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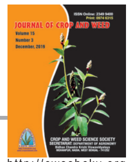

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Weed dynamics as influenced by drip irrigation and mulching in guava

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ABSTRACT

Weeds pose a serious menace in guava orchard, and substantially affect the quality and quantity of crop produce. A two-year field experiment was conducted to study the weed dynamics in guava orchard (VNR Bihi) as influenced by drip irrigation (DI_{50}, DI_{75} and DI_{100}) and mulching treatments (silver-black mulch, black mulch, organic mulch and non-mulch). The results indicated that maximum weed density and weed biomass was observed under DI_{100} and minimum was noted in DI_{50}. Mulches exerted significant influence on total weed density and biomass as compared with the unmulched plots. Silver-black and black mulches resulted in complete control of weeds during October and December in both the years. However, Cyperus could penetrate silver-black mulch during March. Moreover, minimum weed biomass was recorded with black mulch, followed by silver-black mulch while maximum weed biomass was found in unmulched plots. Thus, it might be inferred that the use of black mulch along with drip irrigation might help in weed management in guava orchard.

Keywords: Drip irrigation, guava, mulching and weed biomass

Bestowed with diverse soil and climatic conditions, all types of fruits are grown in India. Most of the current research works are directed towards different aspects of fruit production in the country. Despite the Golden Revolution in the country, the average productivity of fruit crops is far below than that in other countries. Many reasons can be attributed to low productivity. Among various biotic stresses, weeds pose a major hindrance in fruit production system, causing enormous losses to fruits by one or the other way (Sharma *et al*., 2017). Weeds compete with crop plants for nutrients, water, space, and sunlight, thereby inhibiting tree growth in young orchards and reducing quality of crop produce (Atay *et al*., 2017; Abbas *et al*., 2018). Weed pressure can reduce tree growth in most of the fruit cops to the extent of 15-96%, while yield losses can reach up to 35% because of the adverse impact on fruit quality in which the fruit excluded ratio reaches up to about 45% (Abouziena *et al*., 2016). In some cases, weeds growing around tree trunks become hosts for pests and pathogens that attack the trees (Shweta *et al*., 2018). The losses in fruit yield depend upon the nature of weed flora, weed density, type of fruit crop, prevailing season etc. (Futch *et al*., 2019). Therefore, the management of weeds in fruit crops is of utmost importance to prevent losses in yield and quality. Further, an integrated and environment-friendly approach is required to be standardized for weed management in different fruit crops (Abouziena *et al*., 2008).

Irrigation management is essential to develop a holistic system for weed management in crops. As water resources become costlier, drip irrigation technologies may be more widely utilized by growers worldwide. Although drip irrigation may be adopted due to water savings, the impact of drip irrigation on weed control is noteworthy. The ability to reduce soil wetting will allow for improved weed control over sprinkler and surface irrigation systems. In arid growing regions, the combination of plastic mulch and drip irrigation may provide an acceptable weed control without the use of herbicides.

Weeds in fruit production are primarily managed through herbicide use (Brar *et al*., 2017), which is most commonly followed in about 92% of orchards (Di Prima *et al*., 2018). Increasing pressure to reduce the use of chemical herbicides and growing interests for organic farming underline the importance of alternative approaches for orchard weed suppression (Goh *et al*., 2001). In recent years, non-chemical weed control methods are becoming more popular with the spread of organic and environment-friendly farming systems. Among different non-chemical methods of weed control, mulching is very effective and offers other benefits like conservation of soil moisture, increased soil organic matter, and improvement of soil structure and nutrient status (Downer, 2009). Plastic mulches reduce weed growth and improve yield and quality of crops (Liu *et*

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al., 2011). Organic waste materials such as cereal straw, weeds, aquatic weeds, manure, compost, bark, and composted municipal waste have effectively been used as mulch material to control weeds. Organic mulching can only be feasible if locally or on-site available material is used as mulch, considering the huge transportation costs of bulky organic material (Ames *et al*., 2004).

Guava (*Psidium guajava* L.) is the fifth most important fruit crop of India, occupying 2.65% of total area under fruit cultivation. Presently, India is producing 4.24 million ton (mt) of guava fruits from an area of 0.28 million hectares under plantation along with a national productivity of 15.3 t ha^{-1} (Anonymous, 2019). In Uttarakhand, guava occupies an area of about 4102 ha with a total production of 0.02 mt and productivity of 5.16 t ha^{-1} (Anonymous, 2018) which is much lower than that of other guava producing states and also the national average. Therefore, the present study was undertaken to evaluate the response of weed population and biomass to different drip irrigation and mulching treatments.

MATERIALS AND METHODS

Field experiments were conducted in a five-year old guava orchard at the Horticulture Research Centre of the G B Pant University of Agriculture and Technology in Uttarakhand, India in two consecutive years of 2019-20 and 2020-21. The experimental site was located in the foothills of the Shivalik range of the Himalayas (29.0° N latitude, and 79.5° E longitude with an altitude of 243.84 m above mean sea level. The climate of the experimental site has been categorized as sub-humid and sub-tropical climate with hot and dry summer and extreme cold winter. The mean annual rainfall of this region is 1450 mm, out of which 70% is received during rainy season (July-September). The total rainfall was 1296.6 and 1252.8 mm during the year of 2019-20 and 2020-21. The soil of the experimental site has been classified as Mollisol. The texture of the experimental soil was silty loam having neutral pH (7.1) and EC (0.38 ds m" 1) with medium organic carbon (0.67%), low available nitrogen (185.95 kg ha^{-1}), medium available phosphorus (28.92 kg ha^{-1}) and potassium (220.34 kg ha^{-1}). In the orchard, guava plants cv. VNR Bihi (wedge grafted) were planted at a spacing of 5 m × 3 m under medium high-density planting system. The plants were drip irrigated from initial year of planting.

The experiment was carried out under natural field conditions, considering two factors *viz.* drip irrigation and mulching. Three levels of drip irrigation regimes at 50% ETc (DI_{50}), 75% ETc (DI_{75}), and 100% ETc (DI_{100}), and four different mulching treatments *viz.* silver-black mulch (M_{SB}), black mulch (M_B), organic mulch (M_{OM}), and without mulch (M_{WM}) were assigned in a factorial randomized block design with three replications. Irrigation was applied through drip system mainly during fruit growth period. Water supply was stopped during monsoon season (July-September) due to adequate rainfall fulfilling the crop water need during this period. Polyethylene mulches of silver-black and black colour with 100 micron thickness and 1.2 m width were used as inorganic mulches, whereas 10 cm thick paddy straw was used as organic mulch as per treatment schedule. Under the same water deficit, different mulching treatments received the same irrigation amount.

The treatments were imposed in the month of September after cleaning the beds. The recommended dose of fertilizer at 375:325:250 g $N:P_2O_5:K_2O$ $tree^{-1}$ $year^{-1}$ was applied in both the years of study. Weed samples were collected and identified to record data on weed density and biomass. Weed density was recorded with the help of a quadrat (1 m × 1 m) placed randomly in between the two trees for each treatment. The weeds under each quadrat were identified, and also counted in the months of October, December and March during both the years. Counts were taken for grasses and sedges together and separately for broad-leaved weeds. The species-wise weed biomass was also recorded in the months of October, December and March by drying out the weeds in a hot air oven at 65 °C temperature. Weed biomass was expressed in g m^{-2}. Data on weed density and biomass were subjected to square root ($X = \sqrt{x+0.5}$) transformation for statistical analysis. Data were analyzed with R software using the package 'doebioresearch' (Popat and Banakara, 2020).

RESULTS AND DISCUSSION

Weed flora

A total of ten species including grasses, sedges and broad-leaved weeds were recorded in the guava orchard during the investigation period. These were *Digitaria sanguinalis, Dactyloctenium aegyptium, Cynodon dactylon* (grasses), *Cyperus rotundus* (sedges) and *Solanum nigrum, Stellaria media, Gnaphalium purpureum, Coronopus didymus, Mollugo stricta* and *Ageratum conyzoides* (broad-leaved).

Effect on weed density

The weed density was significantly influenced by irrigation regimes during both the years of experimentation (Table 1). Grasses (*Digitaria,* and *Dactyloctenium*) and the sedge (*Cyperus*) were found to be the predominant weeds in the month of October. Relatively more weed density was observed under drip irrigation at 100% ETc (8.50 and 11.00 m^{-2} in first and second year, respectively) in the same month. Broad-

Table 1: Weed density and biomass as affected by irrigation levels and mulching in guava orchard

Treatment	Weed density (no. m^{-2})						Weed biomass (g m^{-2})					
	October		December		March		October		December		March	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
Irrigation levels												
DI_{50}	6.50	8.50	20.75	22.75	34.50	37.00	4.58	5.56	8.68	10.59	23.00	25.59
	(1.82)	(2.00)	(3.19)	(3.26)	(5.23)	(5.48)	(1.61)	(1.72)	(2.20)	(2.36)	(4.54)	(4.82)
DI_{75}	7.25	10.00	23.00	24.50	39.75	41.50	4.63	6.23	10.79	12.81	27.50	30.11
	(1.89)	(2.12)	(3.46)	(3.49)	(5.75)	(5.83)	(1.62)	(1.79)	(2.47)	(2.68)	(5.01)	(5.24)
DI_{100}	8.50	11.00	26.50	28.50	53.25	56.75	4.64	6.25	15.62	16.93	33.55	35.81
	(2.00)	(2.20)	(3.80)	(3.85)	(7.04)	(7.22)	(1.62)	(1.79)	(2.95)	(3.07)	(5.56)	(5.75)
SEm±	0.013	0.009	0.023	0.011	0.022	0.047	0.010	0.007	0.018	0.022	0.046	0.029
LSD (0.05)	0.039	0.026	0.068	0.032	0.065	0.137	NS	0.020	0.052	0.064	0.135	0.085
Mulching												
Silver-black	0.00	0.00	0.00	0.00	21.67	24.00	0.00	0.00	0.00	0.00	14.90	15.54
	(0.71)	(0.71)	(0.71)	(0.71)	(4.62)	(4.88)	(0.71)	(0.71)	(0.71)	(0.71)	(3.90)	(3.99)
Black	0.00	0.00	0.00	0.00	15.67	17.67	0.00	0.00	0.00	0.00	12.93	14.52
	(0.71)	(0.71)	(0.71)	(0.71)	(3.90)	(4.17)	(0.71)	(0.71)	(0.71)	(0.71)	(3.65)	(3.86)
Organic	0.00	0.00	12.00	10.00	28.00	25.67	0.00	0.00	5.13	5.97	21.79	25.10
	(0.71)	(0.71)	(3.45)	(3.16)	(5.26)	(5.03)	(0.71)	(0.71)	(2.31)	(2.46)	(4.68)	(5.04)
No mulch	29.67	39.33	81.67	91.00	104.67	113.00	18.45	24.06	41.64	47.79	62.44	66.85
	(5.48)	(6.30)	(9.06)	(9.56)	(10.25)	(10.64)	(4.35)	(4.95)	(6.46)	(6.93)	(7.92)	(8.20)
SEm(±)	0.015	0.010	0.027	0.013	0.026	0.054	0.011	0.008	0.021	0.025	0.053	0.034
LSD (0.05)	0.045	0.030	0.079	0.037	0.075	0.158	0.034	0.023	0.061	0.074	0.155	0.099
Interaction (DI×M)												
SEm(±)	0.027	0.018	0.046	0.022	0.045	0.093	0.020	0.014	0.036	0.044	0.092	0.058
LSD (0.05)	0.078	0.053	0.136	0.064	0.130	0.273	NS	0.040	0.105	0.128	0.269	0.171

** Data in parentheses were square root transformed. DI: Drip irrigation, NS: Not significant*

Table 2: Weed biomass of different species as affected by irrigation levels and mulching in guava orchard during October

Treatment	Weed biomass (g m^{-2})									
	Grasses and sedges						Broad-leaved			
	Digitaria sanguinalis		*Dactyloctenium aegyptium*		*Cyperus rotundus*		*Mollugo stricta*		*Ageratum conyzoides*	
	2019-20	**2020-21**	**2019-20**	**2020-21**	**2019-20**	**2020-21**	**2019-20**	**2020-21**	**2019-20**	**2020-21**
Irrigation levels										
DI_{50}	1.33(1.13)	2.36(1.32)	2.82(1.39)	2.69(1.37)	0.00(0.71)	0.18(0.81)	0.43(0.90)	0.00(0.71)	0.00(0.71)	0.34(0.87)
DI_{75}	1.30(1.13)	2.65(1.36)	2.71(1.37)	2.89(1.40)	0.00(0.71)	0.22(0.82)	0.62(0.96)	0.00(0.71)	0.00(0.71)	0.48(0.92)
DI_{100}	2.39(1.32)	3.11(1.43)	1.86(1.23)	2.50(1.34)	0.16(0.80)	0.25(0.83)	0.23(0.83)	0.00(0.71)	0.00(0.71)	0.40(0.89)
SEm(±)	0.007	0.006	0.007	0.003	0.001	0.001	0.002	0.00	0.00	0.002
LSD (0.05)	0.020	0.017	0.020	0.009	0.002	0.003	0.006	NS	NS	0.007
Mulching										
Silver-black	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
Black	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
Organic	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
No mulch	6.70(2.66)	10.82(3.36)	9.84(3.20)	10.76(3.35)	0.21(0.83)	0.86(1.16)	1.71(1.47)	0.00(0.71)	0.00(0.71)	1.62(1.46)
SEm(±)	0.008	0.007	0.008	0.003	0.001	0.001	0.002	0.000	0.00	0.003
LSD (0.05)	0.023	0.019	0.023	0.010	0.003	0.004	0.007	NS	NS	0.008

** Data in parentheses were square root transformed. DI: Drip irrigation, NS: Not significant*

Table 3: Weed biomass of different species as affected by irrigation levels and mulching in guava orchard during December

Treatment	Weed biomass (g m^{-2})													
	Grasses and sedges						Grasses and sedges							
	Digitaria sanguinalis		*Digitaria sanguinalis*		*Digitaria sanguinalis*		*Digitaria sanguinalis*		*Digitaria sanguinalis*		*Digitaria sanguinalis*		*Digitaria sanguinalis*	
	2019-20	**2019-20**	**2019-20**	**2019-20**	**2019-20**	**2019-20**	**2019-20**	**2019-20**	**2019-20**	**2019-20**	**2019-20**	**2019-20**	**2019-20**	**2019-20**
Irrigation levels														
DI_{50}	0.66	1.16	0.00	0.00	0.14	0.00	0.59	0.59	0.57	1.89	5.61	4.84	1.11	2.11
	(0.97)	(1.10)	(0.71)	(0.71)	(0.79)	(0.71)	(0.95)	(0.95)	(0.95)	(1.37)	(1.73)	(1.64)	(1.09)	(1.28)
DI_{75}	1.33	2.04	0.00	0.00	0.15	0.25	1.18	2.10	1.11	0.57	4.86	5.53	2.17	2.33
	(1.13)	(1.36)	(0.71)	(0.71)	(0.79)	(0.83)	(1.10)	(1.42)	(1.09)	(0.95)	(1.65)	(1.72)	(1.29)	(1.31)
DI_{100}	1.86	2.88	0.00	0.00	0.20	0.31	2.58	2.73	2.40	1.14	5.89	6.96	2.68	2.91
	(1.24)	(1.57)	(0.71)	(0.71)	(0.82)	(0.86)	(1.51)	(1.53)	(1.50)	(1.09)	(1.76)	(1.86)	(1.37)	(1.40)
SEm(±)	0.006	0.004	0.000	0.000	0.001	0.001	0.004	0.007	0.005	0.006	0.014	0.011	0.007	0.005
LSD (0.05)	0.017	0.013	NS	NS	0.003	0.003	0.011	0.022	0.013	0.017	0.040	0.033	0.020	0.016
Mulching														
Silver-black	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)
Black	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)
Organic	0.00	1.32	0.00	0.00	0.00	0.00	0.88	1.63	4.25	3.02	0.00	0.00	0.00	0.00
	(0.71)	(1.27)	(0.71)	(0.71)	(0.71)	(0.71)	(1.06)	(1.38)	(2.15)	(1.86)	(0.71)	(0.71)	(0.71)	(0.71)
No mulch	5.13	6.79	0.00	0.00	0.65	0.74	4.92	5.58	1.19	1.77	21.81	23.11	7.94	9.80
	(2.33)	(2.68)	(0.71)	(0.71)	(1.07)	(1.08)	(2.28)	(2.41)	(1.14)	(1.28)	(4.72)	(4.84)	(2.87)	(3.20)
SEm(±)	0.007	0.005	0.000	0.000	0.001	0.001	0.004	0.008	0.005	0.007	0.016	0.013	0.008	0.006
LSD (0.05)	0.020	0.015	NS	NS	0.003	0.004	0.012	0.025	0.015	0.020	0.046	0.038	0.024	0.018

** Data in parentheses were square root transformed. DI: Drip irrigation, NS: Not significant*

Table 4: Weed biomass of different species as affected by irrigation levels and mulching in guava orchard during March

Treatment	Weed biomass (g m^{-2})							
	Grasses and sedges				Broad-leaved			
	Digitaria sanguinalis		*Cyperus rotundus*		*Solanum nigrum*		*Gnaphalium purpureum*	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
Irrigation levels								
DI_{50}	4.82 (1.96)	3.67 (1.71)	0.60 (0.96)	0.82 (1.02)	1.94 (1.42)	2.81 (1.73)	15.65 (3.87)	18.29 (4.17)
DI_{75}	5.16 (2.21)	4.52 (1.91)	1.14 (1.11)	1.18 (1.13)	3.29 (1.79)	3.99 (1.94)	17.91 (4.11)	20.42 (4.43)
DI_{100}	6.41 (2.42)	5.67 (2.21)	1.15 (1.09)	1.45 (1.27)	3.81 (1.90)	3.90 (1.93)	22.18 (4.62)	24.79 (4.89)
SEm(±)	**0.011**	**0.007**	**0.003**	**0.005**	**0.006**	**0.007**	**0.029**	**0.028**
LSD (0.05)	**0.032**	**0.022**	**0.010**	**0.014**	**0.017**	**0.021**	**0.084**	**0.083**
Mulching								
Silver-black	1.35 (1.29)	0.27 (0.85)	0.00 (0.71)	0.21 (0.83)	2.11 (1.59)	1.85 (1.51)	11.44 (3.45)	13.20 (3.69)
Black	0.97 (1.21)	0.45 (0.96)	0.07 (0.75)	0.28 (0.87)	0.00 (0.71)	0.58 (1.01)	11.88 (3.51)	13.21 (3.69)
Organic	6.10 (2.56)	5.00 (2.33)	0.00 (0.71)	0.00 (0.71)	2.61 (1.73)	3.39 (1.97)	13.09 (3.65)	16.71 (4.13)
No mulch	13.43 (3.73)	12.76 (3.64)	3.77 (2.05)	4.11 (2.14)	7.33 (2.79)	8.45 (2.98)	37.91 (6.19)	41.53 (6.48)
SEm(±)	**0.013**	**0.009**	**0.004**	**0.005**	**0.007**	**0.008**	**0.033**	**0.033**
LSD (0.05)	**0.037**	**0.025**	**0.012**	**0.016**	**0.020**	**0.024**	**0.097**	**0.096**

** Data in parentheses were square root transformed. DI: Drip irrigation, NS: Not significant*

leaved weeds were found dominant in the months of December and March. The data also revealed that the weed density was higher under drip irrigation at 100% ETc and the lowest under drip irrigation at 50% ETc in the months of December and March during both the years of study.

Different types of mulches (silver-black, black and organic) significantly reduced the weed density as compared to the unmulched treatment in both the years (Table 1). No weed species were recorded under silver-black and black mulches in the months of October and December. Considerable weed density was recorded under the unmulched plots in the month of October (29.67 and 39.33 m^{-2} in first and second year, respectively), and continued to significantly multiply in the month of December (81.67 and 91.00 m^{-2} in first and second year, respectively) while low weed density was recorded under paddy straw mulch (12.00 and 10.00 m^{-2} in first and second year, respectively). Sufficient depths of organic mulches proved to be effective in controlling weeds by reducing photosynthesis (Thakur *et al.*, 2012; Mohanty *et al.*, 2002). Furthermore, maximum weed density was recorded under unmulched plots in the month of March (104.67 and 113.00 m^{-2} in first and second year, respectively), followed by paddy straw mulch (28.00 and 25.67 m^{-2} in first and second year, respectively) whilst the lowest weed density was recorded under black mulch (15.67 and 17.67 m^{-2} in first and second year, respectively). Mulches made of plastics and organic materials could inhibit the emergence of weeds by restricting light, thereby suppressing their growth. Silver-black and black polyethylene mulches could provide high weed control efficiency by restricting water penetration as well as light penetration on the soil surface (Brar *et al.*, 2020). There was a reduction in weed density with the use of black plastic and grass mulches in drip-irrigated Nagpur mandarin (Shirgure *et al.*, 2003). Kaur and Kaundal (2009) also reported effectiveness of black plastic mulch in controlling weed species like *Cynodon, Cyperus* and *Sorghum halepense* in Japanese plum as it could act as a physical barrier on the soil surface, which might create partially anaerobic conditions for the survival of weed species.

Effect on weed biomass

Total weed biomass as recorded in the months of October, December and March was significantly influenced by irrigation regimes during both the years of experimentation (Table 1). Pooled data indicated the highest total weed biomass (5.44 g m^{-2}) under drip irrigation at 100% ETc and the lowest (5.07 g m^{-2}) under drip irrigation at 50% ETc in the month of October. Similar trend was found in the months of December and March, being maximum in drip irrigation at 100% ETc and minimum in drip irrigation at 50% ETc.

Mulches exerted significant influence on total weed biomass as compared to the unmulched plots in both the years (Table 1). Silver-black and black mulches resulted in complete reduction of total weed biomass during October and December in both the years whereas comparatively less weed biomass (5.13 and 5.97 g m^{-2} in first and second year, respectively) was observed under paddy straw mulch during December. During March, minimum weed biomass (13.72 g m^{-2}) was recorded with black mulch, followed by silver-black mulch (15.22 g m^{-2}) while maximum weed biomass (64.65 g m^{-2}) was found in unmulched plots on the basis of pooled data. Bons *et al*. (2018) reported the best weed control with the use of polyethylene mulches (black and silver-black), followed by paddy straw during each phase of the growth cycle in the Kinnow mandarin plants. In guava orchard, rice straw mulch significantly reduced the biomass of weeds (Brar *et al.*, 2017). Application of rice straw mulch controlled weeds in papaya fields by 85-98% (Hassan and El-Shammaa, 2001) and in olive groves by 89-95% (Huqi *et al*., 2009).

Different mulches significantly reduced the biomass of all the weed species as compared to unmulched plots during both the years (Table 1). Silver-black, black and paddy straw mulches resulted in complete control of *Digitaria, Cyperus, Dactyloctenium, Mollugo, Ageratum, Solanum nigrum, Stellaria* and *Gnaphalium* weeds during October and December in both the years (Table 2, 3 and 4). Use of paddy straw mulch exhibited a record of biomass of certain weed species (0.88 and 1.63 g m^{-2} for *Solanum nigrum*, and 4.25 and 3.02 g m^{-2} for *Stellaria* in first and second year, respectively) during December. Polyethylene mulches with black or silver-black surface characteristics might be highly effective due to their inability to penetrate photosynthetically active radiation (PAR) (Mohanty *et al*., 2002).

All types of mulches (silver-black, black and paddy straw) were effective in managing the biomass of *Digitaria, Cyperus, Solanum nigrum* and *Gnaphalium* as compared to unmulch condition in the month of March. However, *Cyperus* was found to emerge out of silver-black mulch during March. Brar *et al*. (2017) reported that nutsedge grass (*Cyperus*) emerged under plastic mulch in guava, thereby facilitating light penetration and encouraging germination of other weeds. Minimum biomass of *Digitaria* (0.97 and 0.45 g m^{-2} in first and second year, respectively) and *Cyperus* (0.07 and 0.28 g m^{-2} in first and second year, respectively) were recorded under black mulch during March (Table 4). Among broadleaved weeds, *Solanum* and *Gnaphalium* were mainly observed in all the treatments during March. However, maximum biomass of *Solanum* (0.00 and 0.58 g m^{-2} in first and second year, respectively) was observed under black mulch, and of *Gnaphalium* (11.44 and 13.20 g m^{-2} in first and second year, respectively) under silver-black mulch. Thakur *et al*. (2012) reported weed control efficiency upto 98.5% under black polyethylene mulch in peach. Similarly, Shirgure *et al*. (2003) demonstrated better weed control with the use of polyethylene mulch and grass mulch in drip-irrigated Nagpur mandarins.

CONCLUSION

The study revealed that efficacy of black and silver-black mulches was superior to all other treatments in terms of weed density and weed biomass. Keeping in view of weed control efficacy, use of black and silver-black mulches can be used as an effective chemical free alternative tool for weed management in guava orchard under drip irrigation system.

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