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Effect of organic mulch on growth and flowering of country rose

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Abstract
The present investigation was conducted at Horticulture Polytechnic, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India, during 2019 (November) to 2020 (May). The experiment was laid out in RBD with 4 replications, which consisted of 6 treatments namely, Paddy straw, Sugarcane trash, Grass (*Cynodon dactylon*), Teak leaves, Dry weeds and Control (no mulch). Results revealed that plants mulched with Sugarcane trash was noticed promising to increase the vegetative and reproductive parameters as compare to other mulches used in this experiment. Yield attributes *viz.*, number of flowers plant-1 (239.55), flower yield plant-1 (708.79 g) and flower yield (6.54 kg plot-1 and 8.07 t ha-1) were maximum in plants mulched with sugarcane trash, which was statistically at par with paddy straw. Significantly maximum soil moisture and minimum mean monthly soil temperature in December, January, February, March, April and May and minimum dry weed biomass at 30,60,90,120,150 and at the end of experiment were found with the rose plants mulched with sugarcane trash. From the result of the present experiment, it can be concluded that the country rose mulched with the sugarcane trash enhanced the growth and quality flower yield.

Keywords: Organic mulch, sugarcane trash, paddy straw, grass (Cynodon dactylon), teak leaves and dry weeds

1. Introduction
Undoubtedly, Rose is the most beautiful flower in the world. It is the epitome of beauty, from their dazzling color combinations and their sweet scent of delicate petals. Rose represents their purity, passion, romance and widely used by people to express their feelings. It belongs to the family Rosacea and is universally acclaimed as "Queen of Flowers". Its cultivation was introduced as an industry in Turkey in 17th century. Maharashtra, Karnataka, Punjab, Uttar Pradesh, Delhi, Chandigarh, Rajasthan and West Bengal are the major producing states in India. While in Madhya Pradesh, Gujarat and Tamil Nadu; it is cultivated to a limited extent. The total area under commercial production of rose is 4,487 ha with 41,452 MT production and 9.24 MT per ha productivity in Gujarat (Anon., 2018) [3]. *R. centifolia* also known as Provence rose or Cabbage rose because of its globe like flowers. The species name centifolia, means hundred petals, identified with the many petaled roses mentioned in ancient history. It was valued for the size of flowers and sweetness of the scent. The flowers of *Rosa centifolia* are commercially harvested for the production of rose oil, which is commonly used in perfumery (Phillips and Rix, 2004) [26]. A mulch is a material spread around a plant to enrich or insulate the soil. Large amount of paddy straw and sugarcane trash are available, which can be efficiently used for the mulching purpose. Paddy straw is readily available in the summer and fall after rice crops have been harvested. It is a safe, weed free, organic, economical and great attribute such as weed suppression, excellent water retention properties and ideal for most of the horticultural crops (Goel *et al*., 2019) [12]. Sugarcane trash is the dry leaves of sugarcane crop. It is an excellent biomass resource in sugar producing countries. As mulch sugarcane trash is used to conserve soil moisture for longer time period, moderating soil temperature extremes, improves soil fertility, better aeration, prevent soil erosion, checking weed growth gradual conservation of organic mulch into humus and better environment for microbial activity (Shrivastava *et al*. 1999 and Dipika *et al*. 2019) [35, 10]. Grass clippings are one of the most abundantly and easily available mulch materials. Use of dry grass as mulch material is suggested instead of green grass. Dry weeds can also be used as mulch after checking the presence of seed heads on them.

Being an organic material, dry weeds help to improve physical and chemical properties of soil by its decomposition (Prakash *et al*., 2011) [27]. Teak leaves are natural perfect mulching material soil builder and supply some fertilizer, when they have rotted. It is easy to collect and shred the leaves for mulching (Anon., 2014) [2].

Sustainable green space development in arid regions, including extreme soil temperature, low average rainfall, drought and high potential for evapotranspiration needs a strategy to tackle these limitations, in this field organic mulches can be effectively used. Organic mulches deliver more benefits than inorganic mulches. Organic mulches may have to be replaced each year, but as they break down, they are enriching the soil and feeding all the beneficial bacteria. While plastic mulch needs to be removed from commercial fields annually and residues could accumulate in soils which results in a serious environmental concern for agro-ecosystems. Furthermore, disposal of plastic mulch is not only time consuming but also need great care while taking out to avoid leaving sections of plastic in the field. Further, organic mulch has no negative ecological impacts on the soil. In view of considering above facts the present investigation on effect of organic mulch on growth and flowering of country rose with the following objectives *viz*., to find out the effect of organic mulch on growth of rose, to find out the effect of organic mulch on flowering of rose.

2. Materials and Methods

The present research work was conducted during November 2019 to May 2020. The experiment was laid out in Randomized Block Design (RBD) with 4 replications and 6 treatments *viz*., Paddy straw (T1), Sugarcane trash (T2), Grass (*Cynodon dactylon*) (T3), Teak leaves (T4), Dry weeds (T5) and Control (no mulch) (T6). One year old established plants of country rose were selected, then pruning was done at 45 cm height from ground level on last week of October, 2019 to obtain plants with uniform height and Copper Oxychloride was applied after pruning of branches to avoid fungal infection. Fertilizer was applied at the rate of 60:20:20 g NPK per plant after pruning in the form of urea, SSP and MOP, respectively.

2.1 Imposing of treatments

Different organic mulches *viz.*, paddy straw and sugarcane trash were collected from respective research stations. Grass (*Cynodon dactylon*), teak leaves and dry weeds were collected from Horticultural Polytechnic, then applied in 5 cm layer around the plants during last week of November 2019 after pruning @ 5 t ha-1 as per the treatments.

2.2 Cultural practices and harvesting

Plants were irrigated through drip irrigation system. Before the application of mulch in every row adjusted with the drippers 10 cm apart from the plants while maintaining the pressure 1.2 kg cm-2. The drip irrigation system was operated around 1 hour in winter season at every two days, while 1-5 hours in summer season at alternate days with maintaining 0.8 IW/IPW ratio at 50 mm depth. Timely preventive measures were adopted uniformly as and when required to protect the crop against thrips. Thrips were effectively controlled by spraying of Thiomithoxam 25% WG (4 ml/10 ltr). Fully opened fresh flowers from different treatments were harvested weekly twice by hand picking starting from flower opening and continued up to the end of experiment, for the purpose of observations. Data pertaining to various parameters were tabulated and statistically analyzed using Randomized Block Design. The inference was drawn after comparing the calculated F values with the tabulated F values at 5% (P= 0.05) level of significance.

3. Results and Discussion

3.1 Vegetative parameters

The data on different vegetative characters showed significant difference in all the parameters (Table 1). Maximum plant height (129.00 cm and 139.60 cm) was recorded in T2 (sugarcane trash mulch) which was at par with T2 (122.55 cm and 134.75 cm) and T5 (112.75 cm and 124.65 cm). While, least plant height (98.50 cm and 104.70 cm) was recorded in plant without mulch application (T6) at 120 DAPr and at the end of experiment, respectively. Highest plant height was obtained from the plants mulched with sugarcane trash, might be due to enhanced root establishment and increased plant performance because of improved water retention created by mulches encourages roots to extend and establish effectively compared to plants those in bare soil. Moreover, mulching provides a favorable micro climate for growth which resulted in vigorous and healthier plants (Patel *et al*. 2019) [25].

Maximum plant spread in North-South direction (109.30 cm 120.20 cm) was obtained in plants mulched with sugarcane trash (T2) which was at par with T1 (108.85 cm and 134.75 cm). While, minimum plant spread (92.85 cm and 103.95 cm) was recorded in plant without mulch application (T6) at 120 DAPr and at the end of experiment, respectively. Maximum plant spread in East-West direction (118.35 cm 140.25 cm) was obtained in plants mulched with sugarcane trash (T2) which was at par with T1 (118.05 cm and 139.50 cm). While, minimum plant spread (100.80 cm 109.85 cm) was recorded in control (T6) at 120 DAPr and at the end of experiment, respectively. Reason behind increased plant spread in North-South and East-West direction is might be adequate availability of soil moisture to the plants, resulted in full cell turgidity, eventually higher meristematic activity and better availability of macro and micro nutrients, which leading to more foliage development due to greater photosynthetic rate and consequently better vegetative growth. Similar kind of observations were also reported by Dipika *et al*. (2019) [10] in marigold, Vamaja (2019) [39] in chrysanthemum, Vethamani and Balakrishnan (1990) [40] in okra and Shrivastava *et al*. (1999) [35] in banana.

Plants mulched with sugarcane trash mulch (T2) resulted highest number of secondary branches per plant (28.80 and 54.00) which was at par with T1 (27.20 and 50.85). Whereas least number of secondary branches per plant (21.75 and 38.35) were recorded in plants without mulch (T6) at 120 DAPr and at the end of experiment, respectively. Sugarcane trash mulch recorded maximum number of secondary branches per plant might be due to decomposition of organic mulch might have added organic matter to the soil which helps to prevent soil from compactness and helps to retain oxygen and aeration which is beneficial for stimulation of root growth thereby improving the supply of sufficient quantities of water and nutrients to the plants throughout the crop growth period (Patel *et al*. 2019) [25] which ultimately resulted in better vegetative growth. The results are in accordance with Dipika *et al*. (2019) [10] in marigold, Dere (2011) [9] in watermelon, Hooda *et al*. (1999) [13] in tomato, Vethamani and Balakrishnan (1990) [40] in okra and Ali and Gaur (2013) [1] in strawberry.

Table 1: Effect of organic mulch on vegetative growth and flowering of country rose

Treatments	Plant height (cm)		Plant spread (N-S) (cm)		Plant spread (E-W) (cm)		Number of secondary branches per plant		Flower diameter (cm)		Weight of ten flowers (g)	
	At 120 DAPr	At the end of experiment	At 120 DAPr	At the end of experiment	At 120 DAPr	At the end of experiment	At 120 DAPr	At the end of experiment	Winter	Summer	Winter	Summer
T1	122.55	134.75	108.85	120.20	118.05	139.50	27.20	50.85	6.15	5.50	35.99	32.49
T2	129.00	139.60	109.30	123.95	118.35	140.25	28.80	54.00	6.54	5.89	38.33	35.33
T3	109.30	118.60	96.80	106.05	103.90	119.55	24.15	44.60	5.19	5.15	33.70	29.55
T4	106.30	116.90	93.40	104.80	103.85	119.35	23.60	42.20	5.03	5.06	31.77	28.05
T5	112.75	124.65	97.00	109.05	104.05	119.70	24.35	47.90	5.64	5.22	35.27	30.75
T6	98.50	104.70	92.95	103.95	100.80	109.85	21.75	38.35	4.68	4.75	31.16	27.41
S.Em. ±	5.90	6.90	4.04	4.72	4.52	6.25	1.37	1.94	0.27	0.22	1.44	1.42
C. D. at 5%	17.78	20.80	12.19	14.22	13.63	18.83	4.13	5.83	0.83	0.66	4.34	4.27
C. V.%	10.43	11.20	8.11	8.48	8.36	10.02	10.98	8.36	9.90	8.28	8.39	9.25

3.2 Flowering parameters

The data on flowering parameters showed significant difference in all the parameters (Table 1). Maximum flower diameter (6.54 cm and 5.89 cm) was observed in plants mulched with sugarcane trash much (T2) which was at par with T1 (6.15 cm and 5.50 cm). While smallest flower (4.68 cm and 4.75 cm) observed in control (T6) during winter and summer seasons, respectively. Improvement in flower diameter was observed from the plants mulched with sugarcane trash which might be due to availability of relatively better moisture, changes in root zone temperature which ultimately enhanced the root growth resulted into increase the potential for efficient nutrient uptake which reflected through increased photosynthesis towards reproductive structure which might enhanced the flower diameter (Dipika *et al*. 2019) [10]. These results are in close conformity with Patel *et al*. (2019) [25] in tuberose, Vamaja (2019) [39] in chrysanthemum, Escuer and Vabrit (2017) [11] in ornamentals, Bender *et al*. (2008) [5] in tomato, Masalkar *et al*. (2014) [9] in onion, Vethamani and Balakrishnan (1990) [40] in okra, Sathiyamurthy *et al*. (2017) [32] in chilli and Sujatha *et al*. (2018) [37] in strawberry.

Maximum weight of ten flowers (38.33 g and 35.33 g) was observed in plants mulched with sugarcane trash much (T2) which was at par with T1 (35.99 g and 32.49 g). While minimum weight of ten flowers (31.16 g and 27.41 g) observed in control (T6) during winter and summer seasons, respectively. Enhanced flower quality in terms of flower diameter might have resulted in increased weight of ten flowers. The result is in agreement with the findings of Dipika *et al*. (2019) [10] in marigold, Patel *et al*. (2019) [25] in tuberose, Vamaja (2019) [39] in chrysanthemum, Hooda *et al*. (1999) [13] and Bender *et al*. (2008) [5] in tomato and Vethamani and Balakrishnan (1990) [40] in okra.

3.3 Yield parameters

The data on yield parameters showed significant difference in all the parameters (Table 2). Highest number of flowers per plant (126.70, 112.85 and 239.55) was obtained from plants mulched with sugarcane trash (T2) which was statistically at par with the plants mulched with T1 (115.05, 96.30 and 211.35). Whereas, least number of flowers per plant (89.55, 77.05 and 166.60) was noted from without mulch (T6) in rose during winter, summer and both seasons, respectively. Significantly increased number of flowers per plant was observed from the plants mulched with sugarcane trash. It might be due to improved microclimate both beneath and above the soil surface which led to increased microbial activity in soil which improved the availability and uptake of nutrient by the plants, consequently enhanced the plant growth and development in terms of both vegetative and reproductive, ultimately it enhanced the number of flowers per plant. Moreover, organic mulches enhanced the stress resistance in plants by increasing soluble sugar content and also enhanced photosynthetic rate by augmenting chlorophyll a content (Ni, *et al*. 2016) [22]. Similar findings were in accordance with results of Dipika *et al*. (2018) in marigold, Patel *et al*. (2014) [24], Barman *et al*. (2015) [4] and Patel *et al*. (2019) [25] in tuberose, Vamaja (2019) [39] in chrysanthemum, Younis *et al*. (2012) [42] in Freesia, Dere (2011) [9] in water melon, Hooda *et al*. (1999) [13] in tomato and Sujatha *et al*. (2018) [37] in strawberry.

Highest flower yield (378.43, 330.35 and 708.79) g per plant was recorded in plants mulched with Sugarcane trash (T2), which was statistically at par with the plants mulched with T1 (359.46 g, 308.34 g and 667.79 g). Whereas, lowest flower yield per plant (266.25 g, 209.83 g and 476.08 g) was obtained in control (T6) during winter, summer and both seasons, respectively. Maximum yield of flowers (3.62 kg, 2.92 kg and 6.54 kg) per plot was obtained from plants mulched with Sugarcane trash (T2) which was statistically at par with the plants mulched with T1 (3.43 kg, 2.72 kg and 6.15 kg). Whereas, minimum yield of flowers (2.61 kg,
2.07 kg and 4.68 kg) per plot was recorded with control (T6) during winter, summer and both seasons. Plants mulched with Sugarcane trash (T2) produced highest yield of flowers (4.46, 3.61 and 8.07 t ha-1) which was statistically at par with the plants mulched with T1 (4.23, 3.36 and 7.59 t ha-1). However, lowest yield of flowers (3.23, 2.55 and 5.77 t ha-1) was obtained from plants without mulch treatment (T6) during winter, summer and both seasons.

Significantly increased yield per hectare was obtained from the plants mulched with sugarcane trash. It could be due to sugarcane trash mulch which recorded maximum plant height and spread and better growth throughout growth period which helps in production and accumulation of more carbohydrates in plants also increased the number of flowers per plant which in turn increased the yield. It might also be due to improved soil moisture and temperature regimes, enhanced root development possibly through greater soil moisture and additional nutrient uptake, which favored shoot biomass development and being an organic mulch, sugarcane trash can provide organic matter to the soil resulted in long term soil fertility leading to availability of nutrients throughout the crop

growth period there by increased the number of flowers per plant. By controlling soil water evaporation and conserving water by increasing the depth of water movement into the soil, this mechanism of mulching helps to maintain leaf turgor at certain level to cope with salt stress consequently better-established plants. It could be evident from the present results that sugarcane trash mulch recorded minimum weed density resulted in reduced weed competition for resources with the cultivated plant allowing for greater productivity, maintained optimum soil temperature and soil moisture resulted in better uptake of nutrients by the plants. The similar results were reported by Dipika *et al*. (2018) in marigold, Barman *et al.* (2015) [4], Patel *et al.* (2014) [24] and Patel *et al*. (2019) [25] in tuberose, Sanderson and Fillmore (2012) in rose, Vamaja (2019) [39] in chrysanthemum, Naik *et al*. (2015) [20] in smooth gourd, Masalkar *et al*. (2014) [19] in onion, Kanade and Patil (2009) [16] in cucumber, Vethamani and Balakrishnan (1990) [40] in okra, Hooda *et al*. (1999) [13] in tomato, Shrivastava *et al*. (1999) [35] in banana, Rao and Pathak (1996) in aonla, Solia *et al*. (2005) [36] in smooth gourd, Dasha *et al*. (2006) [8] in mint, Kumar *et al*. (2013) in Sugarcane, Roopashree (2013) [29] in baby corn, Nana (2015) [21] in sesamum, and Sujatha *et al*. (2018) [37] in strawberry.

Table 2: Effect of organic mulch on yield of country rose

Treatments	Number of flowers per plant			Flower yield per plant (g)			Flower yield per plot (kg)			Flower yield per hectare (t)		
	Winter	Summer	Total	Winter	Summer	Total	Winter	Summer	Total	Winter	Summer	Total
T1	115.05	96.30	211.35	359.46	308.34	667.79	3.43	2.72	6.15	4.23	3.36	7.59
T2	126.70	112.85	239.55	378.43	330.35	708.79	3.62	2.92	6.54	4.46	3.61	8.07
T3	93.35	89.35	182.70	310.47	254.00	564.47	2.89	2.31	5.19	3.56	2.85	6.41
T4	91.05	83.75	174.80	283.86	231.23	515.08	2.80	2.23	5.03	3.45	2.75	6.21
T5	107.40	89.15	196.55	338.20	270.88	609.08	3.11	2.52	5.64	3.84	3.11	6.95
T6	89.55	77.05	166.60	266.25	209.83	476.08	2.61	2.07	4.68	3.23	2.55	5.77
S.Em. ±	8.21	5.81	12.53	13.98	10.72	22.88	0.16	0.13	0.27	0.20	0.15	0.34
C. D. at 5%	24.74	17.52	37.77	42.12	32.31	68.94	0.48	0.38	0.83	0.59	0.47	1.02
C. V.%	15.81	12.72	12.84	8.66	8.02	7.75	10.39	10.16	9.90	10.39	10.16	9.90

3.4 Soil parameters

Besides maintaining optimum soil temperature and conserving soil moisture, mulches had significant advantages in bulk density and soil compaction, addition of litter mulch to compacted surface soil could accelerate regeneration and improve the physical properties of soil by improving soil quality and stimulating biological activity.

3.4.1 Soil moisture

The data on soil moisture showed significant difference in all the parameters (Table 3). It is clear from the data that various organic mulches significantly influenced soil moisture in December, January, February, March, April and May months. Maximum soil moisture (28.08
%) was found in Sugarcane trash mulch (T2) which was statistically at par with T2, T5 and T3 being 26.38%, 25.75% and 24.85% respectively. Whereas, minimum soil moisture (22.38%) was observed in T6 in December month. Maximum soil moisture (28.30%) was found in Sugarcane trash mulch (T2) which was statistically at par with T2 and T5 being 26.43% and 26.13%, respectively. Whereas, minimum soil moisture (21.83%) was observed in T6 in January. Highest soil moisture (28.35%) was found in Sugarcane trash mulch (T2) which was statistically at par with T2 and T5 being 26.48% and 26.35%, respectively. Whereas, lowest soil moisture (20.35%) was observed in T6 in February month. In March maximum soil moisture (28.00%) was found in Sugarcane trash mulch (T2) which was statistically at par with T1 and T5 being 26.15% and 25.93%, respectively. Whereas, minimum soil moisture (20.25%) was observed in T6. Maximum soil moisture (27.60%) was found in Sugarcane trash mulch (T2) which is statistically at par with T1 and T5 being 25.80% and 25.75%, respectively. While minimum soil moisture (20.10%) was observed in (T6) in April month. Maximum soil moisture (27.28%) was found in Sugarcane trash mulch (T2) which is statistically at par with T2 and T5 being 26.25% and 25.50%, respectively. Whereas, minimum soil moisture (19.58%) was observed in T6. Soil moisture being an important soil physical property was found significant for December, January, February, march, April and May due to organic mulching application, conserves soil moisture from the direct solar radiation and air flow across the soil surface, which reduced soil evaporation from the surface while allowing rainfall to penetrate, by reducing the impacts of raindrops and splash, thereby preventing soil compaction, reducing surface run-off and increasing higher water infiltration resulted in more stored soil moisture. Similar trends for soil moisture due to mulch was also observed by Chavan *et al*. (2009) [6] in sorghum, Shrivastava *et al*. (1999) [35] in banana, Lima *et al*. (2016) [17] in anthurium, Das *et al*. (2016) [7] in litchi, Sarangi *et al*. (2020) [31] in potato and Shirgure *et al*. (2003) [33] in mandarin.

3.4.2 Soil temperature

The data on mean monthly soil temperature showed significant difference in all the parameters (Table 4). Different organic mulch treatments significantly influenced mean monthly soil temperature in December, January, February, March, April and May month. In December minimum soil temperature (22.10 ^{0}C) was noted in Sugarcane trash mulch (T2) which is statistically at par with T1 and T5 being 22.46 ^{0}C and 22.70 ^{0}C, respectively. Whereas, maximum soil temperature (25.12 ^{0}C) was observed in T6. In January minimum soil temperature (22.18 ^{0}C) was recorded with Sugarcane trash mulch (T2) which is statistically at par with T1 and T5 being 22.71 ^{0}C and 22.94 ^{0}C, respectively. Whereas, maximum soil temperature (25.55 ^{0}C) was observed in T6. In February minimum soil temperature (22.19 ^{0}C) was

found in Sugarcane trash mulch (T2) which is statistically at par with T1, T5 and T3, respectively. Whereas, maximum soil temperature (26.44 ^{0}C) was observed in T6. In March month, monthly soil temperature (30.11 ^{0}C) was noted in Sugarcane trash mulch (T2) which is statistically at par with T1 and T5 being 30.98 ^{0}C and 32.08 0C, respectively. Whereas, maximum soil temperature (34.06 ^{0}C) was recorded in T6. Minimum soil temperature (30.15 ^{0}C) was recorded in Sugarcane trash mulch (T2) which is statistically at par with T1 and T5 being 30.20 ^{0}C and 33.43 ^{0}C, respectively. Whereas, maximum mean soil temperature (34.51 ^{0}C) was noted in T6 in April month. Minimum soil temperature (30.34 ^{0}C) was recorded in Sugarcane trash mulch (T2) which is statistically at par with T1 and T5 being 31.15 ^{0}C and 32.91 ^{0}C, respectively. Whereas, maximum soil temperature (34.52 ^{0}C) was observed in T6 in May month. Soil temperature was found significantly affected due to organic mulching application for December, January, February, march, April and May. Minimum soil temperature was recorded from plants mulched with sugarcane trash. It might be due to interactive effects of high solar reflectance and low thermal conductivity and covering of soil surface with mulching helped to reduce soil temperature by interception of the sunlight rays by the boundary layer formed by the mulches and avoiding direct exposure of surface of the soil to the sun. The reduction of variation in the soil temperature and conserved soil moisture also helped to maintain soil temperature to optimum level. Mulch also works as an insulator which cools and moderates the soil temperature during hot days and cold nights. The result is in close conformity with the findings of Lima *et al*. (2016) [17] in anthurium, Tegen *et al*. (2016) [38] in tomato and Kumar *et al*. (2014) in stevia.

3.5 Dry weed biomass

The data on dry weed biomass showed significant difference in all the parameters (Table 5). At 30 days, plants mulched with Sugarcane trash (T2) resulted minimum dry weed biomass (4.85 g m-2) which was statistically at par with the plants mulched with T1, T5 and T3 being 5.13 g m-2, 5.25 g m-2 and 5.85 g m-2 respectively. However, maximum weed density (8.03 g m-2) was obtained from T6. Soil covered with Sugarcane trash mulch (T2) resulted in minimum dry weed biomass (8.55 g m-2) which was statistically at par with the plants mulched with T1 and T5 being 10.48 g m-2 and 10.53 g m-2, respectively. While, maximum dry weed biomass (17.68 g m-2) was obtained T6 at 60 days after mulching. Sugarcane trash (T2) resulted in minimum dry weed biomass (10.70 g m-2) which was statistically at par with the plants mulched with T1 and T5 being 12.30 g m-2 and 12.40 g m-2, respectively. However, maximum dry weed biomass (25.70 g m-2) was obtained from T6 at 90 days after mulching. At 120 days after mulching, minimum dry weed biomass (11.95 g m-2) was observed from soil covered with Sugarcane trash mulch (T2) which was statistically at par with the plants mulched with T1 and T5 being 14.08 g m-2 and 14.13 g m- 2, respectively. However, maximum dry weed biomass (30.30 g m-2) was obtained T6. Sugarcane trash mulching (T2) resulted minimum dry weed biomass (13.50 g m-2) which was statistically at par with the plants mulched with T1 and T5 being 15.78 g m-2 and 15.83 g m-2, respectively. However, maximum dry weed biomass (32.33 g m-2) was obtained from plants without mulch (T6) at 150 days after mulching application. At the end of experiment, Sugarcane trash (T2) reported lowest dry weed biomass (16.15 g m-2) which was statistically at par with the plants mulched with T1 and T5 being 17.65 g m-2 and 19.20 g m-2, respectively. Whereas, highest dry weed biomass (37.70 g m-2) was obtained from T6. Different organic mulches had significant effect on dry weed biomass. Soil mulched with sugar cane trash obtained minimum dry weed biomass. This might be due to prevention of photo induction needed for weed seed germination and acting as a mechanical hindrance which ultimately check the weed seed germination and growth. Plant residues used as mulch have been found to suppress weed emergence and growth due to the phytotoxins release during the breakdown process. Such results are in accordance with the previous findings of Vamaja (2019) [39] in chrysanthemum, Jadhav *et al*. (2018) and Punam *et al*. (2018) [28] in rose, Naik *et al*. (2015) [20] in smooth gourd, Shirgure *et al*. (2003) [33] in mandarin, Sajid *et al*. (2013) [30] in pea, Olabode *et al*. (2007) [23] in okra, Jodaugiene *et al*. (2006) [15] and Sathiyamurthy *et al*. (2017) [32] in chilli.

3.6 Correlation coefficient

Correlation coefficient of sixteen characters studied are presented in Table 6. Plant height had appearance positive and significant correlation with number of secondary branches per plant, flower diameter, number of flowers per plant and flower yield per hectare. Plant spread had positive and significant correlation with number of secondary branches per plant, number of flowers per plant and flower yield per hectare. Number of secondary branches per plant had positive and significant correlation with flower yield per hectare. It might be due to enhanced plant height and plant spread resulted in increased number of secondary shoots which consequently enhance more leaves, which helps in synthesis of more photosynthates, hence a greater number of flowers were resulted. Flower diameter had positive and significant correlation with ten flower weight and flower yield per hectare. Ten flower weights had positive and significant correlation with flower yield per hectare. Number of flowers per plant also had positive and significant correlation with flower yield per hectare. It might be due to increased flower diameter, flower weight and number of flowers per plant were reflected in higher flower yield (Shivaprasad *et al*, 2016) [34].

Table 3: Effect of organic mulching on soil moisture in country rose

Treatments	Soil moisture (%)					
	December	January	February	March	April	May
T1	26.38	26.43	26.48	26.15	25.80	26.25
T2	28.08	28.30	28.35	28.00	27.60	27.28
T3	24.85	25.23	25.18	24.48	24.23	23.98
T4	24.53	24.20	24.65	23.80	23.18	23.80
T5	25.75	26.13	26.35	25.93	25.75	25.50
T6	22.38	21.83	20.35	20.25	20.10	19.58
S.Em.±	1.10	1.02	1.03	1.10	1.11	1.08
C. D. at 5%	3.30	3.07	3.12	3.32	3.35	3.26
C. V.%	8.66	8.02	8.20	8.90	9.09	8.86

Table 4: Effect of organic mulching on mean monthly soil temperature in country rose

Treatments	Mean monthly soil temperature (^{0}C)					
	December	January	February	March	April	May
T1	22.46	22.71	22.32	30.98	30.20	31.15
T2	22.10	22.18	22.19	30.11	30.15	30.34
T3	24.34	24.43	25.11	32.77	33.83	33.98
T4	24.35	24.55	25.32	33.30	34.24	33.97
T5	22.70	22.94	24.54	32.08	33.43	32.91
T6	25.12	25.55	26.44	34.06	34.51	34.52
S.Em. ±	0.71	0.71	0.99	0.87	1.17	0.99
C. D. at 5%	2.14	2.14	2.98	2.61	3.52	3.01
C. V.%	6.03	6.00	8.14	5.37	7.13	6.09

Table 5: Effect of organic mulching on dry weed biomass

Treatments	Dry weed biomass (g m-2)					
	30 days	60 days	90 days	120 days	150 days	At the end of experiment
T1	5.13	10.48	12.30	14.08	15.78	17.65
T2	4.85	8.55	10.70	11.95	13.50	16.15
T3	5.85	12.60	20.95	22.63	23.68	25.40
T4	6.00	13.10	23.90	26.90	28.48	31.15
T5	5.25	10.53	12.40	14.13	15.83	19.20
T6	8.03	17.68	25.70	30.30	32.33	37.70
S.Em. ±	0.34	0.71	0.77	0.81	1.16	1.13
C. D. at 5%	1.03	2.15	2.33	2.43	3.49	3.40
C. V.%	11.63	11.72	8.77	8.05	10.74	9.18

Table 6: Simple correlation coefficients of sixteen characters in country rose

Characters	PH at end of exp.	PS (N-S) @ 120DAPr	PS (N-S) at the end of exp.	PS (E-W) @ 120DAPr	PS (E-W) at the end of exp.	No. of secondary branches/plant @120 DAPr	No. of secondary branches/ plant at the end of exp.	Flower diameter (winter)	Flower diameter (summer)	Ten flower Wt. (winter)	Ten flower Wt. (summer)	No. of flowers/ plant	Flower yield/plant	Flower yield/plot	Flowe yield/ha
PH @ 120DAPr	0.952**	0.465*	0.436*	0.464*	0.491*	0.404*	0.622**	0.549**	0.450*	0.375 NS	0.478*	0.694**	0.682**	0.550**	0.550**
PH at the end of exp.		0.506*	0.437*	0.481*	0.478*	0.440*	0.662**	0.487*	0.435*	0.284 NS	0.358NS	0.602**	0.637**	0.487*	0.488*
PS (N-S) @ 120DAPr			0.645**	0.596**	0.505*	0.334NS	0.367 NS	0.535**	0.230NS	0.218 NS	0.319NS	0.555**	0.616**	0.535**	0.535**
PS (N-S) at the end of exp.				0.705**	0.653**	0.513*	0.606**	0.491*	0.259NS	0.203 NS	0.445*	0.513*	0.646**	0.491*	0.491*
PS (E-W) @ 120DAPr					0.673**	0.539**	0.530**	0.384 NS	0.392NS	0.162 NS	0.267NS	0.445*	0.503*	0.38 NS	0.383NS
PS (E-W) at the end of exp.						0.679**	0.554**	0.429*	0.431*	0.424*	0.542**	0.336NS	0.493*	0.429*	0.428*
No. of secondary branches/plant @120 DAPr							0.728**	0.307NS	0.569**	0.419*	0.491*	0.188NS	0.419*	0.307NS	0.307 NS
No. of secondary branches/plant at the end of exp.								0.586**	0.522**	0.608**	0.674**	0.533**	0.704**	0.586**	0.585**
Flower diameter (winter)									0.421*	0.727**	0.669**	0.870**	0.903**	1.000**	0.999**
Flower diameter (summer)										0.431*	0.440*	0.327NS	0.359NS	0.421*	0.421*
Ten flower Wt. (winter)											0.841**	0.550**	0.659**	0.728**	0.728**
Ten flower Wt. (summer)												0.439*	0.439*	0.669**	0.670**
Number of flowers/plants													0.912**	0.870**	0.871**
Flower yield/plant														0.903**	0.903**
Flower yield/plot															1.000**

***** Significant at P=0.05 PS- Plant spread
****** Significant at P=0.01 Exp-Experiment PH- Plant height Wt-Weight

4. Conclusions

From the results of the present experiment, it can be concluded that the country rose mulched with sugarcane trash enhanced the growth and quality flower yield, along with conserved soil moisture because of increased infiltration, better retention, suffocate weed growth and optimum soil temperature facilitated a better crop growth and yield.

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