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Effect of integrated weed management on weed dynamics in rose

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Abstract

An experiment was directed to assess the effect of integrated weed management practices on weed density and dry biomass in rose *cv.* Gruss-en-Tepltiz by using treatments paddy straw mulch 0.6 kg/m^2, paddy straw mulch 1.2 kg/m^2, oxyfluorfen 0.025 g/m^2, oxyfluorfen 0.025 g/m^2 + paddy straw mulch 0.6 kg/m^2, oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2, hand weeding (at monthly interval) and unweeded control. The least value of weed count of diverse species was recorded in hand weeding closely followed by oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2. Dry biomass of weeds and weed control efficiency was also marked to be lowest in hand weeding followed by oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2. Since hand weeding is costly, tedious, laborious, and if not done legitimately, harms the plant and root system, the result of the study advocated using oxyfluorfen in combination with paddy straw mulch at a rate of 1.2 kg/m^2 for effectively reducing weed growth.

Key words: Hand weeding, oxyfluorfen, paddy straw mulch, rose, weeds

Introduction

Flowers have become an indispensable part of life over years, and are associated with all phases of life, ideally from birth till death. Rose has grown as the most admired object on this planet of our own. Rose (*Rosa* spp.) is widely accepted as "Queen of flowers", and has a place in the family of Rosaceae. Rose holds the first position in the international flower trade, much grown as a cut flower for decorative purposes and different improvements *viz.*, bouquets, buttonholes, corsages, and potpourri. Roses make prime constituent in the making of commercial products *viz.*, rose water, gulroghan, pankuri, rose oils, attars, and gulkhand (Leghari *et al.,* 2016).

Weeds are the main cause of restraints in the commercial cultivation of roses, as they hamper their growth since they are planted by row or double-row method resulting in vacant spaces next to the rows and between rows that favors the weeds to grow. Weeds cause harm to plants by removing nutrients that showed a great impact on the availability of nutrients to the crop, other than filling in as substitute hosts to several insect pests and pathogens (Hussain *et al*., 2020). The reduction in quality and yields of rose flowers and increase in expenses of production are supremely caused by weeds (Calado *et al.,* 2010).

Hand weeding is widely used to keep rose plants free from weeds. Alternatively, some of the synthetic chemicals, called herbicides and mulching material could be used. Herbicides act by inhibiting various physicochemical reactions *viz.*, cell division, photosynthesis, biosynthesis of amino acids and carotenoids in weeds (Smith, 2015). Control of dicot and monocot weed can be better accomplished with oxyfluorfen 0.5 kg/ha and glyphosate 1.0 kg/ha in rose (Mukherjee, 2008; De, 2014). Oxyfluorfen 0.25 kg/ha + 0.25 kg/ha lowered dry weight accumulation in weeds and their intensity which was closely followed by Oxyfluorfen 0.50 kg/ha (Chahal *et al.,* 2013). Mulching has the effect of forcing weeds to deplete root reserves by (a) preventing them from photosynthesizing and replenishing root reserves or (b) killing rhizomes through desiccation or frost exposure. Mulching maintains soil temperature, eliminates weeds, provides humus-making material to growing plants, and increases microbial activity in soil by improving the microclimate (Siczek and Frac, 2012). Mulching with the straw, leaf manure, lawn clippings, and farmyard manure with the thickness of 5 to 8 cm is desired in a rose for effective control of weeds (De, 2014). Rice straw mulch, applied at a rate of 8 t/ha was quite effective in controlling *Brachiaria decumbens* and *Amaranthus viridis* (Pivetta *et al*., 2013). Moreover, hand weeding is not productive in rose, as it may harm the rooted stem cuttings. The information about using paddy straw mulch and herbicides in combination or alone in rose is lacking under Punjab conditions. So there is a need to identify different mulches and more herbicides in roses that will be valuable for weed control and quality production of flowers. Thus, the present study was carried out to study the effect of different practices of floor management on weeds in rose.

Material and methods

Location of the experimental site: Punjab has a subtropical climate with hot, dry winds in May and June and intermittent ground frost in the stretches of December and January during winters. Mean monthly maximum and minimum temperature were of range 20 to 39.7 ^{o}C and 5.8-27.3 ^{o}C, respectively. The research field of rose was located in Punjab Agricultural University, Ludhiana, Punjab about 245 above mean sea level and lie in 75 54' East Longitude and 33 55' North Latitude. The texture of soil was typically sandy loam which contained 83% sand, 10% silt, and 7% clay, subnormal water holding capacity, and medium fertility.

Experiment description: The experiment was performed on Rosa *cv.* Gruss-en-Tepltiz, where six-month-old plants prepared through cuttings were transplanted in the first week of March by the double-row method. The experimental field was divided into 21 blocks of about 4.5 × 1.2 m, by leaving a working space of 1.5 m. The spacing between rows and plants was kept as 60 cm and 75 cm, respectively. Treatments included paddy straw mulch 0.6 kg/m^2, paddy straw mulch 1.2 kg/m^2, oxyfluorfen 0.025 g/m^2, oxyfluorfen 0.025 g/m^2 followed by paddy straw mulch 0.6 kg/m^2, oxyfluorfen 0.025 g/m^2 followed by paddy straw mulch 1.2 kg/m^2, hand weeding (at monthly interval) and unweeded control applied by using randomized complete block design and three replications were maintained for each treatment. Application of paddy straw mulch, at the rate of 0.6 kg/m^2 and 1.2 kg/m^2 and oxyfluorfen as pre-emergence herbicides by using a knapsack sprayer with the flat fan type nozzle was done during the first week of March, when the research work was started and the first week of September after giving general hoeing to the entire field. Weeding in hand weeding was done at 30 days intervals throughout the investigation period.

Data collection- The weeds that appeared in the experimental plot were collected by using quadrat sizing, 25 x 25 cm. Collected weeds were then classified species-wise as broadleaves weeds, sedges, and grasses for determining their weed density and dry biomass of weeds, respectively. The data was taken at an interval of 90 days after treatments were applied. Weed control efficiency was calculated for checking the relative effectiveness of weed control methods by using the following formula:

$$WCE (\%) = [(DWC-DWT)/ DWC] \times 100$$

Where, WCE = Weed control efficiency. DWC = Dry weight of weeds from the control plot. DWT = Dry weight of weeds from the treated plot

Data analysis: The data recorded under study were subjected to analysis of variance (ANOVA) using the PROC MIXED procedure in SAS version 9.3 (SAS, 2011). Weed density and dry biomass data were square-root transformed prior to analysis. Means of significant treatment were separated with Duncan's Multiple Range Test (DMRT) at P=0.05.

Result and discussion

Weed flora: The predominant weed flora in the rose field was identified and grouped as broad leaves weeds, sedges, and grasses. The major predominant weed population consisted of *Amaranthus viridis, Anagallis arvensis, Cannabis sativa, Chenopodium album, Cyperus rotundus, Dactyloctenium aegyptium, Digitaria sanguinalis, Eleusine indica, Euphorbia microphylla, Eragrostis tenella, Medicago denticulata, Melilotus indica, Oxalis martiana, Phyllanthus niruri, Parthenium hysterophorus, Sorghum halepense,* and *Trianthema portulacastrum* were identified in the experimental field. The existence of identical weeds in the rose field was also reported earlier (Kumar and Singh, 2013; Singh *et al*., 2019).

Weed density: Weed density of different species was significantly affected by different weed management treatments (Table 1). The lowest count of *Cyperus rotundus,* after 90 and 180 days of treatment, was obtained in hand weeding followed by oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2 as compared to other treatments. The highest weed population was recorded under unweeded control. Similarly, oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2 treatment significantly reduced the density of *Euphorbia hirta, Dactyloctenium aegyptium, Digitaria sanguinalis, and Eleusine indica,* at 90 and 180 days of treatment, after hand weeding. All the other treatments were statistically equal in weed count except unweeded control that was recorded with the highest weed count of *Euphorbia hirta, Dactyloctenium aegyptium, Digitaria sanguinalis, and Eleusine indica*. Hand weeding and oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2 were significantly superior to unweeded control in reducing the count of *Anagallis arvensis*. The density of *Oxalis martiana* was significantly controlled in hand weeding and oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2 at 90 days after treatment, where it was recorded to be highest in unweeded control. *Oxalis martiana* was effectively suppressed in hand weeding and oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2, at 180 days of treatment, as compared to unweeded control. The lowest weed population in hand weeding was ascribed to frequent weeding in this treatment. The lesser weed population under mulching treatments along with herbicides may be due to the absence of sunlight combined with the physical

Table 1. Effect of integrated weed management in rose on weed density (species-wise)

Treatment	*Cyperus rotundus*		*Euphorbia hirta*		*Digitaria sangunalis*		*Eleusine indica*		*Dactyloceptium aegytopium*		*Anagallis arvensis*		*Oxalis martiana*	
	90	180	90	180	90	180	90	180	90	180	90	180	90	180
Paddy straw mulch 0.6kg/m^2	12.87^{a} (165)	15.69^{a} (245)	3.75^{ab} (13)	4.58^{a} (21)	1.67^{a} (3)	2.71^{a} (8)	2.33^{ab} (5)	3.75^{a} (13)	1.67^{a} (3)	2.33^{bc} (5)	3.67^{ab} (13)	5.20^{a} (27)	5.42^{a} (29)	6.81^{b} (37)
Paddy straw mulch 1.2kg/m^2	11.93^{ab} (141)	15.33^{ab} (235)	3.37^{ab} (11)	4.41^{ab} (19)	1.00^{a} (0)	2.33^{a} (5)	1.00^{c} (0)	2.71^{ab} (8)	1.00^{a} (0)	2.33^{bc} (5)	3.37^{abc} (11)	4.71^{ab} (21)	4.71^{a} (21)	5.25^{c} (27)
Oxyfluorfen 0.025g/m^2	12.89^{a} (165)	16.11^{a} (259)	3.37^{ab} (11)	4.71^{a} (21)	1.67^{a} (3)	2.71^{a} (8)	1.67^{bc} (3)	3.75^{a} (13)	1.67^{a} (3)	3.00^{ab} (8)	3.37^{abc} (11)	5.50^{a} (29)	5.25^{a} (27)	5.92^{c} (35)
Oxyfluorfen 0.025g/m^2+ Paddy straw mulch 0.6kg/m^2	10.71^{bc} (115)	14.89^{ab} (221)	2.71^{a} (8)	4.04^{ab} (16)	1.67^{a} (3)	2.33^{a} (5)	1.00^{c} (0)	3.37^{b} (11)	1.67^{a} (3)	2.33^{bc} (5)	3.00^{bcd} (8)	4.71^{ab} (21)	4.41^{b} (19)	4.96^{c} (24)
Oxyfluorfen 0.025g/m^2+ Paddy straw mulch 1.2kg/m^2	10.23^{cd} (104)	14.24^{b} (203)	2.33^{ab} (5)	3.37^{ab} (11)	1.00^{a} (0)	1.67^{a} (3)	1.00^{a} (0)	2.33^{ab} (5)	1.00^{a} (0)	1.67^{bc} (3)	1.67^{cd} (3)	3.37^{bc} (11)	1.67^{b} (3)	4.29^{c} (19)
Hand weeding (At monthly interval)	8.83^{d} (77)	9.43^{d} (88)	1.67^{b} (3)	2.33^{b} (50)	1.00^{a} (0)	1.00^{a} (0)	1.00^{a} (0)	1.67^{b} (3)	1.00^{a} (0)	1.00^{c} (0)	1.00^{d} (0)	1.67^{c} (2)	2.33^{b} (5)	2.71^{d} (8)
Unweeded control	11.23^{bc} (125)	12.13^{c} (147)	4.04^{a} (16)	4.41^{ab} (18)	2.33^{a} (5)	3.00^{a} (11)	3.00^{a} (8)	3.37^{b} (11)	2.33^{a} (5)	3.37^{a} (11)	4.41^{a} (19)	5.72^{a} (32)	5.72^{a} (32)	6.98^{a} (48)

* In a column, means followed by common letters do not differ significantly at the 5 % level by Duncan's Multiple RangeTest
* Data were subjected to square root transformation $\sqrt{x}+1$. Parentheses are original values.

barrier provided by paddy straw mulch to the growing weeds and herbicides activity in suppressing weed growth includes starvation of the weeds due to lack of photosynthesis, formation of secondary phytotoxic substances, alteration in protective carotenoids related reaction and involvement of photo-oxidative pigments (Kaur *et al.,* 2008; Kumar and Gowda, 2010; Bhullar *et al*., 2015; Kaur *et al.,* 2016). Lower population of *Cyperus rotundus* in unweeded control than oxyfluorfen 0.025 g/m^2 was because the higher population of broadleaves weeds and grasses did not allow it to prosper (Kaur *et al.,* 2008).

Dry biomass of weeds: All weed control treatments resulted in significant variation in weed's dry weight (Table 2). The results indicated that after 90 and 120 days of treatment, hand-weeding significantly lowered dry biomass of broad-leaved weeds (2.52 g/m^2 and 6.41 g/m^2) in the summer season, followed by oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2 (5.68 g/m^2 and 9.98 g/m^2, respectively). The highest dry weight of broad-leaved weeds, at 90 and 180 days of treatment, was recorded under unweeded control (11.22 g/m^2 and 14.95g/m^2, respectively). In the winter season, hand weeding was recorded for the lowest dry biomass of weeds (2.42 g/m^2 and 4.85 g/m^2) followed by oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2 (2.69 g/m^2 and 8.77 g/m^2). But it was recorded to be highest (9.51 g/m^2 and 11.48 g/m^2) with unweeded control. Hand weeding reduced dry biomass of sedges (3.31 g/m^2 and 3.71 g/m^2), at 90 and 180 days after treatments, in the summer season, and was at par with oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2 (4.70 g/m^2 and 8.65 g/m^2). The dry biomass of sedges was recorded highest (9.66 g/m^2 and 10.13 g/m^2) with unweeded control. Similarly, hand weeding was recorded with the lowest dry biomass of sedges (2.48 g/m^2 and 2.32 g/m^2) followed by oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2 (4.06 g/m^2 and 4.71 g/m^2), whereas the maximum was recorded under unweeded control (7.28 g/m^2 and 7.89 g/m^2, respectively), in the winter season. In the case of grasses (Table 2), the lowest dry biomass was recorded in hand weeding (2.21 g/m^2) followed by oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2 (3.24 g/m^2), at 90 days after treatment, in the summer season. The lowest dry biomass was obtained, at 180 days of treatment, in hand weeding (3.73 g/m^2) followed by oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2 (6.39 g/m^2). Dry biomass of grasses, at 90 and 180 days of treatment, was recorded to be highest (7.98 g/m^2 and 10.99 g/m^2) with unweeded control. Periodical removal of weeds by to hand-weeding, and poor germination of weed seeds, anaerobic conditions and hindered photosynthetic activity in oxyfluorfen followed by paddy straw mulch resulted in lower weed count and dry biomass of weeds (Kaur *et al.,* 2008; Kumar and Gowda, 2010; Bhullar *et al*., 2015; Kaur *et al.,* 2016).

Weed control efficiency: The weed control efficiency was significantly influenced by treatments (Table 3). Among different treatments, hand weeding showed the highest weed control efficiency followed by oxyfluorfen 0.025 g/m^2 + paddy straw mulch 1.2 kg/m^2 and oxyfluorfen 0.025 g/m^2 + paddy straw mulch 0.6 kg/m^2. The highest weed control efficiency was obtained, at

Table 2. Effect of integrated weed management in rose on dry biomass of broad leaf, sedges and grassy weeds.

Treatment	90 DAT					180 DAT				
	Summer			Winter		Summer			Winter	
	Broad-leaved	Sedges	Grasses	Broad-leaved	Sedges	Broad-leaved	Sedges	Grasses	Broad-leaved	Sedges
Paddy straw mulch 0.6kg/m^2	9.09^b (82)	8.78^a (76)	6.03^{bc} (35)	8.74^b (75)	5.22^c (26)	11.07^c (122)	10.25^{ab} (104)	9.23^b (84)	10.53^b (110)	6.05^c (36)
Paddy straw mulch 1.2kg/m^2	7.93^c (62)	7.23^b (52)	5.38^{cd} (28)	7.13^c (50)	4.66^{cd} (21)	10.66^d (113)	9.66^{ab} (93)	7.33^{cd} (53)	9.46^c (89)	5.41^{cd} (29)
Oxyfluorfen 0.025g/m^2	9.80^b (95)	9.06^a (81)	6.39^b (40)	8.56^b (72)	5.96^b (34)	12.36^b (152)	11.16^a (124)	9.89^b (97)	10.42^b (107)	7.04^b (48)
Oxyfluorfen 0.025g/m^2+ Paddy straw mulch 0.6kg/m^2	7.71^c (59)	6.82^b (46)	4.91^d (23)	6.83^c (46)	4.34^d (18)	10.68^{cd} (114)	9.37^b (87)	8.01^c (63)	8.88^c (78)	5.38^{cd} (28)
Oxyfluorfen 0.025g/m^2+ Paddy straw mulch 1.2kg/m^2	5.68^d (32)	4.70^c (22)	3.24^e (12)	2.69^d (7)	4.06^d (15)	9.98^d (99)	8.65^b (74)	6.39^d (40)	8.77^c (76)	4.71^d (21)
Hand weeding (At monthly interval)	2.52^e (5)	3.13^c (9)	2.21^f (4)	2.42^d (5)	2.48^e (5)	6.41^e (16)	3.71^b (13)	3.73^e (13)	4.85^d (22)	2.32^e (5)
Unweeded control	11.22^a (125)	9.66^a (93)	7.98^a (63)	9.51^a (91)	7.28^a (52)	14.95^a (237)	10.13^{ab} (103)	10.99^a (120)	11.48^a (131)	7.89^a (61)

* In a column, means followed by common letters do not differ significantly at the 5 % level by Duncan's Multiple Range Test
* Data were subjected to square root transformation $\sqrt{x+1}$. Parentheses are original values.

Table 3. Effect of integrated weed management in rose on weed control efficiency (%)

Treatment	90 DAT					180 DAT				
	Summer			Winter		Summer			Winter	
	Broad-leaved	Sedges	Grasses	Broad-leaved	Sedges	Broad-leaved	Sedges	Grasses	Broad-leaved	Sedges
Paddy straw mulch 0.6kg/m^2	34	*	44	17	50	49	*	30	16	*
Paddy straw mulch 1.2kg/m^2	50	32	55	45	60	52	10	56	32	*
Oxyfluorfen 0.025g/m^2	24	*	36	20	35	36	*	20	18	*
Oxyfluorfen 0.025g/m^2+ Paddy straw mulch 0.6kg/m^2	53	39	63	49	65	52	15	48	40	3
Oxyfluorfen 0.025g/m^2+ Paddy straw mulch 1.2kg/m^2	74	71	81	92	71	58	28	67	42	27
Hand weeding (At monthly interval)	96	88	94	94	90	93	87	89	83	82
Unweeded control	-	-	-	-	-	-	-	-_	-	-

* means values cannot be determined.

90 days after treatments, across the summer and winter seasons. However, the lowest weed control efficiency was recorded in oxyfluorfen 0.025 g/m^2 across all the periods.

The present study is the first attempt to use paddy straw mulch with different rates in conjunction with oxyfluorfen for weed management in rose. Among treatments, hand weeding was closely followed by oxyfluorfen + paddy straw mulch at a rate of 1.2 g/m^2 with respect to weed density and dry biomass of weeds. Since hand weeding is an expensive, laborious, time-consuming operation and considered to be harmful to the root system of plants. Consequently, application of oxyfluorfen followed by paddy straw mulch at a rate of 1.2 g/m^2 was effective for suppressing weeds growth in rose.

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