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Influence of different type of mulches on soil properties and weed biomass in okra {*Abelmoschus esculentus* (L.) Moench}

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Abstract
The field experiment was conducted at in summer season 2017 in okra .Soil properties studied under inorganic and organic mulch and compared with control. The experiment was laid out as randomized block design with three replication and nine treatments. The results reveled that among all the treatments, the soil temperature at 30, 60 and 90 DAS (35.17, 33.93 and 36.27 °C) were recorded with black polythene mulch: 50 micron. The maximum soil moisture content at 30 and 60 DAS (16.33 and 18.33 %) and maximum water use efficiency (WUE) (32.54 kg/ha/mm) were recorded with treatment silver polythene mulch: 50 micron. Also, analysis indicated that minimum weed biomass (19.27 g/m^2) was observed in silver polythene mulch: 50 micron.

Keywords: mulch, soil moisture, soil temperature, WUE, weed biomass

Introduction
Vegetables play an important role in food and nutritional security of ever-growing population of our large vegetarian society. Okra {*Abelmoschus esculentus* (L.) Moench} is herbaceous hairy annual plant and belongs to Malvaceae family. The okra fruit is excellent source of iodine, which is necessary for the resistant against goiter disease of throat. Okra seeds roasted and ground to powder are used as a substitute of coffee. Dry seeds contain 13-22 % edible oil and 20-24 % protein. Mulching is the practice of covering the soil around plants to make conditions more favourable for growth, development and efficient crop production (Nagalakshmi *et al*., 2002) [8]. Mulch increased soil temperature and high soil moisture, proper root growth, better uptake of nutrients, increased CO_2 level and absence of weeds growth in field were responsible for creating favourable microclimate around plant, which ultimately induced better vegetative growth (Tarara, 2000) [13]. The use of plastic mulch helps conserving water by reducing evaporation from soil surface, controlling weed growth, increase water use efficiency and reducing soil compactness.

Materials and Methods
A field experiment was carried out at Agriculture Experimental Station, NAU, Paria (Gujarat) during summer season of 2017. The experiment was laid out in a Randomized Block Design (RBD) in nine treatments with three replication. The treatment consists of: T_1 (Black polythene mulch: 25 micron), T_2 (Black polythene mulch: 50 micron), T_3 (Silver polythene mulch: 25 micron), T_4 (Silver polythene mulch: 50 micron), T_5 (Red polythene mulch: 25 micron), T_6 (Red polythene mulch: 50 micron), T_7 (Paddy straw mulch: 5 tons/ha), T_8 (Sugarcane trash: 10 tons/ha) and T_9 (Control).
Mulch were spread in plot before two days of sowing as per treatment. Plastic mulch was laid by cutting into pieces of 3m x 3m to cover plot area. For the purpose of seed sowing holes were made in plastic at recommended spacing. Paddy straw and sugarcane trash mulch of 10 cm thickness were spread in plot. Irrigation, weeding and plant protection measures were done as and when required. The obtained data were analyzed statistically using standard method as suggested by Panse and Sukhatme (1985) [10].

Soil temperature (0-15 cm depth)
Soil temperature at 0-15 cm depth measure with soil thermometers. Observation were recorded at 30, 60 and 90 DAS in each treatment and expressed in degree celsius (ºC).

Moisture content (%)

Moisture content of soil determined at 30 and 60 DAS. Soil moisture content (0-15 cm depth) was determined by gravimetric method (Jalota *et al*., 1998) [2]. Sample dried in oven at 105°C until constant weight.

It was estimated in percentage by using following formula:

$$\text{Moisture content (\%)} = \frac{W_1 - W_2}{W_2} \times 100$$

Where, W_1 = Weight of moist soil (g)
W_2 = Weight of oven dry soil (g)

Water use efficiency (kg/ha/mm)

Water use efficiency was calculated by using following formula. Maximum water holding capacity of experimental soil is 57%.

$$\text{Water use efficiency (kg/ha/mm)} = \frac{\text{Yield (kg/ha)}}{\text{Irrigation applied ha/mm}}$$

Weed biomass

The weeds were taken from the sampling area and dried in sun or oven dried. In oven sample were dried at 65° ± 5°C to a constant dry weight. Dry weight of weeds were recorded for each treatment and expressed in g/m^2.

Results and Discussion

Soil temperature (°C)

The soil temperature was significantly influenced by different types of mulch. Among nine treatments, the maximum soil temperature at 30, 60 and 90 DAS (35.17, 33.93 and 36.27 °C) were recorded with the Black polythene mulch: 50 micron (Table 1). The lower soil temperature were recorded in control. Soil temperature was significantly higher under the plastic mulches than organic mulch and control. Plastic mulch absorb comparatively large amounts of the incoming radiation and transmit a considerable part of it to soil underneath. Similar results was observed by Tarara (2000) [13]. The soil temperature under black mulch was observed to be highest followed by that under silver mulch, while temperature of soil without any mulch cover was seen to be the lowest (Kayande *et al.*, 2016) [4].

Moisture content (%)

Results revealed that maximum moisture content at 30 and 60 DAS (16.33 and 18.33 %) were recorded in Silver polythene mulch: 50 micron (Table 2). While, minimum moisture content was recorded in control. The use of plastic mulch helps conserving water by reducing evaporation from soil surface, controlling weed growth and reducing soil compaction. Higher soil moisture content was observed at 30, 60 and 90 days after planting in plots covered with black plastic mulch as compared to non-mulched plots (Mahadeen, 2014) [6]. Ramakrishna *et al*. (2006) [12], Panigrahi *et al*. (2010) [9], Kumar and Lal (2012) [5], in which they indicated that the main advantage of using plastic mulch is to retain soil moisture.

Water use efficiency (kg/ha/mm)

Silver polythene mulch: 50 micron was found maximum water use efficiency (32.54 kg/ha/mm) (Table 2). Higher water use efficiency value recorded with black plastic mulch, was compared to without mulch treatment, which indicate that the plastic mulch distinctly improved the water use efficiency of tomato (Baye Berihun, 2011) [1] and polythene mulch recorded the maximum WUE which was 39 per cent higher over no mulch condition (Mukherjee *et al*., 2010) [7].

Weed biomass (g/m^2)

The analysis indicated that minimum weed biomass (19.27 g/m^2) was observed in silver polythene mulch: 50 micron. While, maximum weed biomass (63.23 g/m^2) was found in control (Table 2). Plastic mulch reduces evaporation from the soil surface and soil moisture is maintained with greater uniformity. Due to the lack of light under the black plastic mulch, photosynthesis could not be done and weeds cannot grow. Therefore, the plants will have greater access to water and nutrients. In other words, if the mulch is used, less water is consumed and yield can be expected to be higher Rajbir Singh (2005) [11], Ramakrishna (2006) [12] and (Jolaini *et al*., 2008) [3].

Conclusion

On the basis of present investigation it concluded that the using different type of mulches are effective in soil parameters. Plastic mulch increased soil temperature, moisture content, water use efficiency and reduced the weed biomass compared to organic mulch, which was beneficial to increase the growth, yield and improved the quality parameters of okra under South Gujarat condition.

Table 1: Effect of different type of mulches on soil temperature in okra.

Treatments	Soil temperature (0-15 cm depth)		
	30 DAS	60 DAS	90 DAS
T_1 : Black polythene mulch (25 micron)	33.60	32.47	33.70
T_2 : Black polythene mulch (50 micron)	35.17	33.93	36.27
T_3 : Silver polythene mulch (25 micron)	33.50	32.10	33.57
T_4 : Silver polythene mulch (50 micron)	34.97	33.90	35.17
T_5 : Red polythene mulch (25 micron)	33.20	32.13	33.30
T_6 : Red polythene mulch (50 micron)	34.50	33.57	34.83
T_7 : Paddy straw mulch (5 t/ha)	31.67	30.63	32.43
T_8 : Sugarcane trash (10 t/ha)	31.50	30.50	32.27
T_9 : Control	29.67	28.70	30.07

Table 2: Effect of different type of mulches on moisture content, water use efficiency and weed biomass in okra.

Treatments	Moisture content (%)		Water use efficiency (kg/ha/mm)	Weed biomass (g/m^2)
	30 DAS	60 DAS		
T_1 : Black polythene mulch (25 micron)	12.20	14.10	27.93	26.00
T_2 : Black polythene mulch (50 micron)	16.07	18.10	30.98	20.47
T_3 : Silver polythene mulch (25 micron)	12.23	14.43	29.50	26.91
T_4 : Silver polythene mulch (50 micron)	16.33	18.33	32.54	19.27
T_5 : Red polythene mulch (25 micron)	10.10	12.13	26.33	31.78
T_6 : Red polythene mulch (50 micron)	14.67	16.20	26.86	24.64
T_7 : Paddy straw mulch (5 t/ha)	12.90	14.97	25.07	43.90
T_8 : Sugarcane trash (10 t/ha)	12.87	14.87	24.90	45.53
T_9 : Control	10.23	11.40	23.00	63.23
S.Em.±	0.563	0.720	1.017	1.224
C.D. at 5%	1.69	2.16	3.05	3.67
C.V. %	7.46	8.34	6.42	6.32

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