Journal of Applied Horticulture, 26(2): 212-215, 2024

https://doi.org/10.37855/jah.2024.v26i02.40

Journal of Applied Horticulture
ISSN: 0972-1045

Evaluation of mulch types on weed management, soil moisture conservation and crop performance in *Gladiolus hybridus* cv. Punjab Glance

K.K. Dhatt[1] and Bolagam Ravikumar[1&2]

[1]*Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana, Punjab, India.* [2]*Department of Horticulture, Lovely Professional University, Phagwara, Punjab, India.*E-mail: ravikumar-fl@pau.edu*

Abstract

This study evaluated the effects of various mulch types on weed management, soil moisture conservation, and crop performance in *Gladiolus hybridus* cv. Punjab Glance at Punjab Agricultural University, Ludhiana. The experiment tested different coloured polythene mulches—black (25µ), silver on black (25µ), transparent (25µ), and white (50µ)—as well as paddy straw mulch at the rate of 10, 15, and 20 tonnes/ha, and pendimethalin (0.5 kg/ha). Results demonstrated that transparent and white polythene mulches promoted earlier sprouting, bud initiation, and flowering. Black polythene mulch yielded the tallest plants (90.30 cm) and longest spikes (75.31 cm), while white polythene (50µ) mulch produced the most florets per spike (12.39) and extended the flowering duration (15.60 days). Hand-weeding achieved the highest weed control efficiency (100%), closely followed by black polythene mulch (99.87%). Paddy straw mulch (1 t/ha) was the most effective for soil moisture conservation, with polythene mulches also performing well. Transparent (25µ) and white (50µ) polythene mulches recorded the highest average soil temperatures during the study.

Key words: Gladiolus, mulch, weed control efficiency, soil moisture

Introduction

Gladiolus (*Gladiolus hybridus* Hort.) is a widely admired bulbous cut flower, originated from South Africa and belonging to the Iridaceae family. Known for its economic significance, *Gladiolus hybridus* is known for its elongated spikes adorned with multiple florets, which are available in a spectrum of vibrant colours that consistently attract market demand (Ravikumar and Seenivasan, 2020). This flower's popularity is further augmented by its prolonged vase life and distinctive sword-like leaves, making it a favored choice for bedding, pot displays, and bouquets. Internationally, it ranks fifth among cut flowers in terms of market presence. India contributes significantly to the global production of gladiolus, with an annual yield of 41,970 metric tons of loose flowers and 112.69 lakh units of cut flowers cultivated across 10,440 hectares (Anonymous, 2017).

Weeds compete aggressively with gladiolus for essential resources such as nutrients, space, light, and water. They also release allelopathic compounds, which can lead to a substantial decline in bloom quality and yield, or even cause complete crop failure. Traditionally, managing weeds in gladiolus cultivation involves 4-5 rounds of manual weeding, a practice that is labour-intensive, costly, and time-consuming (Ravikumar and Seenivasan, 2019). Adoption of mulching reduce the soil temperature, increase CO_2 content in soil which eventually promote the nutrient availability, 90 per cent weed control and reduce the water evaporation from soil surface (Pooja *et al.*, 2022). Furthermore, mulching helps to retain soil moisture, which lowers the irrigation requirements. It also acts as an insulating layer, encourages faster crop development, increases root development, and prompts crop harvesting early (Kumar *et al.*, 2020). Because of the advantages of the aforementioned precision technologies, few researchers have looked into how mulching might improve gladiolus output and production in latest research. There is a scope for improving flower quality and yield adopting mulch in commercial gladiolus cultivation. Keeping in view, the current research aimed to identify the effective mulching materials that can enhance the income of farmers cultivating *Gladiolus hybridus* cv. Punjab Glance by reducing input costs and improving overall crop yield.

This study seeks to explore sustainable weed management practices that not only mitigate the adverse effects of weeds but also promote economic and environmental benefits for gladiolus growers.

Materials and methods

The present investigation was conducted at Research Farm, Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana, Punjab, India, from 2021 to 2023. The experiment was designed in randomized block design with three replications and ten treatments *viz.*, T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9, and T_{10} (Table 1). The field was ploughed until fine tilth and seed bed was prepared. The polyethylene mulches were scaled according to the plot size, then lay onto the plots, and corms were planted at 30 × 20 cm spacing. The paddy straw was spread over the plot as per the treatments seven days after planting. The observations were recorded on days to sprouting, plant height (at 60 days), days to bud initiation, days to flowering, spike length, florets/spike, floret size, flowering duration and soil moisture content at 10 days intervals from November to March and soil temperature twice a day at 10cm soil depth. MS10 was used to measure the temperature and moisture content of the soil. Its resin-packed plastic body was sealed, and sensing rods were

Table 1. Treatment details followed in *Gladiolus hybridus cv. Punjab Glance*

Treatment	Mulch type	Mulch thickness
T_1	Black polythene mulch	25 µ
T_2	Transparent polyethylene mulch	25 µ
T_3	Silver on black polythene mulch	25 µ
T_4	White polyethylene mulch	50 µ
T_5	Paddy straw mulch	10 t/ha
T_6	Paddy straw mulch	15 t/ha
T_7	Paddy straw mulch	20 t/ha
T_8	Pendimethalin	0.5 kg/ha
T_9	Hand weeding	Fortnight intervals
T_{10}	Weedy check	-

inserted straight into the soil to measure temperature and moisture content using an analog voltage output signal from an RS-485 output device. The weed control efficiency (WCE) was calculated by using formulae given by Singh *et al.* (2013).

$$WCE = x - y \div x \times 100$$

Where,

WCE = Weed Control Efficiency

x = Dry matter of weeds in weedy check plot (Un-weeded)

y = Dry matter of weeds in a treatment

Data from two years were combined to get mean values, which were then analyzed using R Software (version 4.2.0). The statistical means of several sources of variation were distinguished using the Duncan's Multiple Range Test (DMRT) at p 0.05.

Results and discussion

The number of days taken for sprouting varied across treatments, ranged from 12.58 to 14.36 days. Transparent polythene (25µ) mulch recorded the least days to sprout (9.23 days), which was statistically at par with white polythene (50µ) mulch (9.27 days). The weedy check plot recorded the maximum days to sprout (14.36 days). It might be due to the transparent plastic transmitting 90 % of the incident photosynthetically active radiation (PAR) through the plastic surface and absorbing only 5% of the PAR; therefore, it increases the soil temperature underneath and this rise in soil temperature resulted in early sprouting through better root development and soil micro-environment (Chander and Dhatt, 2021). The maximum plant height was noticed in black polythene (25µ) mulch (90.30 cm) followed by white polythene (50µ) mulch (90.00 cm) and silver on black polythene (25µ) mulch (89.85 cm). The smaller plants were noticed in the weedy check plot (77.68 cm). Baladha (2018) reported that mulched plots showed improved soil moisture retention, weed control efficiency, and soil temperature regulation, ultimately increasing plant height. The enhanced water retention in mulched plots boosted nutrient uptake, promoting both vegetative and reproductive growth in gladiolus compared to plots without mulch.

Number of days taken for bud initiation varied across treatments, ranging from 55.60 to 68.08 days. The minimum days taken for bud initiation were observed with black polythene (25µ) mulch (55.60 days), which was statistically at par with transparent polythene (25µ) mulch (55.61 days) and white polythene (50µ) mulch (56.22 days). Maximum days for bud initiation were taken in paddy (10t/ha) straw mulch (76.09 days), followed by paddy straw (15t/ha) mulch (75.35 days). The soil water retention and soil temperature variations must have helped with better primary root development and, hence, faster plant growth. Further better accumulation of photosynthates in the plant might have induced early bud initiation. Soil temperature increased by 2-3ºC in transparent and white polythene mulch as compared to plots without mulch (Table 4). The number of flowering days varied across treatments, ranging from 76.62 to 91.66 days. The total days to flowering were the least in the transparent polythene (25µ) mulch (74.07 days). A similar trend was also noticed under white polythene (50µ) mulch (75.50 days) and black polythene (25µ) mulch (76.62 days). The early flowering in the mulched plots might be due to reduced time for corm sprouting and bud initiation. The flowering commenced after 74 days in the transparent polythene (25µ) mulch, which was 17 days in advance than weedy check.

The spike length varied across treatments, ranging from 68.91 to 75.31 cm. The maximum spike length was noticed in black polythene (25µ) mulch (75.31 cm), which was at par with white polythene (50µ) mulch (74.80 cm). The weedy check plot noticed the shortest spike (68.91 cm). The spike length was linked with the plant height. The maximum plant height was observed in black polythene mulch (90.30 cm), which may be why the tallest plant tends to produce lengthy spikes (Table 2). The maximum flower yield per plant was noticed in black polythene (25µ) mulch (1.8/plant) while the lowest yield was recorded in paddy straw (20 t/ha) mulch (1.1/plant). The maximum number of florets/spikes were noticed in the plot with white polythene (50µ) mulch (12.39). The minimum florets/spike were recorded in the weedy check plot (9.49) and it was significantly lower than the hand weeding, pendimethalin (0.5 kg/ha) and all mulching treatments. The higher soil temperature might have inclined to increase the root activity and fasten the uptake of the nutrients stored in the corm, helped in better leaf area development and increased the chlorophyll content that ultimately enhanced the photosynthesisrate. There was no significant difference in floret size; however, paddy straw (15t /ha) mulch had the maximum floret size (8.09 cm). The smallest floret size (7.54 cm) was recorded under pendimethalin at 0.5 kg/ha, followed by hand-weeded plot (7.64 cm). The small size of the florets observed in pendimethalin 0.5 kg/ha treatment might be due to the effect of herbicide and their chemical composition. The mulch was inclined to reduce crop-weed competition, which might have helped the crop's healthy growth and ultimately led to good floral growth, as Jat(2017) reported in gladiolus. Duration of flowering varied across treatments, ranging from 8.63 to 15.60 days. The longest flowering duration was observed in black polythene (25µ) mulch (15.60 days) followed by silver on black polythene (25µ) mulch (15.50 days). The shorter flowering duration was noticed in the weedy check plot (8.63 days). The crop-weed competition was reduced in the mulched plots as the plastic mulch restricted the visible light being transmitted through the plastic. The black plastic mulch transmits only 0.9-1.0% of the incident visible light, restricting the germination of positively photoblastic weed seeds. This weed-free environment helped the crop grow better, with better vegetative and floral growth. This might be the reason for the increased flowering duration in the mulched plots, as Jat (2017) reported in gladiolus.

Weed parameters such as weed density, total weed dry weight and weed control efficiency were calculated for the three most prominent weed species observed in research plots *viz.*,

Table 2. Effect of mulching on *Gladiolus hybridus* cv. Punjab Glance cultivation

Treatments	Days to sprouting (days)	Plant height (cm)	Days to bud initiation (days)	Days to flowering (days)	Spike length (cm)	Spikes/plant	Florets/spike	Floret size (cm)	Duration of flowering (days)
T_1	12.58[bc]	90.30[a]	55.60[a]	76.62[a]	75.31[a]	1.8	12.20[a]	7.97[a]	15.60[a]
T_2	9.23[a]	89.20[a]	55.61[a]	74.07[a]	74.20[ab]	1.7	11.90[ab]	7.93[a]	14.19[ab]
T_3	12.43[b]	89.85[a]	57.91[ab]	78.91[b]	74.30[ab]	1.7	10.71[cd]	7.78[a]	15.50[a]
T_4	9.27[a]	90.00[a]	56.22[a]	75.50[a]	74.80[a]	1.6	12.39[a]	8.08[a]	14.10[ab]
T_5	11.32[b]	86.91[b]	76.09[e]	96.58[e]	69.59[de]	1.2	9.73[d]	7.93[a]	10.37[bc]
T_6	13.32[bc]	87.26[b]	75.35[e]	97.71[e]	71.13[cde]	1.2	10.79[bcd]	8.09[a]	10.14[bc]
T_7	12.11[b]	82.80[d]	75.32[e]	98.12[e]	69.40[de]	1.1	9.81[d]	7.95[a]	11.43[abc]
T_8	12.80[bc]	84.90[c]	61.44[bc]	83.92[c]	72.52[bc]	1.4	11.82[ab]	7.54[a]	11.20[abc]
T_9	13.15[bc]	84.23[c]	63.91[c]	84.55[c]	71.30[cd]	1.6	11.34[abc]	8.03[a]	11.22[abc]
T_{10}	14.36[c]	77.68[e]	68.08[d]	91.66[d]	68.91[e]	1.2	9.49[d]	7.64[a]	8.63[c]
CD (P=0.05)	2.01	2.80	2.01	4.05	1.76	1.0	1.335	0.569	0.569
SE±(m)	0.61	0.94	0.61	1.35	0.59	0.2	0.348	0.058	0.058

Oenothera laciniata, Coronopus didymus and Poa annua. Weed density varied between treatments, ranging from 1.00 to 39.76/m^2. Maximum weed density (39.76 no./m^2) was recorded in the weedy check plot, which was significantly higher than other treatments (Table 3). Total weed dry weight distinguished between treatments ranged from 1.00 to 26.99 g. Minimum total weed dry weight recorded in pendimethalin at 0.5 kg/ha (1.16 g/m^2) followed by silver on black polythene (25µ) mulch (1.23 g/m^2) and paddy straw mulch (1.35 g/m^2). Maximum total weed dry weight was recorded in weedy check (26.99 g/m^2). The weed control efficiency (WCE) was 100% in a hand-weeded plot (Table 3). These results were compatible with the findings of Mahawar *et al.* (2020). Pendimethalin 0.5 kg/ha cussed WCE of 99.91%, followed by black polythene (25µ) mulch (99.87 %), 15 t/ha paddy straw (99.85%) and 20 t/ha) paddy straw (99.80 %). Minimum WCE was noticed in transparent polythene (25µ) mulch (58.96 %) followed by white polythene (50µ) mulch (61.12%). The plastic mulches helped reduce the evaporation losses of water from the soil and further restricted weed growth beneath its surface. The plots treated with the silver and black plastic mulches helped to reduce the weed growth beyond 95 %.

The black and silver mulch restricted the photosynthetically active radiation to be transmitted through the sheet as they absorbed most of it, restricting the germination of weeds and this might be the reason for the better WCE under the black and silver on black polythene (25µ) mulches. Rajablariani *et al.* (2012) reported that the polythene mulch helped to reduce the weed growth where black polythene mulch restricted the growth of weeds by 90–98 %. The black and silver on black polythene mulches helped reduce the dry weight of weeds by 95 % and 98 %, respectively, in tomatoes. The black polythene mulch effectively obstructed the weed growth by restricting the sunlight required for germination. If germination occurs, the seedlings die from etiolation due to the absence of the photosynthetically active radiation required for photosynthesis. This might be the reason for lower weed count, weed fresh and dry weight under the plastic mulch as also reported by Salma *et al.* (2016) in gladiolus. The maximum soil moisture retention was noticed under 10 t/ha paddy straw mulch (9.82 %) and transparent polythene (25µ) mulch (9.69 %). The plot with the least soil moisture (5.02 %) retention was weedy check (Table 4). Mulches, either plastic or organic, helped reduce the transpiration losses from the plant`s surface and minimized evaporation losses from the soil surface, leading to better soil moisture retention (Salma *et al.*, 2016). The weekly average soil temperature at 7 a.m. was maximum in the transparent polythene (25µ) mulch in November (16.05 ºC) to March (18.93 ºC). Air temperature, sunshine and relative humidity during October to May in the Ludhiana region showed low temperatures in February to December. Paddy straw accounted for the lowest temperature during the course of the crop (Table 4). It might be due to a cool breeze trapped in the paddy straw mulch (Dhatt and Thakur, 2022). The white polythene film transmits 80-90 % of the incoming visible light, causing the soil temperature to rise. Under the transparent film, the incoming short-wave radiation was trapped due to the water droplets just beneath the surface of the sheet, hence making the long-wave radiation trapped inside. The maximum weekly average soil temperature at 7 p.m. was recorded in the weedy check plot (20.95 ºC) during November. The minimum soil temperature was generally recorded in paddy

Table 3. Effect of mulching on weed density, total weed dry weight and weed control efficiency (WCE %) in *Gladiolus hybridus* cv. Punjab Glance

Treatments	Nov	Dec	Jan	Feb	Mar	Total weed count (no./m^2)	Total weed dry weight (g/m^2)	WCE (%)
T_1	99.70	99.70	99.98	99.99	99.99	2.33[a](13.66)	1.38[a](0.92)	99.87
T_2	52.34	64.63	63.68	55.91	58.28	29.00[c](840.33)	18.39[c](330.5)	58.96
T_3	99.80	99.99	99.99	99.99	99.99	2.92[a](23.28)	1.23[a](0.52)	99.52
T_4	72.61	53.26	66.79	67.34	45.63	27.84[b](774.30)	18.16[b](338.12)	61.12
T_5	100	100	100	99.01	99.06	2.29[a](13.3)	1.78[a](2.18)	99.61
T_6	100	100	100	99.30	99.99	2.03[a](9.64)	1.48[a](1.19)	99.85
T_7	100	100	100	99.51	99.51	2.16[a](11.29)	1.35[a](0.84)	99.80
T_8	100	100	100	99.79	99.79	1.75[a](6.29)	1.16[a](0.35)	99.91
T_9	100	100	100	100	100	1.00[a](0)	1.00[a](0)	100
T_{10}	0.00	0.00	0.00	0.00	0.00	39.76[d](1580.17)	26.99[d](740.8)	0.00

Table 4. Effect of mulching on soil temperature (7 a.m. and 7 p.m.) and soil moisture (%) in *Gladiolus hybridus* cv. Punjab Glance

Treatments	Temperature at 7 a.m.						Temperature at 7 p.m.				Soil moisture (%)
	Nov	Dec	Jan	Feb	Mar	Nov	Dec	Jan	Feb	Mar	
T_1	15.95^{a}	11.92^{b}	10.39^{ab}	9.95^{b}	18.16^{ab}	18.14^{d}	14.61^{b}	13.06^{c}	13.14^{bc}	21.54^{b}	9.43^{ab}
T_2	16.05^{a}	12.89^{a}	10.95^{a}	11.04^{a}	18.93^{a}	19.85^{b}	15.87^{a}	14.25^{a}	14.72^{a}	22.92^{a}	9.69^{ab}
T_3	15.53^{ab}	11.35^{bc}	10.09^{abc}	9.53^{bc}	17.89^{ab}	18.30^{d}	13.69^{d}	12.82^{d}	13.51^{b}	21.51^{b}	9.31^{b}
T_4	15.88^{a}	12.79^{ab}	9.50^{cd}	10.06^{ab}	18.00^{ab}	19.10^{c}	14.23^{c}	13.63^{b}	13.25^{b}	21.72^{b}	9.35^{ab}
T_5	14.93^{bc}	10.85^{cd}	9.60^{bcd}	8.09^{e}	17.54^{b}	17.95^{d}	12.99^{i}	10.33^{i}	13.54^{b}	20.71^{cde}	9.82^{a}
T_6	14.61^{cd}	10.15^{d}	9.31^{cd}	8.41^{de}	15.29^{d}	17.34^{e}	13.43^{e}	12.39^{e}	12.40^{cd}	21.60^{b}	9.62^{ab}
T_7	14.61^{cd}	10.06^{d}	9.11^{d}	8.81^{cde}	15.59^{d}	17.15^{e}	13.20^{g}	12.00^{f}	11.68^{de}	20.11^{e}	9.50^{ab}
T_8	13.39^{e}	11.32^{bc}	9.49^{cd}	9.31^{bcd}	17.00^{bc}	20.11^{b}	13.11^{h}	11.49^{h}	11.14^{e}	20.60^{de}	6.61^{c}
T_9	13.75^{e}	11.39^{bc}	9.10^{d}	8.81^{cde}	16.20^{cd}	20.00^{b}	12.63^{j}	11.54^{g}	10.23^{f}	21.00^{bcde}	7.00^{c}
T_{10}	13.80^{de}	11.43^{bc}	8.99^{d}	9.11bcde	15.93^{cd}	20.95^{a}	13.39^{f}	10.27^{j}	11.21^{e}	21.40^{bc}	5.02^{d}
CD (P=0.05)	0.82	0.95	0.89	1.09	1.26	1.26	0.03	0.05	0.76	0.72	0.53
SE±(m)	0.31	0.27	0.20	0.28	0.39	0.42	0.30	0.42	0.50	0.24	0.47

straw mulch throughout the cropping period (Table 4). The plastic mulches positively influenced the soil temperature. These results were compatible with the results of Deshmukh *et al.* (2013), who reported that polythene mulch raised the soil temperature by 6º C at a depth of 5 cm and 4 ºC at a depth of 10 cm. The soil temperature in the mornings was at peak in black mulch at 10 cm depth, then at 5 cm depth, followed by the paddy straw treatment and then by un-mulched plots and vice-versa in the afternoon for black mulch, followed by un-mulched plots and paddy straw mulch. In gladiolus, mulching lowers the weeding cost and reduces the competition for essential nutrients, increasing the spike length and better corm production (Kumari *et al.*, 2013).

The use of mulch increased the soil temperature near the root zone, which resulted in faster utilization of the stored reserves from the corm and minerals from the soil, which might have led to early sprouting, bud initiation and flowering in transparent and white polythene. The paddy straw mulching at 10, 15 and 20 t/ha recorded the highest water moisture per cent, while the the hand-weeded plot showed high water control efficiency. The black polythene mulch (25µ) promoted plant growth in terms of plant height, spike length and duration of flowering and controlled weed growth with minimum weed count. It may be concluded that using black polythene (25µ) mulch in *Gladiolus hybridus* cv. Punjab Glance increased the spike length and number of florets per spike.

Acknowledgment

We extend our sincere gratitude to Punjab Agricultural University, Ludhiana, Punjab, India.

References

Anonymous. 2016-2017. Area and production of gladiolus in India.In: *India stat agriculture data*.

Baladha, R.F. 2018. *Effect of Drip Fertigation Schedule and Different Mulches on Gladiolus (Psittacinus hybrid*). M.Sc thesis, Junagadh Agricultural University, Gujarat, India.

Chander, A. and K.K. Dhatt, 2021. Mulching effect on weeds and corm production in *Gladiolus hortensis*. *Indian J. Weed. Sci*., 53(2): 198-201.

Deshmukh, Y.K., J. Sinha., G. Sinha and P.D. Verma, 2013. Effect of mulches and level of irrigation on soil temperature, soil moisture depletion and crop yield for bottle gourd. *Int. J. Appl. Eng. Technol*., 3: 29-35.

Dhatt, K.K. and T. Thakur, 2022. Effect of herbicides in managing weeds and on *Gladiolus hybridus* Hort. growth and flowering. *Indian J. Weed Sci*., 54(1):77-80.

Jat, N.R. 2017. *Effect of Fertigation, Spacing and Mulching on The Performance of Gladiolus (Gladiolus hybridus L.) Variety, American Beauty*, Ph.D .dissertation, Rajasthan Agriculture Research Institute, Jaipur, S.K.N Agriculture University, Jobner, Rajasthan.

Kumar, D., D. Chahal., A. Malik and D.S. Dahiya, 2020. Influence of various weed management practices on growth, flowering and corm production of Gladiolus cv. 'Nova Lux'. *Indian J. Pure Appl. Biosci*., 8(5): 364-376.

Kumari, V.R., P.D. Kumar., B. Arunkumar and M. Mahadevamma, 2013. Effect of plant density, planting methods and mulching on floral and cormal parameters in gladiolus (*Gladiolus hybridus* L.). *Asian J. Hortic*., 8: 391-98.

Mahawar, T.C., L.N. Mahawer, S.L. Mundara, R.H. Meena and H.L. Bairwa, 2020. Integrated weed management strategies on weed flora, vase life and economic parameters of Prajwal tuberose. *Indian J. Hortic.,* 77(4): 720.

Pooja, A., K. Swaroop., M.C. Singh., V. Hiremath and S. Nymagoud, 2022. Impact of fertigation and mulching on vegetative, flowering, yield and nutrient status of Gladiolus cv. Pusa Jyotsna. *Biol. Forum*, 14(4a): 91-97.

Rajablariani, H.R., F. Hasankhan and R. Rafezi, 2012. Effect of colored plastic mulches on yield of tomato and weed biomass. *Int. J. Environ. Sci. Dev*., 3: 590-93.

Rao, D.K., P.L. Kameswari., A. Girwani and T.B. Rani, 2014. Chemical weed management in gladiolus (*Gladiolus grandiflorus). Agric. Sci. Dig*., 34: 194-198.

Ravikumar, B and N. Seenivasan, 2019. Economics of cut gladiolus (*Gladiolus grandiflorus* L.) production with application biostimulants. *J. Pharmacogn. Phytochem*., 8(5): 1276-1279.

Ravikumar, B and N. Seenivasan, 2020. Effect of pre-harvest sprays of biostimulants on postharvest vase life of cut gladiolus cv. Arka Amar. *Bioscan*.,15(1): 015-018.

Salma, Z., K.S. Kumar and P.V. Ahalawat, 2016. Effect of mulching and irrigation methods on weed growth and soil moisture percentage in gladiolus. *Int. J. Agric. Sci*., 6(4): 75-80.

Singh, R.K., S.R.K. Singh and U.S, Gautam, 2013. Weed control efficiency of herbicides in irrigated wheat (*Triticum aestivum*). *Indian Res. J. Ext. Edu*., 13(1): 126-28.

Received: March, 2024; Accepted: April, 2024; Accepted: May, 2024