

RESPONSE OF VEGETATIVE AND REPRODUCTIVE COMPONENTS OF CHILI TO INORGANIC AND ORGANIC MULCHES

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A pot experiment was conducted to evaluate the effect of organic and inorganic mulch materials on the vegetative and reproductive components of chili cultivar Sanam (*Capsicum annuum* L.) Mulch treatments used in the study were (T₁ without mulch, T₂ transparent plastic mulch, T₃ rice straw, T₄ wheat straw, T₅ sugarcane bagasse and T₆ black polyethylene mulch). The results revealed that the mulch materials significantly affected physiological growth parameters. The maximum leaf area (7.0 cm²), number of fruit per plant (58.4 fruits), plant height (54.3 cm) and fruit set (86.66%) were observed when transparent plastic mulch was used. Similarly, the black polyethylene mulch produced the same results after transparent plastic mulch. The organic mulches also increased the yield components of chili. While minimum leaf area (4.0 cm²), number of fruit per plant (38.0 fruits) and plant height (32.0 cm) were recorded when no mulch material was applied to the chili plants. The results indicated that among the different mulch material, both transparent plastic mulch and black polyethylene mulch were found to be effective concerning to chili production when compared to the other uncovered plants.

Keywords: Chili, polyethylene mulch, vegetative and reproductive growth

INTRODUCTION

Chili (*Capsicum annuum* L.) is an important vegetable cum condiment and an active ingredient in cookery. It is grown throughout tropical and sub-tropical conditions due to its wide range of adaptability. The chili fruit is rich source of vitamin especially in vitamin A, C and E. It is grown for green, spices, condiments, sauces and pickles. It also imparts peculiar beauty, taste and flavor to cook the vegetables and other dishes.

Mulching is the process or practice of covering the soil/ground to make more suitable environment for plant growth, development and good crop production. Technically, mulch means 'covering of soil'. While organic mulches such as wheat straw, dead leaves and compost have been used for centuries but during the past 60 years, the beginning of artificial materials has modified the methods and advantages of mulching. The research has proved that mulches are fruitful and productive in the production of horticultural crops. It is investigated that polyethylene mulches (transparent and black) are completely resistant to water and therefore reduces immediate loss of water from the soil surface and decreases the moisture losses and conserves soil particles over the surface (Tarara, 2000). In this way it plays a vital role in water

conservation for longer period of time but increases the soil temperature as well (Ham *et al.*, 1993).

The use of plastics is an important practice that is adopted by growers to achieve appropriate conditions for early crop production (Graham *et al.*, 1995) but growers must understand the optimum conditions that are necessary for good crop production. As for instance the transparent plastic sheet increased the growth of tomato under mulch conditions (Hudu *et al.*, 2002).

In subtropical climate, the pepper showed rapid growth on transparent polyethylene film as compared to other organic mulches (Vos and Sumarni, 1997) while in semi arid climate black plastic mulch had injurious effects as it blistered the fruits and decreased the yield (Roberts and Anderson, 1994).

The production of vegetables under tunnel is hardly possible without the use of plastic mulch because mulches enhance yield, boost up early maturity and minimize the disorders in fruit and vegetables. In addition, mulches minimize the loss of moisture from the ground surface, suppress the weed growth, warm the soil temperature, decrease the cost of production, conserve the soil structure and prevent insect pest attack (Ekinci and Dursun, 2006).

The organic material such as straw, dry leaves and grasses when used as mulch boost up vegetable yield and also add organic matter into soil which further improves soil structure. The plants grown on mulch material are more productive because organic mulch increases vegetative growth, blooming and number of fruit per plant which leads to early maturity and early harvest (Gomez *et al.*, 1997). The objective of this study was to investigate the effect of inorganic and organic mulches on the yield components of chili and to compare efficacy of inorganic and organic mulches.

MATERIAL AND METHODS

Seeds of chili cultivar Sanam were collected from Ayub Agricultural Research Institute, Faisalabad. The experiment was designed in completely randomized design (CRD) design with six treatments replicated thrice containing five pots per replication. The pots were filled with growth media containing top soil, farm yard manure and silt in equal proportion (1:1:1). Five seeds were sown randomly in each pot. The pot size was fixed at 2.5 x 0.75 feet. The pots were covered with different mulching materials such as (T₁) without mulch, (T₂) transparent plastic mulch, (T₃) rice straw, (T₄) wheat straw, (T₅) sugarcane bagasse and (T₆) black polyethylene mulch. After emergence of seedlings, only one healthy seedling was selected and retained in the pot while all other seedlings were uprooted. The transparent and black polyethylene mulches used were 25µm thick, while all other organic treatments were applied on the surface of pot at the rate of 200 g per pot. Before proceeding to different cultural practices, the mulching material was first removed and then covered after completion of cultural operations. All required cultural practices such as irrigation, weeding and fertilizers were carried out uniformly to all experimental pots. Data concerning to leaf area (cm²),

number of leaves per plant, plant height (cm), flowering time (days), Fruit set (%), fruit length (cm), fruit width (cm), fruit weight (g), first harvest time (days), yield (fruit per plant) were recorded. Leaf area was determined by leaf area meter. Plant height was measured from ground level to top of chili plants by using measuring tape. Flowering time was determined by counting number of days from sowing to appearance of bloom. Fruit set % was calculated by using the following formula.

$$\text{Fruit set (\%)} = \frac{\text{Total fruit set}}{\text{Total No. of flowers}} \times 100$$

Fruit weight was measured by using electrical balance and was expressed in gram. Fruit length and width was measured by using measuring tape. First harvest time was recorded by counting number of days starting from sowing of seed to picking of fruit.

Data collected on different vegetative and reproductive parameters of chili were analyzed statistically by using MSTAT-C program for analysis of variance and means were compared using Fisher's protected least significant differences (LSD) test at 5 % probability level (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

Leaf area (cm²): Leaf area was significantly affected by different mulch material as shown in (Table 1). Maximum leaf area (7.03 cm²) was produced by the chili plant when transparent polyethylene mulch was applied that was statistically similar to black polyethylene mulch leaf area (6.26 cm²). The average leaf area was observed in rice straw mulch (5.35 cm²) that was statistically analogous to wheat straw (5.20 cm²). The minimum leaf area was noted in control plants (4.20 cm²) that were statistically alike to sugarcane bagasse (5.0 cm²). The improvement in leaf is

Table 1. Effect of organic and inorganic mulches on the vegetative components of Chili

Treatments	Leaf area (cm ²)	Number of leaves per plant	Plant height (cm)	flowering time (days)
Control	4.2 c	56.3 d	32.0 d	73.3 a
Transparent Plastic mulch	7.0 a	75.0 a	54.3 a	57.0 d
Rice straw	5.3 b	61.0 c	49.3 b	62.0 bc
Wheat straw	5.2 b	65.0 bc	46.0 c	60.0 cd
Sugarcane Begas	5.0 bc	66.0 b	49.0 b	64.3 b
Black polyethylene mulch	6.2 a	71.0 a	51.0 b	60.3cd
LSD (p=0.05)	0.8	4.2	2.8	3.7

In columns, figures sharing similar letter(s) are not statistically different at P = 5%

due to maintenance of moisture and increased in soil temperature. Similar results were reported by (Hallidri, 2001) that polyethylene mulch increases the vegetative growth of cucumber.

Number of leaves per plant: The mulch material significantly influenced the number of leaves per plant as presented in Table 1. The maximum number of leaves per plant (75.0 leaves) was noted in polyethylene mulch followed by the black polyethylene mulch (71.0 leaves), while other mulch treatments showed similar response. The lowest number of leaves per plant (56.33 leaves) were recorded in control plants. Hallidri (2001) reported that number of leaves were higher in black and transparent polyethylene mulch than control (bare soil). Greater and early vegetative growth of cucumber under these mulches also led to a greater yield than under bare soil. These results support the findings of Wien *et al.*, (1993) who reported that increased tomato growth and yield by polyethylene mulching and it might be due to enhanced root growth and nutrient uptake early in the season.

Plant height (cm): The mulch material significantly increased plant height as shown in (Table 1). The maximum plant height (54.3 cm) was observed in transparent polyethylene mulch followed by black polyethylene mulch (51.0 cm) which was statistically not significant from rice straw (49.3 cm) and sugarcane begas (49.0 cm), respectively. The moderate plant height (46.0 cm) was recorded in wheat straw. The minimum plant height (32.0 cm) was yielded in those plants which received no mulch material. This might be due to availability of moisture and enhanced temperature during growth period of chili. These findings were confirmed by the results of Olabode *et al.* (2007). Who found that use of polyethylene mulch increased the plant height in okra (*Abelmoschus esculentus*)

Number of days to flower: The mulch material significantly reduced number of days to flower as shown in (Table 1). The minimum days to flowering (57.0 days) were recorded in transparent polyethylene mulch followed by black polyethylene mulch (60.3 days) that was statistically at par with wheat straw (60.0 days) and rice straw (62.0 days). Maximum days to flower were taken by the control (73.33 days) followed by the sugarcane begas (64.33 days). The use of polyethylene mulch is effective in early flowering because it promotes the soil temperature that leads to early maturity of plant. Present results support the findings of Tuli and Yesilsoy, (1997) that early

blooming can be developed by the application of polyethylene mulch in case of squash.

Fruit set (%): Mulching had a significant effect on fruit set as demonstrated in Figure 1. Maximum fruit set (86.66%) was observed in polyethylene mulch followed by black polyethylene mulch (81.66%). The fruit set observed in rice straw was (76.66%) that was statistically at par with sugarcane begas (76.66%), wheat straw (75.0%) and control (73.66%), respectively. This might be due to better vegetative growth of chili plants under mulch material which results in more number of flowers and branches per plant; as a result, the fruit set increased. Our results are in accordance with the outcome of Iqbal *et al.* (2009) that mulch material boost up the fruit percentage in pepper.

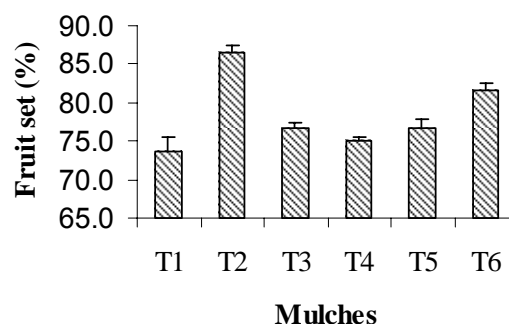


Figure 1. Effect of mulches on the fruit set (%) of chili

Fruit length (cm): The result indicated that there was a significant variation among different mulch material as presented in Figure 2. The highest fruit length (8.83 cm) was recorded in black polyethylene mulch that was statistically similar to transparent polyethylene mulch (8.58 cm) followed by sugarcane begas (7.18 cm), wheat straw (7.00 cm) and rice straw (5.66 cm), respectively. The lowest fruit length (3.31 cm) was noted when no mulch material was applied. These results have similar response with those studied by Farios-Larios and Orozco-Santos (1997) who investigated that fruit length of watermelon was higher with polyethylene mulches because the mulches conserved the soil moisture and enhanced soil temperature which increased the fruit length.

Fruit width (cm): Fruit width (cm) was modified by the application of mulch material as shown in Figure 3. The maximum fruit width (3.41 cm) was obtained in transparent polyethylene mulch that was statistically non significant with black polyethylene mulch (3.21 cm) and sugarcane begas (2.58 cm). It was also found that

the mulch material such as rice straw (2.54 cm) and wheat straw (2.49 cm) produced the same fruit length, while control produced the minimum fruit width (1.43 cm). Mulches mostly influence the field microclimate by modifying the radiation budget of the surface and decreasing soil water losses. These microclimate factors strongly impact the soil temperature and moisture in the root area, which in response may increase plant growth and yield (Aguyoh *et al.*, 1999; Osiru and Hahn, 1994).

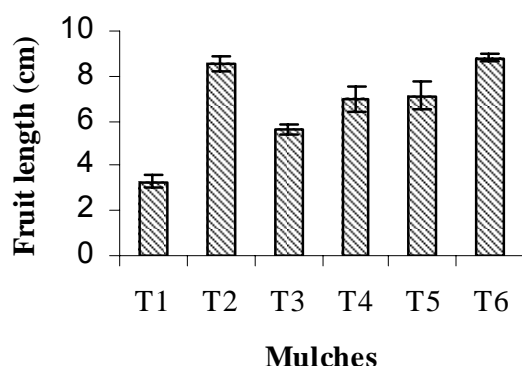


Figure 2. Effect of mulches on the fruit length (cm) of chili

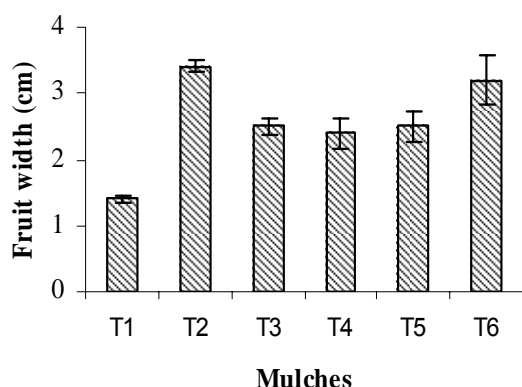


Figure 3. Effect of mulches on the fruit width (cm) of chili

Fruit weight (g): Results revealed that mulch material had significant difference as demonstrated in Figure 4. The maximum fruit weight (8.0 g) was observed in black polyethylene mulch followed by transparent polyethylene mulch (7.07g) and sugarcane begas (5.66 g). The fruit weight found in rice straw (4.50g) and wheat straw (3.87g) was statistically at par with one another. The minimum fruit weight (3.16g) was measured in control. Farias-Larios and Orzoc-Santos (1997) observed increased fruit weight in watermelon by the application of clear polyethylene mulch as

compared to un-mulched soil as early and higher vegetative growth support better fruit weight gain.

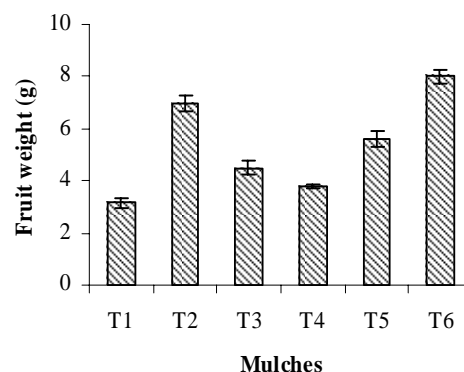


Figure 4. Effect of mulches on the fruit weight (g) of chili

Number of days to first harvest: The mulch material significantly decreased the number of days to first harvest as predicted in Figure 5. The minimum days concerning to first harvesting (90.0 days) were counted in transparent polyethylene mulch followed by black polyethylene mulch (95.0 Days). While wheat straw plants took (98.6 days) for first harvest that was statistically similar with rice straw (90.0 days) and sugarcane begas (99.0 days), respectively. The maximum numbers of days (103.3 days) were observed in control plants. Plants under plastic mulches took less time to bring the plant to early maturity and improved plant productivity by conserving of soil moisture, maintaining a uniform temperature for the better growth and development of roots. This speeds up the ripening period of the fruit (Saijapongese *et al.*, 1989).

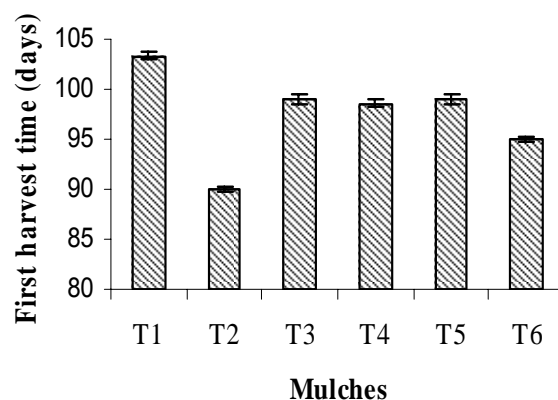


Figure 5. Effect of mulches on the first harvest time (days) of chili

Number of fruit per plant or yield: Fruit per plant was significantly increased by the use of polyethylene mulch as demonstrated in Figure 6. Maximum fruit per plant (61.0 fruit) was recorded in black polyethylene mulch that was statistically same in transparent mulch (58.47 fruit) followed by sugarcane begas (51.0 fruit). The fruit per plant (47.33 fruit) noted in rice straw was statistically not different from the wheat straw (46.0 fruit). Minimum fruit per plant (38.0) was obtained in control. Taber and Lawson (1997) reported that total and early yields increased with polyethylene mulches. Similar results with other vegetables were obtained by Pakyurek and Kaşka (1992) in watermelon, Apaydin *et al.*, (1998), Pakyurek *et al.*, (1992) and Tuzel and Boztok (1990) in tomato, Çevik *et al.*, (1992) in cucumber, Pakyurek *et al.*, (1992) in pepper and eggplant inorganic mulches, predominantly polyethylene mulch, produced the higher yields as compared to the non-mulch materials.

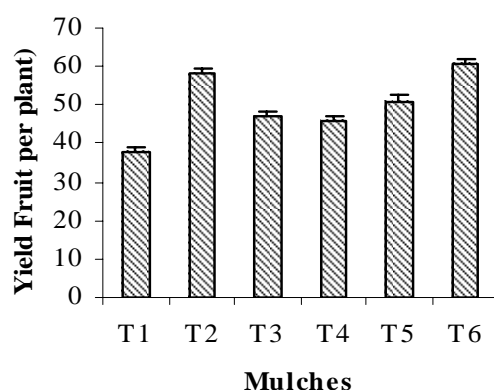


Figure 6. Effect of mulches on the yield (fruit per plant) of chili

CONCLUSIONS

From the above study it could be concluded that polyethylene mulches (both transparent and black) are effective in promoting the growth and yield of chili as these increase the soil temperature and conserve the soil moisture but these are cost bearing and difficult to decay and remove from the field. On the other hand the sugarcane begas can also be used for the conservation of soil moisture in arid and semi arid regions as it can be dumped into the soil after harvesting of crop and can improve the soil fertility.

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