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MULCH AND IRRIGATION EFFECTS ON TOMATO PERFORMANCE AND WEED INFESTATION

M. K. Shahadat[a], M. A. Rahman[a], M. G. Miah[b], A. K. M. A. Hoque[b], S. Cundu[a]

[a]Bangladesh Agricultural Research Institute (Gazipur-1701, Bangladesh)
[b]Bangatandhu Sheikh Mujitur Rahman Agricultural University (Gazipur-1701, Bangladesh)

The experiment was conducted at the Bangabandhu Sheikh Mujibur Rahman Agricultural University research farm, Gazipur, Bangladesh during November 2008 to March 2009 for determining the effects of irrigation and mulch on the performance of tomato. The experiment was laid out in a split-plot design with three replications where mulch materials (*Senna* leaf, rice straw and no-mulch) were assigned in main plots, while five irrigation levels (IW/CEP 1.0, IW/CEP 0.75, IW/CEP 0.50, IW/CEP 0.25, and IW/CEP 0.0) were distributed in subplots. *Senna* leaf mulch gave 4.64 % and 25.02% higher tomato yield than rice straw and no mulch treatment, respectively. IW/CPE 1.0 produced 5.64 %, 13.40 %, 33.04 %, and 87.65 % more yield compared to IW/CPE 0.75, 0.50, 0.25 and no irrigation levels, respectively. *Senna* leaf mulch with IW/CPE 1.0 level of irrigation produced the highest (58.54 t ha^{-1}) yield, which did not vary significantly with rice straw with IW/CPE 1.0 (56.89 t ha^{-1}) and *Senna* leaf mulch with IW/CPE 0.75 (56.73 t ha^{-1}). Reducing sugar, total sugar and ascorbic acid were increased with the decreasing irrigation levels, but β carotene increased with increasing irrigation levels. Weed was suppressed significantly under mulch materials than no mulch treatment. Therefore, *Senna* leaf could be used as potential mulch material for soil moisture conservation, higher tomato yield and weed suppression. About 26 % irrigation water could be saved without significant yield loss if *Senna* leaf is used as mulch.

Keywords: tomato, weed, mulch, irrigation, yield

ВЛИЯНИЕ МУЛЬЧИРОВАНИЯ И ОРОШЕНИЯ НА УРОЖАЙНОСТЬ ТОМАТОВ И ПОДАВЛЕНИЕ РОСТА СОРНЯКОВ

М. К. Шахадат[1], М. А. Рахман[1], М. Г. Миах[2], А. К. М. А. Хокуе[2], С. Кунду[1]

[1]Сельскохозяйственный исследовательский институт Бангладеш (г. Газипур-1701, Бангладеш)
[2]Сельскохозяйственный университет Бангабандху им. Муджибура Рахмана (г. Газипур-1701, Бангладеш)

Эксперимент проводился на исследовательской ферме Аграрного Университета Бангабандху Шейх Муджибур Рахман, округ Газипур, Бангладеш с ноября 2008 по март 2009 г. Целью эксперимента было выявить влияние орошения и мульчирования на урожайность томатов. Эксперимент проводился на дробных делянках и включал в себя 3 серии; основные участки или мульчировались (листьями сенны и рисовой соломой) или оставались без мульчирования, в то же время на дробных делянках использовались 5 уровней орошения (IW / CEP1,0, IW/CEP 0.75, IW/CEP 0.50, IW/CEP 0.25, и IW/CEP 0.0). Мульчирование листьями сенны дало прирост урожая томатов на 4,64 и 25,02 % выше, чем при мульчировании рисовой соломой и при отсутствии мульчирования соответственно. При урове орошения IW/CPE 1.0 урожай был выше на 5,64, 13,40, 33,04 и 87,65 % по сравнению с уровнями IW/CPE 0,75, 0,50, 0,25 и при отсутствии полива соответственно. Мульчирование листьями сенны в сочетании с уровнем орошения IW/CPE 1.0 дало самый высокий урожай (58,54 т/га – 1), который существенно не отличался при мульчировании рисовой соломой и применении уровня орошения IW/CPE 1.0 (урожайность 56.89 т/ га – 1), мульчирование листьями сенны в сочетании с уровнем орошения IW/CPE 0,75 дало урожай 56,73 т га – 1. Повышение содержания редуцирующего сахара, общего сахара и аскорбиновой кислоты наблюдалось в томатах при снижении уровня орошения, тогда как содержание β-каротина увеличивалось при повышении уровня орошения. Мульчирование значительно подавляло рост сорняков. Следовательно, листья сенны можно использовать в качестве мульчи для сохранения влаги в почве, повышения урожайности томатов и подавления роста сорняков. Использование для мульчирования листьев сенны позволяет сэкономить около 26 % оросительной воды без существенной потери урожайности.

***Ключевые слова*:** томаты, сорняки, мульча, орошение, урожайность

Introduction

Tomato (*Lycopersicon esculentum)* belonging to the family Solanaceae, is a very popular and world's most widely grown vegetable after potato and sweet potato [2]. Among different varieties of tomato, "Shila" is one of the most popular varieties in Bangladesh which gives better yield, available in the market and can be stored relatively long time as fresh [1].

Statistics shows that tomato growing area increased by 145 % in the period of 2003–2004 compared to 1971–72. Although its total production increased by 98 %, but yield per unit area (ton ha^{-1}) decreased by 18 % at the same time [3]. An average yield of 7.4 Mg ha^{-1} is, however, poor compared to other tropical countries [4]. This poor yield is due to the use of low-yielding varieties, improper cultural practices including insufficient supply of nutrients and water and poor disease management [5]. These facts suggest that there is a possibility to increase tomato yield per unit area as well as total production by using appropriate management techniques.

Tomato is grown in the Rabi (dry) season (November through March) in Bangladesh, when lack of water becomes a serious constraint for crop production. Tomato is sensitive to water stress [4; 7–8]. Both excess and shortage of irrigation are detrimental to its growth and yield. Water stress during the growth stage of plant increases flower drop and retards fruit growth [9]. Calculating soil water balance based on evaporation and rainfall is easily understood and suitable for crop irrigation scheduling [10].

Application of mulch material is one of the good agronomic practices that could conserve soil environment and reduce weed infestation. The mulch promotes crop growth and development and increase crop yield. Weed growth is suppressed by the mulch as it can prevent the penetration of light needed for weed growth [11]. Mulch can also retard the loss of moisture from the soil, maintaining higher and uniform soil moisture thus reducing the irrigation frequency [12].

Zhang et al. [13] observed that mulching with straw reduced soil evaporation loss and increased water use efficiency of wheat in northern China. In Bangladesh, rice straw is used as traditional mulch and its potential use has been evaluated by many researchers [14–15]. Besides mulch, rice straw is also used as fuel, cattle feed, house making material etc. but the availability of rice straw is reducing because of extensive use. In this situation tree leaves could be used as potential mulch material. *Senna siamea* is a good agroforestry species, whose leaf is hard, decomposes slowly and persists in the soil for long time [16].

Estimation of the amount and rate of the crop water use may help avoid over and under irrigation of crops, thus leading to increase in the water use efficiency. In the context of increased tomato yield in water available condition, it is important to understand the causes or mechanism of the observed yield advantage and reduced irrigation cost under different mulches. This is perhaps, related to better soil moisture conservation due to probable lower rate of evapotranspiration resulting from mulching effect.

Information on the interaction effect of moisture regimes and tree leaf mulches in tomato is lacking in Bangladesh. However, it is possible that there is a positive interaction of these two important inputs that might have reduced the irrigation water requirement and ultimately contributed to better yield of tomato.

The findings of this study also have another economic importance from practical point of view. This study results will help farmers, particularly subsistence farmers to use irrigation water more judiciously. It is also believed that mulching has the potential to suppress weeds, which ultimately reduces the competition between the crop and weeds and thus improve crop yield. In the mean time, this will also reduces production cost because in this way farmers need not to use much inorganic fertilizers and other agrochemicals due to mulches and this will ultimately conserve the soil environment as well as agro-ecosystem.

Thus, the present study was aimed:

– To examine the yield and quality of tomato under different irrigation and mulching regimes.

– To determine the optimum rate of irrigation water for tomato production during the dry season.

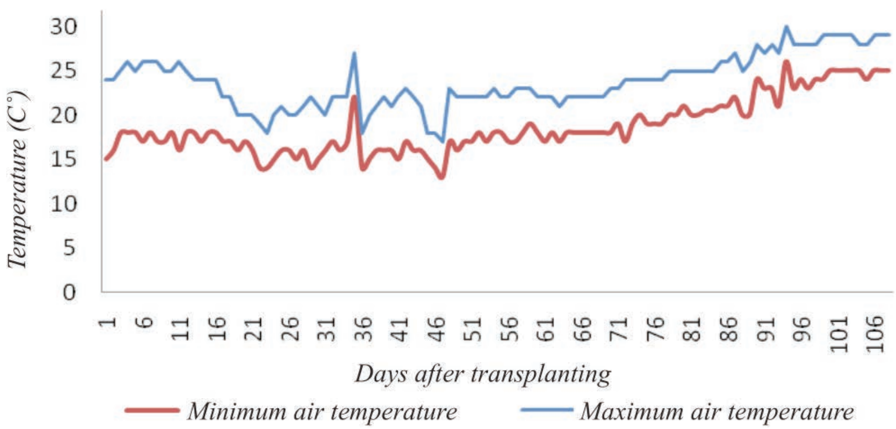
– To understand the weed suppression due to application of mulch.

– To compare tree leaf mulch with rice straw mulch for tomato production.

Materials and methods

Experimental condition

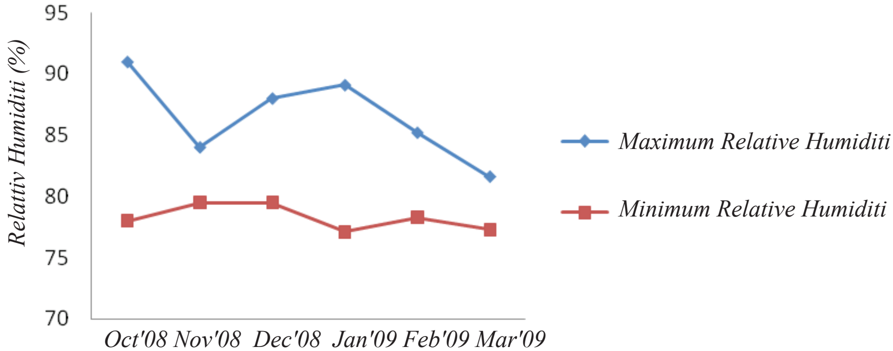
The experiment was conducted at the experimental farm of the Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur during October, 2008 to March, 2009. The location of the experimental site located in an upland condition which is situated at 24°.09' N latitude and 90°.20' E longitude with an elevation of 8.20 m above the mean sea level [17]. The location is situated in the sub-tropical climatic zone characterized by heavy rainfall during May to September and scanty during the rest of the year. During the study period, daily maximum and minimum air temperature was recorded as 27.13° C and 19.3° C, respectively (Fig. 1). Maximum and minimum relative humidity was 86.5 % and 78.3 %, respectively (Fig. 2). It is noted that there was no rainfall before final irrigation.



F i g. 1. Atmospheric temperature during the study period

Р и с. 1. Температура окружающей среды в течении изучаемого периода

Soil of the experimental site was silty clay loam in texture belonging to Salna series having 1.59 g cm^{-3} bulk density. Soil pH, total nitrogen and organic matter content were 6.15, 0.077 % and 1.64 %, respectively.



F i g 2. Atmospheric relative humidity during the study period

Р и с. 2. Относительная влажность воздуха в изучаемый период

Experimental treatments

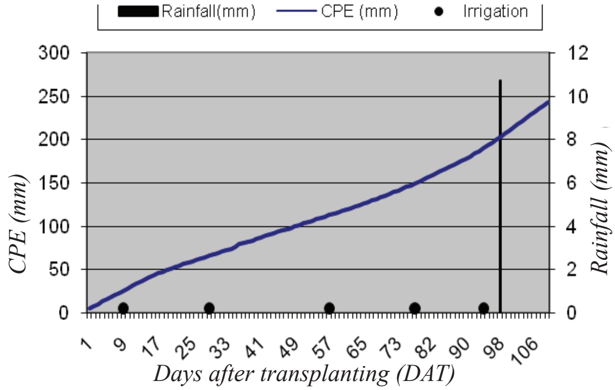
The experiment was laid out in split-plot design with three replications. Main-plots were treated with three mulch materials *viz.* open field i.e. no mulch (M_0), rice straw (M_1) and *Senna siamea* leaf (M_2). *Senna siamea* leaf and rice straw were sundried on a threshing floor for about five days and spread on the field after one week from the transplanting of seedlings at the rate of 5 ton ha^{-1}. Sub-plots were treated with five irrigation levels *viz.* no irrigation (I_0), irrigation water/cumulative pan evaporation (CPE) 0.25=10 mm/40 mm (I_1), IW/CPE 0.50 = 20/40 mm (I_2), IW/CPE 0.75 = 30/40 mm (I_3) and IW/CPE 1.00 = 40/40 mm (I_4). Surface irrigation was applied based on CPE and rainfall (fig. 3). When CPE was equal or exceeded 40 mm, then 0, 10, 20, 30 and 40 mm of irrigation water (IW) were applied in the I_0, I_1, I_2, I_3 and I_4 treatments, respectively. Forty five unit plots, 4 m × 2 m in size, adjacent blocks and neighboring plots were separated by 2.5 m and 0.5 m spacing, respectively. Thirty three (33) days old healthy, uniform seedlings of BARI Tomato 8 (Shila) were transplanted at 60 cm×60 cm spacing.

Measurements

Soil water content (0–30 cm) was measured at different DAT. Daily pan evaporation data was collected from the nearest weather station. Five plants were selected randomly from each plot excluding borders. At each harvesting, number of fruits per plant, fruit width, fruit length and fruit weight was recorded. At the second harvest, after recording data, some of the fruits were preserved to determine total Sugar, reducing Sugar, β-Carotene and ascorbic acid as described by Pleshkov (1976) and Nagata et al. (1992). After final harvest, a square frame was placed in the center of each plot to collect weed samples. Weed samples were then oven dried at 70^0 C for 72 hours.

Data analysis

All data were subjected to the analysis of variance (ANOVA) with computer software. The significance of the treatment effect was determined using the F-test, and Duncan's multiple range test (DMRT) was used to determine the significance of the difference among the means of the treatments at the 5 % probability level.



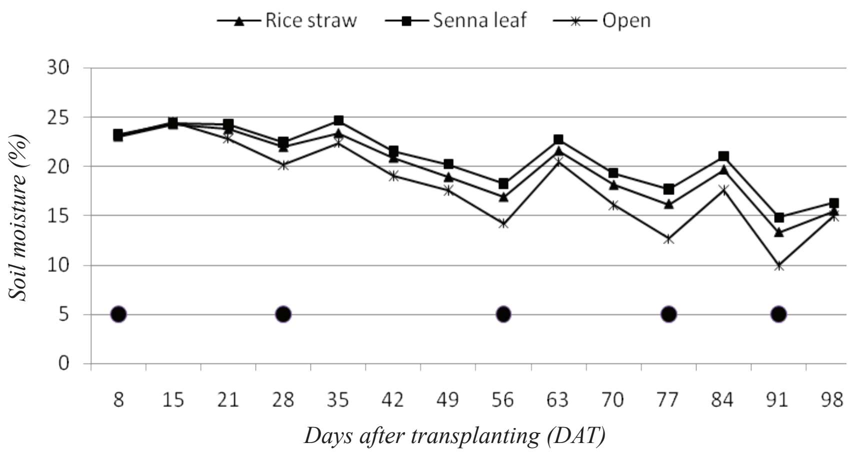
F i g. 3. Cumulative pan evaporation (CPE) and rainfall recorded during the experiment. Solid circle represents irrigation date

Р и с. 3. Полное куммулятивное испарение и количество осадков в период эксперимента. Черными точками обозначены дни орошения

Results and discussion

Soil Water Content

In general, soil water content increased with irrigation. Higher soil water content was conserved in the mulch treated plots (M_1 and M_2) compared to no mulch (M_0) treated plots. In contrast, soil water content was higher under the *Senna* leaf mulch (M_2) than the straw mulch (M_1) plot. Doring et al. [18] observed higher soil water content in mulch treatment compared to no mulch treatment. Initially (8 DAT), soil water content did not vary much among the mulch treatments, because same amount of irrigation (40 mm) was applied to all the treatments after seedling transplanting. After application of irrigation, soil water content decreased gradually with time and again it rose (at 35, 63 and 84 DAT) when following irrigation was applied (Fig. 4). Similar trend of variation in soil moisture content was observed by Rahman [19].



F i g. 4. Soil moisture content at different days after transplanting as influenced by mulching. Black circles indicate days of irrigation

Р и с. 4. Изменение показателей увлажненности почвы под влиянием мульчирования после пересадки

The highest plant height was observed under mulch treatments than no mulch (M_0) treatment. *Senna* leaf mulch (M_2) treatment produced the tallest plant (78.36 cm), which was statistically similar to straw mulch treatment (M_1) (6.78 cm). Similar plant height of tomato was found by (Hasan, 2006) when mulched by Mahogany tree leaf. Among the irrigation levels, the highest plant height (80.48 cm) was observed at IW/CPE 1.0 (I_4) treatment, which was statistically similar to IW/CPE 0.75 (I_3) (79.68 cm) and IW/CPE 0.5 (I_2) (78.23 cm) treatments. Significantly the smallest plant (66.31 cm) was recorded in no irrigation (I_0) treatment. The combined effect of mulch and irrigation was insignificant, where the tallest and smallest plants were noted in Senna leaf mulch with IW/CPE 1.0 (M_2I_4) and no mulch with no irrigation (M_0I_0) treatment, respectively.

The highest number of clusters was found in Senna leaf mulch (7.16), which did not vary significantly with straw mulch (6.78). However, significantly the minimum number of clusters per plant (5.52) was recorded in no mulch treatment. The number of clusters per plant was significantly influenced by irrigation levels. The highest number of clusters per plant was recorded in the highest level of irrigation (I_4), which was statistically similar with I_3 treatment. Thereafter, the number of clusters decreased significantly with decreasing the level of irrigation and reached to the minimum in no irrigation treatment. The highest number of clusters per plant was noted in M_2I_4 (8.46), which were insignificantly followed by M_1I_4, M_2I_3, M_1I_3, M_1I_2 and M_2I_2 treatments.

A strong variation was observed among the mulch materials in producing number of fruits per plant where significantly the highest and lowest number of fruits per plants was recorded in M_2 (26.18) and in M_0 (23.87) treatments. Among the irrigation levels, the maximum number of fruits per plant was found in I_4 treatment, which did not vary significantly with I_3 treatment. Significantly the minimum number of fruits was noted in I_0 (21.05) treatment. In case of combined effects, number of fruits was the highest in M_1I_4 (27.94) that was insignificantly followed by M_2I_4 (27.81), M_2I_3 (27.61), M_1I_3 (27.44), M_2I_2 (27.25), M_1I_2 (27.21) and M_0I_4 (26.71) treatments.

Fruit diameter did not vary significantly between two mulch materials but it varied significantly when no mulch material was applied. The highest fruit diameter (55.07 mm) was recorded in *Senna* leaf mulch (M_2), while significantly the lowest value (52.97 mm) was recorded in no mulch treatment. Fruit diameter was the highest in I_4 treatment (55.87 mm), which was statistically similar to I_3 treatment (55.78). Significantly the lowest fruit diameter was noted in the no irrigation level (51.00 mm) (Table 2). Ara [21] revealed that fruit diameter decreased progressively with decreasing irrigation levels. The combined effect of mulch and irrigation was insignificant, where the maximum and minimum fruit diameter was noted in Senna leaf mulch with IW/CPE 1.0 and no mulch with no-irrigation treatments, respectively.

The highest fruit length (51.38 mm) was observed in *Senna* mulch (M_2) treatment, which was statistically similar with rice straw mulch (M_1), while the lowest fruit length (49.15 mm) was observed in no mulch (M_0) treatment.

Among the irrigation levels, fruit length was maximum (51.33 mm) in I_4 treatment which was statistically similar to I_3 (50.86 mm) treatment. Fruit length decreased distinctly after that. However, significantly the minimum fruit length was noted in no-irrigation level. In case of combined effect, fruit length was the highest in M_1I_4 (51.51 mm) treatment, which was closely followed by M_2I_4 (51.46 mm), M_2I_3 (51.00 mm), M_1I_3 (50.99 mm), M_0 I_4 (51.00 mm), M_2I_2 (50.82 mm), M_1I_2 (50.76 mm) and M_0 I_3 (50.58 mm) treatments. Similar results also reported by Rahman [19], where he found the highest fruit length in *Senna siamea* leaf much with IW/CPE 1.0 irrigation level.

Individual fruit weight was not affected by mulch materials, where the highest (65.42 g) and the lowest (62.72 g) values were recorded in Senna leaf and no mulch treatments, respectively. On the other hand, individual fruit weight was influenced significantly by irrigation levels. The highest fruit weight was found in I_4 (68.01 g) level which was statistically similar to I_3 (67.48 g). The lowest fruit weight was observed in no irrigation level i.e. I_0 (56.00 g).

In case of combined effect, maximum fruit weight was found in M_2I_4 (68.67 g), which was statistically similar to M_2I_3 (68.27 g), M_1I_4 (68.18 g), M_1I_3 (68.10 g), M_0I_4 (67.97 g), M_2I_2 (67.78 g) and M_1I_2 (67.27 g) levels. Begum (1999) recorded maximum average fruit weight under the highest irrigation level, which progressively decreased with decreased irrigation and observed smallest fruit under no irrigation condition.

The highest fruit yield (48.97 t ha^{-1}) was noted in *Senna* leaf mulch (M_2) treatment and it was significantly higher than straw mulch (M_1) (46.80 t ha^{-1}). Significantly the lowest yield (39.17 t ha^{-1}) was recorded in no-mulch treatment.

Among the irrigation levels, significantly the highest (54.68 t ha^{-1}) and significantly the lowest (29.14 t ha^{-1}) increasing fruit yield was obtained in IW/CPE 1.0 (I_4) and no-irrigation (I_0) treatment, respectively.

In case of combined effects, M_2I_4 treatment gave the highest fruit yield (58.54 t ha^{-1}), which was insignificantly followed by M_2I_3 (56.73 t ha^{-1}) and M_1I_4 (56.89 t ha^{-1}) treatments. The lowest yield was noted in M_0I_0 (27.42 t ha^{-1}). Begum et al. [7] reported that irrigation is indispensable and high frequency of irrigation is required for obtaining good yield of tomato in the clay terrace soil of Bangladesh.

The cultivation of tomato with *Senna* leaf mulch produced higher fruit yield of 4.43 % and 20.01 % than rice straw and no mulch treatments, respectively. Maximum irrigation level (IW/CPE 1.0) produced 5.34 % and 24.83 % more yield than IW/CPE 0.75 and minimum (IW/CPE 0.25) irrigation levels, respectively. Mohapatra et al. [22] mentioned that irrespective of irrigation level, mulch material gave higher yield because of better moisture conservation than no mulch treatment.

Table

Таблица

Main and combined effects of irrigation and mulch materials on the performance of tomato

Влияние орошения и мульчирования на урожай томатов по отдельности и одновременно

Treatment	Plant height (cm)	Number of cluster	No. of fruits per plant	Fruit diameter (mm)	Fruit length (mm)	Individual fruit weight (g)	Yield (t ha^{-1})
1	2	3	4	5	6	7	8
Mulch materials							
M_0	72.41 b	5.52 b	23.87 c	52.97 b	49.15 b	62.72 a	39.17 c
M_1	76.70 a	6.78 a	25.58 b	54.50 a	50.00 a	64.98 a	46.80 b
M_2	78.36 a	7.16 a	26.18 a	55.07 a	50.38 a	65.42 a	48.97 a
Irrigation levels							
I_0	66.31 c	4.31 d	21.05 d	51.00 d	47.38 d	56.00 d	29.14 e
I_1	74.43 b	5.80 c	24.44 c	53.30 c	49.39 c	64.20 c	41.10 d

End of table

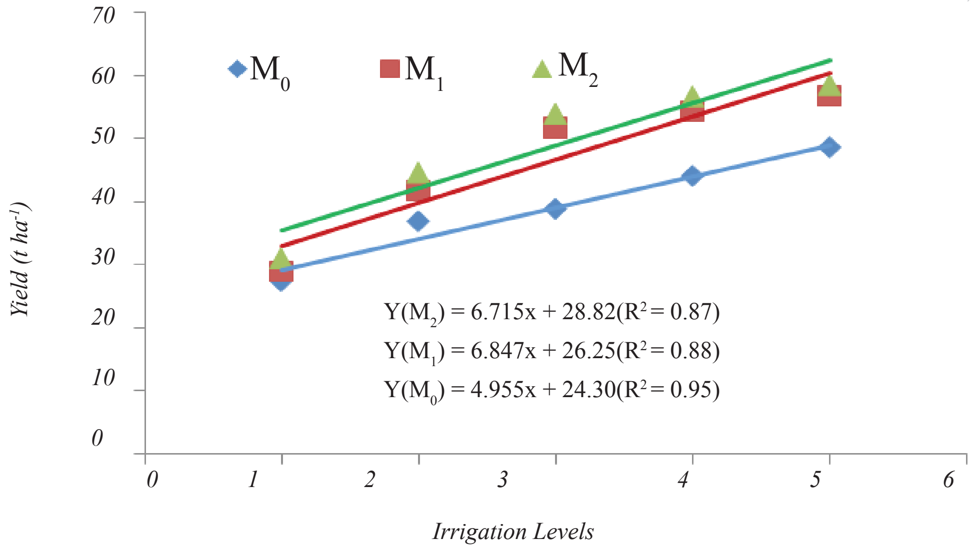
1	2	3	4	5	6	7	8
I_2	78.23 a	7.13 b	26.13 b	54.95 b	50.27 b	66.16 b	48.22 c
I_3	79.68 a	7.43 ab	27.13 a	55.78 ab	50.86 a	67.48 ab	51.76 b
I_4	80.48 a	7.76 a	27.30 a	55.87 a	51.33 a	68.01 a	54.68 a
Combination of mulch materials and irrigation levels							
M_0 I_0	62.87	3.80 g	19.97 g	50.10	46.19 f	55.36 e	27.42 i
M_0 I_1	71.33	5.20 e	22.95 ef	52.38	48.75 d	62.16 d	36.89 g
M_0 I_2	73.35	5.40 e	23.57 ef	52.78	49.24 cd	62.60 d	38.85 fg
M_0 I_3	76.19	6.33 cd	26.15 bc	54.60	50.58 ab	65.50 bc	44.08 e
M_0 I_4	78.29	6.86 bc	26.71 abc	54.99	51.00 ab	67.97 ab	48.60 d
M_1 I_0	65.07	4.26 fg	20.85 g	51.03	47.39 e	56.33 e	28.99 hi
M_1 I_1	75.09	5.46 de	24.47 de	53.31	49.37 cd	63.61 cd	41.79 ef
M_1 I_2	80.60	7.96 a	27.21 abc	55.85	50.76 ab	67.27ab	51.87 c
M_1 I_3	81.53	7.96 a	27.44 abc	56.52	50.99 ab	68.10 ab	54.46 bc
M_1 I_4	81.23	8.26 a	27.94 a	55.78	51.51 a	68.18 ab	56.89 ab
M_2 I_0	71.00	4.86 ef	22.33 f	51.88	48.56 d	56.32 e	31.02 h
M_2 I_1	76.87	6.73 c	25.90 cd	54.21	50.06 bc	66.83 ab	44.62 e
M_2 I_2	80.73	7.70 ab	27.25 abc	56.23	50.82 ab	67.78 ab	53.95 bc
M_2 I_3	81.30	8.03 a	27.61 ab	56.21	51.00 ab	68.27 ab	56.73 ab
M_2 I_4	81.90	8.46 a	27.81 ab	56.83	51.48 a	68.67 a	58.54 a

Means within a column followed by the same letters are not significantly at the 5 % level according to DMRT.

M_0 = No mulch; M_1 = Rice straw and M_2 = *Senna siamea* leaves. I_0 = No irrigation; I_1 = IW/CPE 0.25= 10mm/40mm; I_2 = IW/CPE 0.50 = 20mm/40mm; I_3 = IW/CPE 0.75 = 30mm/40mm; I_4 = IW/CPE 1.0 = 40mm/40mm.

Relationship between irrigation levels and tomato yield under different mulch materials

The yield response of tomato as influenced by different levels of irrigation under different mulch materials is presented in Figure 5. The linear relationships between irrigation levels and fruit yield of tomato were estimated as Y = 6.715x+28.827 (R^2= 0.87**), Y = 6.847x+26.25 (R^2 = 0.88**) and Y = 4.955x+24.30 (R^2 = 0.957**) for *Senna* leaf mulch, rice straw and no mulch respectively, where R^2 values are very high and highly significant. From the regression line, it is obvious that irrigation levels influenced 96 %, 89 % and 87 % of fruit yield of tomato under no mulch, rice straw and *Senna* leaf mulch, respectively. The relationships also stated that yield of tomato was changed at the rate of 4.9 t ha^{-1}, 6.8 t ha^{-1} and 6.7 t ha^{-1} for no mulch, rice straw and *Senna* leaf mulch, respectively, per unit of changing of irrigation. Using these equations, it showed that the yield of tomato did not decrease significantly up to 26 % of irrigation reduction for both the mulch materials and up to 19 % of irrigation reduction for no mulch without significant yield loss.



F i g. 5. Trend in tomato fruit yield as affected by different mulch treatments and irrigation levels. (1 = No irrigation; 2 = IW/CPE 0.25; 3 = IW/CPE 0.50; 4 = IW/CPE 0.75; 5= IW/CPE 1.0; M_0 = No Mulch, M_1= Rice straw and M_2= *Senna siamea* leaf)

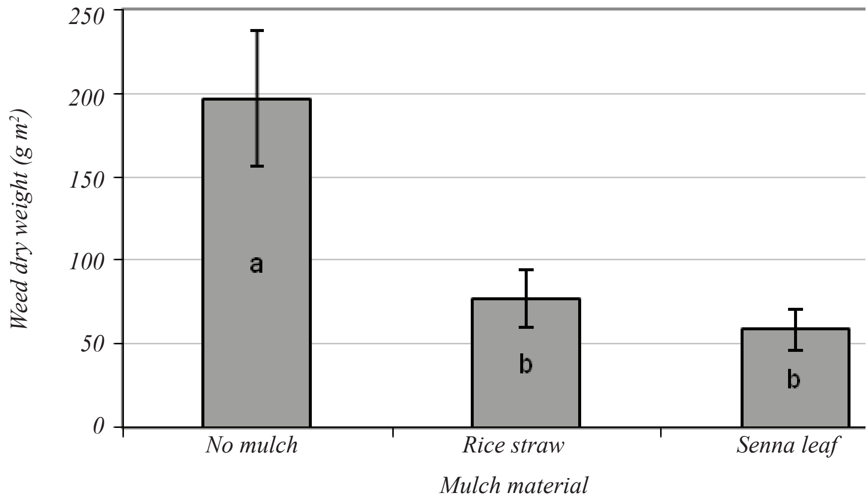
Р и с. 5. Показатели урожая томатов при применении различных методов мульчирования и объемов орошения (1–без орошения; орошение/испарение: 2–2– 0,25; 3–0,50; 4–0,75; 5–1,0; M_0 – без мульчирования, M_1 – мульчирование рисовой соломой, M_2 – листья *Senna Siamea*)

Fruit Quality

β-carotene content of tomato was influenced due to application of mulch materials and irrigation levels. The β-carotene content of tomato was relatively higher in mulch treatments compared to no-mulch treatment; and the values increased with increasing irrigation levels. The β-carotene content did not vary much among the mulch materials under I_0 and I_1 irrigation levels. However, under I_2 and I_3 irrigation levels, β-carotene content was remarkably higher in both mulch materials compared to no-mulch treatment. The ascorbic acid content was higher in no-mulch treatment compared to mulch treatments. In general, ascorbic acid of tomato fruit decreased with increasing irrigation levels from I_0 to I_4. The highest (15.52 mg 100 g^{-1}) and the lowest (8.30 mg 100 g^{-1}) ascorbic acid contents were noted in M_0I_0 and M_2I_4 treatments, respectively. Reducing sugar content of tomato was decreased gradually with increasing irrigation levels. Reducing sugar content was the highest (22.51 mg 100 g^{-1}) at no irrigation under no mulch ($I0M_0$) and the lowest (15.04 mg 100 g^{-1}) under *Senna* leaf treatment ($I4M_2$). At I_4 irrigation level, reducing sugar content was almost equal among the mulch materials but at other irrigation levels, the highest values were noted in no-mulch treatment, which was followed by rice straw and *Senna* leaf much. The highest (39.69 mg 100 g^{-1}) and the lowest (26.41 mg/100 g) total sugar contents were noted at no irrigation under no mulch and at IW/CPE 1.0 under *Senna* leaf treatments, respectively. At I_4 treatment total sugar content did not vary among the mulch materials but marked variation occurred with the increase of irrigation level from I_3 to I_0. However, total sugar contents were very close in *Seena* leaf mulch and rice straw much irrespective of irrigation levels.

Dry weight of weed

Significantly the highest weed dry weight was recorded in no mulch treatment. Although the lowest weed dry weight (58.69 g m^{-2}) was found in *Senna* leaf treatment, it was statistically similar to rice straw mulch (76.98 gm^{-2}) treatment. Significantly lower weed biomass was also reported by Kamara et al. [16] using *Senna* leaf mulch and by Ramakrishna et al. [12] using rice straw mulch compared to no mulch treatment. *Cynodon dactylon*, *Cyperus rotundus*, *Desmodum trifolium, Alternanthera sessilis, Setaria viridis* etc. are some common weed species found in the study.



F i g. 6. Effect of mulch materials on dry weight of weed grown in the tomato field. Measurement was done after final harvest of tomato fruit. Means followed by a common letter are not significantly different at 5% level of significance according to DMRT. Bars represent ± SE

Р и с. 6. Влияние материала мульчирования на сухой вес сорняков на томатном поле. Показатели, не имеющие значимых различий (до 5 % по тесту Дункана), объеденины под общими литерами

Conclusions

Both mulch materials and irrigation levels have an influential effect on different morphological characters, yield and yield contributing characters and quality of tomato. *Senna* leaf mulch gave 4.64 and 25.02 % higher tomato yield than rice straw and no mulch treatment, respectively. IW/CPE 1.0 produced 5.64, 13.40, 33.04, and 87.65 % more yield compared to IW/CPE 0.75, 0.50, 0.25 and no irrigation levels, respectively. About 26 % and 19 % irrigation water could be saved without significant yield loss if *Senna* leaf and rice straw are used as mulch. Reducing sugar, total sugar and ascorbic acid were increased with the decreasing irrigation levels, but β carotene increased with increasing irrigation levels. About 235 % and 155.5 % weed was suppressed in *Senna* leaf and rice straw mulch, respectively. Therefore, *Senna* leaf could be used as potential mulch material for soil moisture conservation, higher tomato yield and weed suppression even than rice straw mulch.

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About the authors:

Shahadat M. K., Scientific Officer, Agronomy Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh

Rahman M. A., Assistant Professor, Agronomy Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh

Miah M. G., Professor, Department of Agroforestry and Environment, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh

Hoque A. K., Scientific Officer, Professor, Department of Agroforestry and Environment, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh

Cundu S., Scientific Officer, Horticulture Research Center, Planning and Evaluation Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh

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Об авторах:

Шахадат М. К., научный сотрудник отдела агрономии Сельскохозяйственного исследовательского института Бангладеш (г. Газипур-1701, Бангладеш)

Рахман М. А., старший научный сотрудник отдела агрономии Сельскохозяйственного исследовательского института Бангладеш (г. Газипур-1701, Бангладеш)

Миа М. Г., профессор кафедры агролесничества и экологии Сельскохозяйственного университета Бангабандху им. Муджибура Рахмана Сельскохозяйственного исследовательского института Бангладеш (г. Газипур-1701, Бангладеш)

Хок А. К., профессор кафедры агролесничества и экологии Сельскохозяйственного университета Бангабандху им. Муджибура Рахмана Сельскохозяйственного исследовательского института Бангладеш (г. Газипур-1701, Бангладеш)

Кунду С., научный сотрудник исследовательского центра растениеводства, отдел планирования и оценки Сельскохозяйственного исследовательского института Бангладеш (г. Газипур-1701, Бангладеш)

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