike noticed to be best with colchicine @ 0 ppm + 3 h whereas, sprouting percentage and survival percentage was observed to the best with colchicine @ 0 ppm at all the dipping times. From the present investigation, it can be concluded that the bulbs treated with colchicine @ 500 ppm for 9 h of dipping time exhibited superior performance with respect to most of the growth and yield characters in tuberose.

Keywords: Colchicine, bulbs, dipping time, survival, growth.

INTRODUCTION

Tuberose (*Agave amica*), formerly named as *Polianthes tuberosa*, is one of the most important tropical ornamental bulbous flowering plants cultivated for its beautiful, elegant, sweet-scented long lasting spikes. It is popularly known as Rajanigandha or Nishigandha. It belongs to family Asparagaceae with basic chromosome number of n = 30 and is native of Mexico. It has great economic potential both as cut as well as loose flower crop due to its pleasant fragrance and long lasting nature. It is commercially propagated vegetatively by means of bulbs. It is a day neutral plant, requires a temperature of 20°C–30°C and high humidity for its luxuriant growth. The main emphasis in breeding tuberose is to improve floral traits *viz*., colour, flower form, size, number of florets, shelf life, vase life, year-round production and growth habit. Since it is a vegetatively propagated crop, one of the options to create variation is by induction of polyploidy. Polyploidy may occur naturally due to the formation of unreduced gametes or can be induced artificially by doubling the number of chromosomes. Artificial induction of polyploidy by colchicine provides a tool to overcome the limitations of variability in plants. Polyploidy has now become one of the most important technologies for the development of new varieties. In some cases, when the crossing between two species is not possible because of differences in ploidy level, polyploids can be used as a bridge for gene transferring between them. Polyploidy can be induced artificially by the use of chemicals like colchicine, oryzalin and trifluralin. Type, dosage and duration of application (exposure time) of the chemical are considered as the main factors. Amongst them, colchicine is the most applied and well-known antimitotic agent which is found to have higher specificity for tubulin binding sites in plant materials.

Hence the present investigation has been planned with the objective to study the effect of colchicine on growth and yield characters of tuberose.

MATERIAL AND METHODS

The research work was carried out at College of Horticulture, Venkataramannagudem, West Godavari district of Andhra Pradesh during October 2021- June 2022. The design of the experiment is factorial randomized block design with 2 factors. The first factor is concentration of colchicine which has 6 levels, (C_1: 0 ppm, C_2: 100 ppm, C_3: 200 ppm, C_4: 300 ppm, C_5: 400 ppm and C_6: 500 ppm). The second factor is dipping time consisting 3 levels namely, D_1: 3 h, D_2: 6 h and D_3: 9 h. It has 18 treatment combinations with 2 replications.

Healthy, disease free and uniform sized bulbs of 2- 2.5 cm were selected for planting. After imposing the treatments, bulbs were planted at a spacing of 30 cm between the rows and 30 cm between the plants. The number of plants per plot (4 m²) are 44.

RESULTS AND DISCUSSION

Days taken for sprouting of bulbs

Days taken for sprouting varied significantly with the concentration of colchicine and dipping time as well as their interactions (Table 1, 2 and 3).

Among colchicine concentrations, colchicine @ 0 ppm (C_1) performed the best with minimum number of days (15.60 days) for sprouting followed by the bulbs treated with colchicine @ 100 ppm (C_2) (17.21 days) while, maximum delay was observed for sprouting of bulbs (22.32 days) with colchicine @ 500 ppm (C_6). The bulbs dipped for 3 h (D_1) recorded the earliest sprouting within 18.20 days followed by dipping of bulbs for 6 h (D_2) (18.51 days). Maximum delay was observed for sprouting of bulbs dipped in colchicine for 9 h (D_3) (19.56 days).

A significant interaction between colchicine concentration and dipping time was clearly evident for delay in sprouting of bulbs. Significantly less number of days was taken for sprouting (15.23 days) in bulbs treated with colchicine @ 0 ppm + 3 h dipping time (C_1D_1). Maximum delay was observed for sprouting of bulbs (23.81 days) with colchicine @ 500 ppm + 9 h dipping (C_6D_3).

Delayed sprouting of bulbs at higher concentrations and dipping time might be probably related with the cytological effect of colchicine in preventing the formation of spindle fibres due to possible chromosome doubling. This perhaps have led to decrease in rate of cell division and cell differentiation thus resulting in maximum number of days for sprouting. These results are in accordance with the Manzoor *et al*. (2018) in Gladiolus corms, Boora *et al.* (2003) in Tuberose, Omezzine *et al*. (2009) in the seeds of sea trigonella and Essel *et al*. (2015) in Cow pea where we could find the maximum number of days taken for sprouting at higher concentration of colchicine.

Sprouting percentage (%). There were significant differences in percentage of bulbs due to the influence of colchicine concentration and dipping time. However, the interaction effect was found non-significant (Table 1, 2 and 3).

The influence of different concentrations of colchicine revealed that colchicine @ 0 ppm (C_1) significantly recorded the highest percentage (100%) of sprouted bulbs, followed by 100 ppm (C_2) which recorded (97.40%) whereas, the lowest percentage of sprouted bulbs were noticed at a colchicine concentration of 500 ppm (C_5) with 86.59%.

Among dipping times, dipping for 3 h (D_1) produced significantly maximum percentage of sprouting (94.70%) whereas, dipping time of 9 h (D_3) reported minimum sprouting percentage of 93.31%.

The interaction means revealed that no significant difference was observed with respect to sprouting percentage of bulbs. The bulbs treated with 0 ppm colchicine recorded maximum sprouting percentage (100%) at all the dipping times i.e., C_1D_1, C_1D_2 and C_1D_3. It was observed to be minimum (85.97%) at 500 ppm of colchicine with 9 h dipping time (C_6D_3).

The observations recorded in the present investigation revealed that there was a decline in the per cent sprouting for every rise in the concentration of colchicine. Rejeb *et al*. (2014) stated that different defence mechanisms such as synthesis of heat shock proteins, activation of ion channels and phytohormones regulate the gene expression that has made the plant to survive by tolerating the phytotoxic chemical stress. The decline in sprouting percentage might be due to impediment in the physiological processes like hormonal imbalance, enzyme activity and inhibition of mitosis. It could also be due to the damage caused to cell membrane and other cellular constituents leading to breaks, physiological injuries (Khan and Goyal 2009) and ultimately the metabolic activity of the cells. Kumar *et al*. (2013) stated that the decline in sprouting might be due to toxic nature of the chemical mutagen. The results of our present investigation are in accordance with those of Pawar *et al*. (2020) in Garlic, Manzoor *et al*. (2018) in Gladiolus, Essel *et al*. (2015) in Cow pea and Mensah *et al*. (2005) in Sesame.

Survival percentage (%). There were significant differences in the survival percentage among the treatments under the influence of concentration of colchicine. However, the dipping time and the interaction effect was found non-significant (Table 1, 2 and 3).

Among colchicine concentrations, colchicine @ 0 ppm (C_1) resulted in maximum percentage of survival with 100% plants followed by colchicine @ 100 ppm (C_2) recording 82.20% of survival. The minimum survival percentage (74.32%) was observed in colchicine @ 500 ppm (C_6).

The effect of dipping time in colchicine for survival percentage was found non-significant. Among dipping times, dipping for 3 h (D_1) was found to be the best showing maximum percentage of survival with 82.43% whereas, it was recorded to be minimum at 9 h of dipping (D_3) with 80.24%.

The interaction between colchicine concentration and dipping time for survival percentage was found non significant. Corresponding to survival percentage, the maximum values were recorded with colchicine @ 0 ppm at all the dipping times (C_1D_1, C_1D_2 and C_1D_3) with 100% of survival. This was followed by colchicine @ 100 ppm + 3 h of dipping (C_2D_1) which recorded 84.09%, whereas, minimum survival percentage (72.73%) was reported with 500 ppm colchicine with 9 h of dipping (C_6D_3).

From the recorded data, it can be concluded that the survival percentage of plants was found to decrease with an increase in the concentration of colchicine. Reduction in survival rate might be due to tissue necrosis caused when the bulbs were soaked in different colchicine concentrations. Higher dose of colchicine might be toxic to the plant cell causing imbalance and affecting the internal process of cell. The results of our present investigation are in consistence with Zhang *et al*. (2007) in *Phlox subulata*, Chen *et al*. (2011) in Anthurium, Gantait *et al*. (2011) in Gerbera, Atichart (2013) in *Dendrobium chrystotoxum*, and Omidbaigi *et al.* (2010) in Basil.

Plant height (cm). The data pertaining to plant height varied significantly by the influence of colchicine concentration, dipping time and their interactions (Table 1, 2 and 3).

Treating of bulbs with colchicine @ 500 ppm (C_6) resulted in maximum plant height of 53.74 cm followed by colchicine @ 400 ppm (C_5) which recorded 50.93 cm of plant height whereas, the minimum plant height of 48.14 cm was observed in colchicine @ 0 ppm (C_1). Among dipping times, 9 h (D_3) had the maximum plant height throughout the period of study and recorded 51.52 cm, whereas, minimum was found at dipping for 3 h (D_1) with 50.07 cm.

The interaction between colchicine concentration and dipping time for plant height was significant. The maximum plant height was observed significant in bulbs treated with colchicine @ 500 ppm + 9 h of dipping (C_6D_3) with 53.89 cm. This was followed by colchicine @ 500 ppm + 6 h of dipping (C_6D_2) with 53.72 cm. The minimum plant height was recorded in 0 ppm colchicine + 3 h of dipping time (C_1D_1) with 48.10 cm.

Application of colchicine upto 500 ppm caused an increase in plant height (cm) which might be due to the phenotypic effect in polyploid plants. The changes in cell division and cell differentiation perhaps have led to an increase in cell size due to possible chromosomal doubling ultimately resulting in increase of plant height. Similar findings were reported by Alam *et al.* (2001) in Potato, Boora *et al.* (2003) in Tuberose, Koriech (2007) in Snapdragon and Larkspur, Azizan *et al.* (2021) in Stevia and Kushwah *et al.* (2021) in Vicia faba and Chrysanthemum.

Number of leaves per plant. Number of leaves per plant exhibited significant differences due to the influence of colchicine concentration, dipping time and their interaction (Table 1, 2 and 3).

The number of leaves per plant was significantly higher with the treatment of colchicine at 500 ppm (C_6) which produced 29.09 leaves. This was followed by colchicine @ 400 ppm (C_5) with 28.14 leaves per plant. While, the minimum number of leaves per plant was observed with 0 ppm colchicine (C_1) showing 24.18 leaves per plant.

Among different dipping times, 9 h (D_3) recorded significantly maximum number of leaves per plant *viz.*, 27.88. Whereas, minimum number of leaves per plant (25.47) was reported in 3 h of dipping time (D_1).

The interaction between colchicine concentrations and dipping times for number of leaves per plant was significant except at 60 DAP. The maximum number of leaves per plant (31.37) was observed significant in bulbs treated with colchicine @ 500 ppm + dipping for 9 h (C_6D_3). It was found to be minimum with 23.87 leaves per plant which was observed with treatment of colchicine @ 0 ppm + 3 h of dipping (C_1D_1).

Increase in the number of leaves per plant might be due to increase in cell proliferation rate which in turn was due to the increased physiological activity of cell due to possible chromosome doubling. The results of our present investigation are in accordance with Rahayu *et al*. (2014) in Tuberose, Alam *et al*. (2001) in Potato and He *et al*. (2016) in *Tagetes erecta* that there was an increase in leaf number with colchicine treatment.

Leaf length (cm). The results revealed that colchicine concentration, dipping time and their interaction caused significant variation in the leaf length (Table 1, 2 and 3).

Among colchicine concentrations, 500 ppm (C_6) recorded maximum leaf length with an average value of 52.27 cm. This was followed by colchicine @ 400 ppm (C_5) with an average leaf length of 50.45 cm whereas colchicine @ 0 ppm recorded the minimum observation of 47.54 cm.

The maximum value of leaf length (50.74 cm) with respect to dipping time was recorded in the bulbs dipped for 9 h (D_3) which was followed by dipping up to 6 h (D_2) with a leaf length of 49.75 cm.

The interaction effect of both the colchicine concentrations and dipping times revealed a remarkable variation and was found significant among all the treatments. Maximum leaf length (52.57 cm) was perceived when the bulbs were treated with 500 ppm colchicine for a dipping time of 9 h (C_6D_3) followed by colchicine @ 500 ppm + 6 h of dipping time with 52.25 cm. It was found to be minimum at 0 ppm colchicine coupled with 3 h of dipping (C_1D_1) which recorded a leaf length of 47.50 cm.

Application of different colchicine concentrations at various dipping durations caused an increase in leaf length (cm). This could be due to the phenotypic effect in polyploid plants which led to changes in cell division and cell differentiation. This perhaps have led to an increase in cell size due to possible chromosomal doubling ultimately resulting in increase of leaf length. Similar findings were observed by Gantait *et al*. (2011) in Gerbera, Talebi *et al.* (2017) in *Anise hyssop*, Azizan *et al*. (2021) in Stevia and Shaikh *et al*. (2021) in *Commelina benghalensis*.

Leaf width (mm). The influence of colchicine concentrations, dipping times and their interactions on mean leaf width was significant (Table 1, 2 and 3).

The influence of various colchicine concentrations on bulbs of tuberose revealed that colchicine @ 500 ppm (C_6) significantly performed the best with maximum lead width recording 15.70 mm. This was followed by colchicine @ 400 ppm (C_5) which recorded a leaf width of 14.53 mm. The mean minimum leaf width was observed in 0 ppm colchicine (C_1) with 13.13 mm.

The maximum value of leaf width with regard to dipping times was observed in the bulbs treated up to 9 h of dipping (D_3) which recorded 14.49 mm whereas, minimum value of leaf width was noticed for a dipping time of 3 h (D_1) with 13.80 mm.

The interaction between colchicine concentrations and dipping times for leaf width was significant. The maximum leaf width (16.10 mm) was observed in bulbs treated with colchicine @ 500 ppm + 9 h of dipping (C_6D_3) followed by colchicine @ 500 ppm + dipping for 6 h (C_6D_2) with 15.80 mm leaf width. The minimum leaf width of 13.00 mm was recorded with colchicine @ 0 ppm and at 3 h of dipping time (C_1D_1). The significant increase in leaf width due to colchicine might be due to the phenotypic effect in polyploid plants which led to changes in cell division and cell differentiation. This perhaps have led to an increase in cell size due to possible chromosomal doubling ultimately resulting in increase of leaf width. Similar findings were also reported by Zhang *et al*. (2007) in Phlox, Gantait *et al*. (2011) in Gerbera, Talebi *et al.* (2017) in *Anise hyssop,* Mo *et al*. (2020) in *Rhododendron fortunei*, Bhattarai *et al*. (2021) in Gerbera and Shaikh *et al*. (2021) in *Commelina benghalensis*.

Leaf chlorophyll content (SPAD units). In the present investigation, colchicine concentrations, dipping times as well as their interactions were found to have significantly influenced the leaf chlorophyll content (Table 1, 2 and 3).

Among the colchicine concentrations, maximum leaf chlorophyll content was noticed in colchicine @ 500 ppm (C_6) with 59.90 SPAD units. This was followed by bulbs treated with colchicine @ 400 ppm (C_5) recording 59.33 SPAD units, while the minimum leaf chlorophyll content (52.07 SPAD units) was observed with 0 ppm colchicine concentration (C_1).

With respect to dipping times, the bulbs dipped for 9 h (D_3) showed significantly maximum leaf chlorophyll content (58.53 SPAD units) while, significantly minimum leaf chlorophyll content was reported as 55.44 SPAD units with 3 h of dipping time (D_1).

Among interactions, the maximum value for leaf chlorophyll was noticed at 500 ppm colchicine concentration in combination with a dipping time of 9 h (C_6D_3) (61.81 SPAD units) which was followed by colchicine @ 400 ppm + 9 h of dipping (C_5D_3) with 61.22 SPAD units. The data was recorded as the minimum for leaf chlorophyll at 0 ppm colchicine + dipping for 3 h (C_1D_1) *i.e*., control (52.00 SPAD units).

Higher content of leaf chlorophyll can be ascribed to the greater size of cells in leaves due to the application of colchicine. The results of our present investigation are in conformity with the findings of Mensah *et al*. (2007) in Sesame and Ye *et al*. (2009) in Crape myrtle.

Number of florets per spike. The effect of colchicine concentration, dipping time and their interaction was found to exert significant influence on the number of florets per spike (Table 1, 2 and 3).

A perusal of data clearly indicated that number of florets per spike was found maximum (27.43) by the application of colchicine @ 0 ppm (C_1). It was followed by colchicine @ 100 ppm (C_2) which recorded 26.10 florets per spike. Colchicine @ 500 ppm (C_6) recorded the minimum number of florets per spike as (23.74).

Among dipping times, 3 h (D_1) recorded the maximum number of florets per spike (26.53) which gradually decreased up on the extent of dipping for 6 h (D_2) with 24.88 florets.

Among the interactions, the treatment comprising 0 ppm colchicine + 3 h of dipping time (C_1D_1) recorded maximum number of florets per spike (27.75). It was followed by colchicine @ 0 ppm + 6 h of dipping time (C_1D_2) with 27.51 florets while, the minimum number of florets per spike (23.10) were noticed in colchicine @ 500 ppm + 9 h dipping time (C_6D_3).

The decline in the number of florets noticed might be due to irregular growth and development of the plants caused due to application of colchicine. A deprivation in the assimilation of carbohydrates due to certain physiological mechanisms might also be responsible for the decline in the number of florets. The results of our present investigation are in consistence with those of

Ye *et al.* (2010) in Crape myrtle, Zaffar *et al.* (2003) in Saffron and Koriech *et al.* (2007) in Snapdragon and Larkspur reported that there was reduction in the number of florets. The data with respect to weight of hundred florets as influenced by colchicine concentration, dipping time and their interaction was found significant.

Among the different colchicine concentrations, the treatment consisting colchicine @ 500 ppm (C_6) recorded maximum mean weight of hundred florets with 131.14 g. It was followed by colchicine @ 400 ppm (C_5) with 129.83 g whereas, minimum weight of hundred florets was recorded as 126.39 g.

With respect to dipping time, maximum weight of hundred florets (129.37 g) was recorded at 9 h of dipping time (D_3). It was noticed to be minimum with 128.00 g for a dipping of 3 h (D_1).

Among the interaction of colchicine concentrations and dipping times, weight of hundred florets was found to be maximum with 131.74 g in 500 ppm colchicine + 9 h dipping time (C_6D_3). It was followed by colchicine @ 500 ppm + 6 h of dipping (131.50 g). While, minimum weight of hundred florets was recorded in 0 ppm colchicine + 3 h of dipping (C_1D_1) with 126.25 g.

Increase in the weight of hundred florets might be due to an increase in the size, length, diameter of the flower and thickness of the petals in colchicine treated plants caused due to increase in cell size. This increase in cell size could be due to possible chromosome doubling in the cells. Similar results were documented by Boora *et al.* (2003) in Tuberose and Manzoor *et al*. (2018) in Gladiolus who reported an increase in weight of the floret.

Table 1: Effect of concentration of colchicine on growth and yield of tuberose.

Concentration of colchicine (C)	Days taken for sprouting of bulbs (days)	Sprouting percentage (%)	Survival percentage (%)	Plant height (cm)	No. of leaves per plant	Leaf length (cm)	Leaf width (mm)	Leaf chlorophyll content (SPAD units)	No. of florets per spike	No.of bulbs per plant
C_1	15.60	100.00 (5.74)	100.00 (5.74)	48.14	24.18	47.54	13.13	52.07	27.43	4.32
C_2	17.21	97.40 (5.67)	82.20 (5.20)	50.07	25.19	49.19	13.83	55.34	26.10	4.82
C_3	18.01	95.85 (5.62)	78.06 (5.07)	50.49	25.48	50.01	14.03	56.48	25.65	4.92
C_4	18.21	94.25 (5.57)	75.75 (4.99)	50.72	27.8	50.11	14.07	58.77	24.97	6.22
C_5	21.19	90.43 (5.45)	74.32 (4.95)	50.93	28.14	50.45	14.53	59.33	24.28	7.20
C_6	22.32	86.59 (5.34)	77.47 (5.03)	53.74	29.09	52.27	15.7	59.90	23.74	7.31

Table 2: Effect of dipping time of colchicine on growth and yield of tuberose.

Dipping time of colchicine (D)	Days taken for sprouting of bulbs (days)	Sprouting percentage (%)	Survival percentage (%)	Plant height (cm)	No. of leaves per plant	Leaf length (cm)	Leaf width (mm)	Leaf chlorophyll content (SPAD units)	No. of florets per spike	No.of bulbs per plant
D_1	18.20	94.70 (5.59)	80.84 (5.15)	50.07	25.47	49.31	13.8	55.44	26.53	5.28
D_2	18.51	94.31 (5.57)	82.01 (5.19)	50.46	26.59	49.75	14.36	56.98	24.88	5.75
D_3	19.56	93.31 (5.54)	80.88 (5.15)	51.52	27.8	50.74	14.49	58.53	24.68	6.37

Table 3: Interaction effect of colchicine concentrations on growth and yield of tuberose.

Treatment combinations	Days taken for sprouting of bulbs (days)	Sprouting percentage (%)	Survival percentage (%)	Plant height (cm)	No. of leaves per plant	Leaf length (cm)	Leaf width (mm)	Leaf chlorophyll content (SPAD units)	No. of florets per spike	No. of bulbs per plant
C_1D_1	15.23	100.00 (5.74)	100.00 (5.74)	48.10	23.87	47.50	13.00	52.00	27.75	4.28
C_1D_2	15.36	100.00 (5.74)	100.00 (5.74)	48.15	24.26	47.52	13.28	52.08	27.51	4.31
C_1D_3	16.21	100.00 (5.74)	100.00 (5.74)	48.16	24.42	47.59	13.12	52.14	27.04	4.36
C_2D_1	16.48	98.86 (5.70)	82.95 (5.23)	49.03	24.18	48.11	13.20	53.58	27.50	4.33
C_2D_2	17.32	98.08 (5.68)	84.09 (5.26)	50.02	25.59	49.46	14.00	55.34	25.51	4.77
C_2D_3	17.84	96.59 (5.64)	79.55 (5.12)	51.17	25.80	50.00	14.30	57.10	25.29	5.35
C_3D_1	17.47	96.36 (5.63)	77.27 (5.04)	49.42	24.50	49.00	13.70	54.69	27.02	4.42
C_3D_2	18.02	96.14 (5.63)	78.41 (5.08)	50.33	25.93	49.80	14.10	56.48	25.07	4.87
C_3D_3	18.54	95.04 (5.59)	78.49 (5.08)	51.72	26.00	51.23	14.30	58.28	24.85	5.46
C_4D_1	17.90	95.00 (5.59)	75.00 (4.97)	50.10	26.14	49.50	13.50	56.90	26.29	5.59
C_4D_2	18.12	94.32 (5.57)	76.14 (5.01)	50.26	27.59	49.64	14.30	58.76	24.40	6.16
C_4D_3	18.60	93.44 (5.55)	76.11 (5.00)	51.80	29.66	51.20	14.40	60.64	24.23	6.90
C_5D_1	20.85	91.44 (5.48)	75.24 (4.98)	50.14	26.46	49.72	14.20	57.45	25.56	6.47
C_5D_2	20.35	91.05 (5.47)	72.73 (4.89)	50.30	27.93	49.80	14.70	59.33	23.73	7.13
C_5D_3	22.37	88.84 (5.41)	75.00 (4.97)	52.35	30.02	51.82	14.70	61.22	23.55	8.00
C_6D_1	21.26	87.57 (5.37)	74.59 (4.95)	53.60	27.64	52.00	15.20	58.00	25.08	6.57
C_6D_2	21.88	86.24 (5.33)	80.68 (5.15)	53.72	28.26	52.25	15.80	59.90	23.04	7.24
C_6D_3	23.81	85.97 (5.32)	77.14 (5.01)	53.89	31.37	52.57	16.10	61.81	23.10	8.12

CONCLUSION

Among different colchicine concentrations evaluated, the bulbs treated with colchicine @ 500 ppm recorded highest plant height, number of leaves per plant, leaf length, leaf width, leaf chlorophyll content and number of bulbs per plant. However, days taken for sprouting, sprouting percentage, survival percentage and number of florets per spike performed best in case of colchicine @ 0 ppm.

Among dipping times, dipping for 9 h was noticed to be maximum for plant height, number of leaves per plant, leaf length, leaf width, leaf chlorophyll content and number of bulbs per plant whereas, 3 h was recorded best for days taken for sprouting of bulbs, sprouting percentage, survival percentage and number of florets per spike. It can be concluded from the present study that, colchicine @ 500 ppm + 9 h proved to be the best for most of the growth and yield characters.

FUTURE SCOPE

1. The stability of the crop (*Agave amica*) on colchicine over generations can be elucidated.
2. The effect of other antimitotic agents like oryzalin and trifluralin alone or in combination with colchicine may also be studied.

REFERENCES

Atichart, P. (2013). Polyploid induction by colchicine treatments and plant regeneration of *Dendrobium chrysotoxum*. *Thai Journal of Agricultural Science*, *46*(1): 59-63.

Alam, M. M., Karim, M. R., Aziz, M. A., Hossain, M. M., Ahmed and Mandal, B. A. (2001). Induction and evaluation of polyploidy in some local potato varieties of Bangladesh. *Journal of Biodiversity and Environmental Sciences*, *1*: 6-21.

Azizan, N., Shamsiah, A., Hasan, N. A. and Hussein, S. (2021). Morphological characterization of colchicine induced mutants in *Stevia rebaudiana*. In IOP Conference Series: *Earth and Environmental Science*, *7*(2): 1-7.

Bhattarai, K., Kareem, A. and Deng, Z. (2021). *In vivo* induction and characterization of polyploids in gerbera daisy. *Scientia Horticulturae*, *3*(2): 1-8.

Boora, E. S., Godara, N. R. and Goyal, R. K. (2003). Effect of colchicine on tuberose cv. Double. *Journal of Ornamental Horticulture*, *6*(2): 163-64.

Chen, C., Hou, X., Zhang, H., Wang, G. and Tian, L. (2011). Induction of *Anthurium andraeanum* "Arizona" tetraploid by colchicine *in vitro*. *Euphytica*, *181*(2): 137-145.

Essel, E, Asante, I. K. and Laing, E. (2015). Effect of colchicine treatment on seed germination, plant growth and yield traits of cowpea. *Canadian Journal of Pure and Applied Sciences*, *9*(3): 3573-3576.

Gantait, S., Mandal, N., Bhattacharyya, S. and Das, P. K. (2011). Induction and identification of tetraploids using *in vitro* colchicine treatment of *Gerbera jamesonii* cv. Sciella. *Plant Cell, Tissue and Organ Culture*, *106*(3): 485-493.

Khan, S. and Goyal, S. (2009). Improvement of mungbean varieties through induced mutations. *African Journal of Plant Science*, *3*(8): 174-180.

Koriech, E., Moghazy, E. I., Abd-El-Fattah, Y. M. and El-Sadek, M. A. (2007). Studies on induction of polyploidy and morphological characters of snapdragon (*Antirrhinum majus*) and larkspur (*Delphinum ajacis*) plants by using colchicine. *Journal of Plant Production*, *32*(10). 8435-54.

Kumar, A. P, Boualem, A, Bhattacharya, A, Parikh, S, Desai, N, Zambelli, A, Leon, A, Chatterjee, M. and Bendahmane, A. (2013). SMART–sunflower mutant population and reverse genetic tool for crop improvement. *Plant Biology*, 13(1): 1-8.

Kushwah, K. S., Patel, S., Chaurasiya, U. and Wani, M. B. (2021). The effect of colchicine on *Vicia faba* and *Chrysanthemum carinatum* plants and their cytogenetical study. *Vegetos*, *34*(2): 432-438.

Manzoor, A., Ahmad, T., Bashir, M. A., Baig, M. M. Q., Quresh, A. A., Shah, M. K. N. and Hafiz, I.A. (2018). Induction and identification of colchicine induced polyploidy in *Gladiolus grandiflorus* 'White Prosperity'. *Folia Horticulturae*, *30*(2): 307-19.

Mensah, J. K., Obadoni, B. O., Akomeah, P. A., Ikhajiagbe, B. and Ajibolu, J. (2007). The effects of sodium azide and colchicine treatments on morphological and yield traits of sesame seed. *African Journal of Biotechnology*, 6(5): 534-538.

Mo, L., Chen, J., Lou, X., Xu, Q., Dong, R., Tong, Z., Huang, H. and Lin, E. (2020). Colchicine induced polyploidy in *Rhododendron fortunei* plants, *9*(4): 424-26.

Omezzine, F., Ladhari, A., Nefzi, F., Harrath, R., Aouni, M. and Haouala, R. (2012). Induction and flow cytometry identification of mixoploidy through colchicine treatment of *Trigonella foenum-graecum*. *African Journal of Biotechnology*, *11*(98): 16434-42.

Omidbaigi, R., Yavari, S., Hassani, M. E. and Yavari, S. (2010). Induction of autotetraploidy in dragonhead (*Dracocephalum moldavica*) by colchicine treatment. *Journal of Fruit and Ornamental Plant Research*, *18*(1): 23-35.

Pawar, A., Kale, V., Nagre, P., Sonkamble, A. and Shyamsunder, M. (2020). Effect of gamma radiation, EMS and colchicine on sprouting in garlic (*Allium sativum*). *International Journal of Current Microbiology and Applied Sciences*, *9*: 3196-200.

Rahayu, Y. S. S., Prasetyo, I. K. and Riada, A. U. (2014). The effect of colchicine usage on vegetative growth of tuberose plants in medium plains. *Agromix*, *5*(1): 44-56.

Rejeb, I. B., Pastor, V. and Mani, B. M. (2014). Plant responses to simultaneous biotic and abiotic stress: Molecular Mechanisms. *Plants*, *3*(1): 458-475.

Shaikh, N., Verma, R. C., Khah, M. A., Filimban, F. Z., Albaz, A. A. and Alam, Q. (2021). Morphological and chromosomal characterization of diploid and colchicine induced autotetraploid plants of *Commelina benghalensis*. *Cytologia*, *86*(2): 167-73.

Talebi, S. F., Saharkhiz, M. J., Kermani, M. J., Sharafi, Y. and Fard, R. F. (2017). Effect of different antimitotic agents on polyploid induction of anise hyssop (*Agastache foeniculum*). *Caryologia*, *70*(2): 184-93.

Ye, Y. M., Tong, J., Shi, X. P., Yuan, W. and Li, G. R. (2010). Morphological and cytological studies of diploid and colchicine induced tetraploid lines of crape myrtle (*Lagerstroemia indica*). *Scientia Horticulturae*, *124*(1): 95-101.

Zaffar, G., Wani, S. A., Anjum, T. and Zeerak, N. A. (2003). Colchicine induced variability in saffron. *Proceedings of I International Symposium on Saffron Biology and Biotechnology*, *65*(1): 277-280.

Zhang, Z, Dai, H. and Xiao, M. (2007). *In vitro* induction of tetraploids in *Phlox subulata*. *Euphytica*, *159*(1): 59-65.

How to cite this article: B.L. Sravani, P.L. Kameswari, A.V.D. Dorajee Rao and D.R. Salomi Suneetha (2022). Studies on Effect of Colchicine on Growth and Yield of Tuberose (*Agave amica*). *Biological Forum – An International Journal*, *14*(3): 1428-1433.