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Mulching effect on weeds and corm production in *Gladiolus hortensis*

Anish Chander* and K.K. Dhatt

Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana, Punjab141004, India

**Email: anish81995@gmail.com*

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ABSTRACT

The present experiment was conducted to study the effect of different mulching materials and herbicide application on weed growth parameters, weed control efficiency (WCE) and corm yield in gladiolus variety '*Punjab Glance*'. The experiment was laid out in a randomized block design with three replications each using polythene mulches of colours, *viz*. black 25µ, silver on black 25µ, transparent 25µ and white 50 µ along with rice straw mulch at concentrations of 1.0 kg, 1.5 kg and 2.0 kg/m^2 respectively. The predominant weeds observed were *Oenothera laciniata, Coronopus didymus* and *Poa annua* during November to March. The black and silver on black polythene mulch 25µ along with pendimethalin 0.5 kg/ha reported minimum total weed count, total weed fresh and dry weight. The hand-weeded plot showed maximum WCE (100%) followed by pendimethalin 0.5 kg/ha (99.9%) and similar results were recorded under black and silver on black polythene mulch 25µwith 99.8and 99.5% WCE respectively. The black polythene mulch 25µ best promoted plant growth in terms of corms per plant (1.8) cormels per plant (28.5) and corm weight (61.2 g). It suppressed the weeds efficiently with weed count of only ($2.3/m^2$) from November to March.

Gladiolus hortensis L. is an important bulbous cut flower. It is a native to South Africa's Cape region and is commercially well accepted because of its long spike that bears the florets and wide variation in colours. It is a herbaceous crop that has sword-like leaves. Gladiolus stands in the top few cut flower which has huge demand in the world flower market because of its varied colours, it is being used for bedding purposes, as cut flower, bouquet and pot plant. Weeds compete with the main crop for water, nutrients, space and light and also are alternate hosts to certain insect pests and pathogens. The practice of hand weeding is generally followed for Gladiolus cultivation, but it leads to additional cost. Hence it is necessary to adopt other methods for controlling weeds in this crop. Manual weeding can help us to attain better plant growth and yield but is laborious as well as time-consuming and further the adverse climate obstructs its physical application on the field. Herbicide is an easy option that is cheaper but its repetitive application develops resistance in weeds and also hinders crop growth (Sorkin 1981). Repeated emergence of weeds in the field can reduce the plant growth adversely by 50-100% (Jain *et al.* 2015). Therefore, an experiment was conducted with the objective to evaluate the effects of different mulching materials and herbicide applications on the weed growth and corm yield in Gladiolus.

This present study was carried out at Research Farm, Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana, Punjab, India during 2018-2019. The experiment was laid out in a randomized block design with three replications with ten treatments as presented in **Table 1**. The field was well prepared by ploughing and then planking to get a fine soil tilth. The polythene mulches were measured according to the plot and then laid onto the plots and subsequently, the corms were planted at a spacing of 30 x 20 cm. The rice straw was spread as per the treatments after 6-7 days of sowing. The observations on weed parameters in terms of total weed count, total weed dry weight and weed control efficiency for all the weed species recorded in the field, *viz. Oenothera laciniata, Coronopus didymus, Poa annua, Rumex dentatus, Chenopodium album, Cannabis sativus* and *Anagallis arvensis*. The weed density and weed dry weight for the most prominent weed species, *viz. Oenothera laciniata, Coronopus didymus* and *Poa annua* was calculated. Corm, cormels and corm weight per plant were recorded. The WCE was worked out using the formulae by (Singh *et al.*2013).

$$WCE = [(x - y) \div x] \times 100$$

where,

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

y = Dry matter of weeds in a treatment.

The comparison done was based upon 5 percent level of significance using (DMRT) Duncan Multiple Range Test. The software used was Statistical Analysis Software (SAS) University edition 15.1.

Effect on weeds

Total weed control was noticed in the hand-weeded plot. Minimum weed count was noticed with pendimethalin 0.5 kg/ha (1.7/m^2) which was at par with rice straw mulch 1.5 kg/m^2 (2/m^2), rice straw mulch 2.0 kg/m^2 (2.1/m^2), rice straw mulch 1.0 kg/m^2 (2.2/m^2), black polythene mulch 25µ (2.3/m^2) and silver on black polythene mulch 25µ (2.9/m^2) (**Table 1**). Minimum fresh (2.8 g/m^2) and dry weight (1.1 g/m^2) of weeds was noticed in pendimethalin 0.5 kg/ha which was at par with black polythene mulch 25µ (1.2 g and 3.1 g/m^2), rice straw mulch 1.5 kg/m^2 (1.4 g and 3.3 g/m^2), rice straw mulch 2 kg/m^2 (1.3 g and 3.4g/m^2) and silver on black polythene mulch 25µ (1.2 g and 3.7g/m^2).

Black and silver on black polythene mulch 25µ along with rice straw mulch 1.0, 1.5, 2.0 kg/m^2 and pendimethalin 0.5 kg/ha showed effective WCE of up to 99%. White polythene mulch 50µ showed lower WCE (61.1%) followed by transparent polythene mulch 25µ (58.9%) and lowest in weedy check plot (0%). The most reliable method for weed suppression was mulching that too especially for annual weeds and it also saves the labour costs as reported by Sethi (1966) in potato.

The plastic mulches are a good aid for reducing the evaporation and transpiration losses of water from the soil and to further restrict the growth of weed under it. The black polythene mulch in specific is very efficient in reducing the weed growth as firstly, it cuts the sunlight required by the weed seed to germinate, and secondly, if they germinate, they die from etiolation due to the absence of the photosynthetically active radiation required to perform photosynthesis. Similar results were recorded in Gladiolus by Salma *et al.* (2016) with the use of plastic mulches resulting in lower weed count, weed fresh and dry weight. Jeevan *et al.* (2016) reported weed dry weight of mere (1.0 g/m^2) by the use of black polythene mulch in tuberose.

The data pertaining to weed count (no./m^2) and dry weight g/m^2 of *Oenothera laciniata, Coronopus didymus* and *Poa annua* in Gladiolus as influenced by mulching and herbicide application are presented in **Table 2**. Total weed control was noticed in the hand-weeded plot throughout the five months. Minimum weed count reported in pendimethalin 0.5 kg/ha which was statistically at par with rice straw mulch 1.0, 1.5, 2.0 kg/m^2. Moreover, black and silver on black polythene mulch 25µ effectively controlled the major weed species throughout the trial. Transparent polythene mulch 25µ and white polythene mulch 50µ showed significantly higher weed count as compared to black and silver on black polythene mulch 25µ. Maximum weed count was recorded in weedy check plot which was significantly higher than the rest treatments throughout the trial.

Table 1. Effect of mulching and herbicide application on total weed count, weed fresh weight, weed dry weight and weed control efficiency (WCE) in Gladiolus

Treatment	Total weed count (no.m^2)	Total weed fresh weight (g/m^2)	Total weed dry weight (g/m^2)	WCE (%)
Black polythene mulch (25 µ)	2.3(13.6)	3.1(9.5)	1.3(0.9)	99.8
Transparent polythene mulch (25 µ)	29.0 (840.3)	29.5(873.3)	18.3(330.5)	58.9
Silver on black polythene mulch (25 µ)	2.9(23.2)	3.7(13.7)	1.2(0.5)	99.5
White polythene (50 µ)	27.8 (774.3)	29.0 (845.4)	18.1(338.1)	61.1
Rice straw mulch (1 kg/m^2)	2.2(13.3)	3.7(13.3)	1.7(2.1)	99.6
Rice straw mulch (1.5 kg/m^2)	2.0 (9.6)	3.3(10.3)	1.4(1.1)	99.8
Rice straw mulch (2 kg/m^2)	2.1(11.2)	3.4(11.8)	1.3(0.8)	99.8
Pendimethalin 0.5 kg/ha	1.7(6.2)	2.8(7.1)	1.1(0.3)	99.9
Hand weeded (fortnight intervals)	1.0 (0)	1.0 (0)	1.0 (0)	100
Weedy check	39.7(1580.1)	41.2(1702.1)	26.9(740.8)	0
LSD (p=0.05)	0.934	0.874	0.097	-

Data is subjected to square root transformation ($\sqrt{x+1}$). In Parentheses are the original values

In column, means that follows the common letter do not differ significantly in Duncan Multiple Range Test (DMRT) at 5% level.

WCE was calculated by simple formula mentioned in review of literature

Minimum weed dry weight was observed in black and silver on black polythene mulch 25µ closely followed by rice straw mulch 1.0, 1.5, 2.0 kg/m^2 and pendimethalin 0.5 kg/ha with a weed dry weight of around (1.0 g/m^2) throughout the trial as these treatments suppressed the weed growth of *Oenothera laciniata, Coronopus didymus* and *Poa annua.* Maximum number of weeds were noticed in weedy-check plot in November and in successive months up to March which was significantly higher than other treatments. Amongst the plastic mulches, transparent polythene mulch 25µ and white polythene mulch 50µ showed lesser ability to supress the weeds

The black mulch doesn't let the photo-synthetically active radiation to be transmitted through the sheet because they absorb most of it, restricting the germination of weeds. black polythene mulch efficiently suppressed the weed throughout the trial because of its ability to absorb most of the incident light and transmitting mere 0.5-1% light. The black and silver on black polythene mulches helped to reduce the dry weight of weeds by 95% and 98% respectively.The transmittance of 80-90% of visible light via the transparent polythene mulch must have triggered the maximum weed growth under it as reported by Rajablariani *et al.* (2012) in tomato. The

Table 2. Effect of mulching and herbicide application on weed growth of *Oenothera laciniata, Coronopus didymus* and *Poa annua* in Gladiolus

Treatment	Weed density/m^2					Weed dry weight g/m^2				
	Nov	Dec	Jan	Feb	Mar	Nov	Dec	Jan	Feb	Mar
Oenothera laciniata										
Black polythene mulch (25µ)	1.8(2.6)	1.2(0.6)	1.4(1.1)	1.5(1.3)	1.3(1)	1.0 (0.1)	1(0)	1(0)	1(0)	1(0)
Transparent polythene mulch (25µ)	8.7(74.9)	8.8(77)	9.7(94.8)	8.4(70.4)	8.1(64.8)	5.8(33.3)	6.2(38.7)	6.5(42.3)	5.9(34.3)	5.6(31.4)
Silver on black polythene mulch (25µ)	2.3(4.6)	2.1(4)	1.1(0.3)	1.3(1)	1.3(1)	1.1(0.2)	1.1(0.2)	1(0)	1(0)	1(0)
White polythene (50µ)	8.3(68.7)	8.4(70.3)	8.8(76.8)	8.4(69.7)	8.3(68.4)	5.5(29.6)	5.8(32.9)	6(36.3)	5.2(26.5)	5.9(34.2)
Rice straw mulch 1 kg/m^2	1.0(0)	1.0(0)	1.8(3)	1.7(2.6)	1.3(1)	1.0(0)	1.0(0)	1.0(0)	1.2(0.6)	1(0)
Rice straw mulch 1.5 kg/m^2	1.0(0)	1.0(0)	1.7(2.3)	1.6(2)	1.1(0.3)	1.0(0)	1.0(0)	1.0(0)	1.1(0.3)	1(0)
Rice straw mulch 2 kg/m^2	1.0(0)	1.0(0)	1.5(1.6)	1.1(0.3)	1.6(1.6)	1.0(0)	1.0(0)	1.0(0)	1.0(0)	1(0)
Pendimethalin 0.5 kg/ha	1.0(0)	1.0(0)	1.2(0.6)	1.2(0.6)	1.2(0.6)	1.0(0)	1.0(0)	1.0(0)	1.0(0)	1(0)
Hand weeded (fortnight intervals)	1.0(0)	1.0(0)	1(0)	1(0)	1(0)	1.0(0)	1.0(0)	1.0(0)	1.0(0)	1(0)
Weedy check	16(256)	16.5(273)	15.3(236)	14.2(203)	13.7(188)	11.8(139)	11.1(123)	10.9(119)	10(100.8)	13.7(188.8)
LSD (p=0.05)	0.467	0.582	0.695	0.788	0.508	0.223	0.442	0.405	0.572	0.327
Coronopus didymus										
Black polythene mulch (25µ)	1.2(0.6)	1.5(1.5)	1.1(0.3)	1.1(0.3)	1.1(0.3)	1.1(0.2)	1.2(0.5)	1(0)	1(0)	1(0)
Transparent polythene mulch (25µ)	11.1(126.9)	5.4(28.2)	3.9(15.7)	5.7(32.1)	5.7(32.1)	4.5(20.2)	3.9(15.2)	2.8(7.3)	4.2(17.4)	3.7(13.2)
Silver on black polythene mulch (25µ)	1.2(0.6)	1.1(0.3)	1.5(1.3)	1.4(1.3)	1.2(0.6)	1(0)	1(0)	1(0)	1(0)	1(0)
White polythene (50µ)	6.2(45.4)	5.3(35.2)	4.6(23.2)	5.6(32.3)	6.4(43.2)	3.9(15.2)	3.4(11.4)	3.2(10)	3.8(13.7)	4.3(18.1)
Rice straw mulch 1 kg/m^2	1.0(0)	1.0(0)	1.6(1.6)	1.7(2.6)	1.1(0.3)	1.0(0)	1.0(0)	1.0(0)	1.2(0.6)	1.1(0.2)
Rice straw mulch 1.5 kg/m^2	1.0(0)	1.0(0)	1.5(1.3)	1.4(1.3)	1.1(0.3)	1.0(0)	1.0(0)	1.0(0)	1.2(0.8)	1.0(0)
Rice straw mulch 2 kg/m^2	1.0(0)	1.0(0)	1.6(1.6)	1.1(0.3)	1.1(0.3)	1.0(0)	1.0(0)	1.0(0)	1.0(0.1)	1.0(0)
Pendimethalin 0.5 kg/ha	1.0(0)	1.0(0)	1.2(0.6)	1.2(0.6)	1.1(0.3)	1.0(0)	1.0(0)	1.0(0)	1.0(0)	1.0(0)
Hand weeded (fortnight intervals)	1.0(0)	1.0(0)	1(0)	1(0)	1(0)	1.0(0)	1.0(0)	1.0(0)	1.0(0)	1.0(0)
Weedy check	7.2(54.9)	4.5(20.9)	3.8(16.3)	4.3(19.7)	3.2(9.7)	5.4(28.5)	3.7(13.2)	2.8(7.6)	3.6(12.4)	2.5(5.5)
LSD (p=0.05)	2.431	2.062	1.729	1.349	1.246	0.586	0.613	0.652	0.698	0.367
Poa annua										
Black polythene mulch (25µ)	1.3(1)	1.5(1.3)	1.1(0.3)	1.1(0.3)	1.1(0.3)	1(0)	1(0)	1(0)	1(0)	1(0)
Transparent polythene mulch (25µ)	5.5(31.9)	5.5(37.6)	5.7(33.2)	7.4(55.2)	8(65.2)	3.1(9.2)	3.3(10.7)	3.6(12.1)	4.9(23.4)	5.1(26.3)
Silver on black polythene mulch (25µ)	1.7(2)	1.9(3)	1.2(0.6)	1.2(0.6)	1.6(1.6)	1(0)	1(0)	1(0)	1(0)	1.1(0.3)
White polythene (50µ)	4.2(19.4)	7.8(67.1)	5.9(35.9)	6.3(39.2)	8.9(78.8)	1.6(1.7)	5.6(35.2)	3.3(10.2)	4(15.3)	6.4(40.2)
Rice straw mulch 1 kg/m^2	1.0(0)	1.0(0)	1.2(0.6)	1.3(1)	1.1(0.3)	1.0(0)	1.0(0)	1.0(0)	1.1(0.3)	1(0)
Rice straw mulch 1.5 kg/m^2	1.0(0)	1.0(0)	1.5(1.3)	1.1(0.3)	1.1(0.3)	1.0(0)	1.0(0)	1.0(0)	1(0)	1(0)
Rice straw mulch 2 kg/m^2	1.0(0)	1.0(0)	1.8(2.3)	1.4(1.3)	1.6(1.6)	1.0(0)	1.0(0)	1.0(0)	1.2(0.6)	1.2(0.6)
Pendimethalin 0.5 kg/ha	1.0(0)	1.0(0)	1.2(0.6)	1.3(1)	1.3(1)	1.0(0)	1.0(0)	1.0(0)	1.1(0.3)	1.3(0.8)
Hand weeded (fortnight intervals)	1.0(0)	1.0(0)	1(0)	1(0)	1(0)	1.0(0)	1.0(0)	1.0(0)	1(0)	1(0)
Weedy check	6.2(45.3)	9.2(84.9)	7.7(60)	6.7(48.4)	7.4(61.1)	1.8(2.2)	6.1(37.2)	5(24.3)	3.9(14.8)	5.3(34.3)
LSD (p=0.05)	2.398	2.744	1.587	1.642	1.868	0.343	1.592	0.379	0.532	1.781

Data is subjected to square root transformation ($\sqrt{x+1}$) in parentheses are the original values

Table 3. Effect of mulching and herbicide application on corms per plant, corm weight per plant and cormels per plant in Gladiolus

Treatment	No. of corms/plant	Corm weight/plant (g)	Cormels/plant
Black polythene mulch 25 µ	1.8	61.2	28.5
Transparent polythene mulch 25 µ	1.7	59.2	27.8
Silver on black polythene mulch 25 µ	1.7	58.1	24.2
White polythene 50 µ	1.6	59.2	25.6
Rice straw mulch 1.0 kg/m^2	1.2	48.3	22.9
Rice straw mulch 1.5 kg/m^2	1.2	47.3	22.4
Rice straw mulch 2.0 kg/m^2	1.1	48	22.3
Pendimethalin 0.5 kg/ha	1.4	54	24.6
Hand weeded (fortnight intervals)	1.6	56.1	27.3
Weedy check	1.2	47	21.8
LSD (p=0.05)	0.245	3.497	3.497

black, silver on black and rice straw mulches were able to restrict the incident light hence were able to obstruct the weed germination in it on the other hand transparent and white plastic mulch by transmitting most of the incident light through it helped in weed seed germination.

Corm yield

Maximum number of corms/plant was noticed in the plot with black polythene mulch 25µ (1.8) so did the maximum number of cormels/plant (28.5) and the maximum corm weight (61.2 g) closely followed by transparent polythene mulch 25µ, silver on black polythene mulch 25µ and white polythene mulch 50µ (**Table 3**). All these treatments presented a non-significant difference for corm yield *viz.* corms per plant, corm weight and cormels per plant in Gladiolus. The plastic mulch treatments outperformed the rest treatments in accordance to corm yield. These results were in line with Kumari *et al* (2013) as the study reported the maximum number of corms produced were under the mulched plot and lesser number of corms produced in non-mulched plots in Gladiolus. These findings were in line with Baladha (2018) as the report exhibits that the corm yield was higher when harvested from the mulched plots. Jat (2017) reported maximum corm weight observed in the mulched plots than in the non-mulched plots in Gladiolus.

The mulch tends to provide optimum soil temperature for root growth and aggravates the soil microbial activity that leads to better uptake of nutrients and minerals form the soil by the plant. Mulching maintains adequate soil temperature regularly and prevents evaporation losses which helps the plant to efficiently perform photosynthesis which in turn helps maintaining a better accumulation of photosynthates. This may be the reason for good corm yield in the mulched plots for gladiolus as reported by Jat (2017).

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