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Assessment of Crop Residue Mulches on Morphological Traits and Yield of Tomato (*Lycopersicon esculentum* L.) in North Bihar Region

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Organic mulches are easily available and cheap in North Bihar region. Therefore, an experiment was conducted to find out the suitability of different types of organic mulches in tomato cultivation. Among the vegetables tomato cultivation faces challenges in producing crop without chemicals for effective weed control. Use of several kinds of mulches gives the opportunity to control weeds effectively, regulate soil temperature and also lower down evaporation from the soil. The experiment was conducted in Krishi Vigyan Kendra, Jalalgarh, Purnea during 2015 and 2016. The treatments were designed by using different organic materials as mulch i.e. pea straw, dry neem leaves, paddy straw and one control without mulch. The observations were recorded on plant height (cm), number of branches per plant, days to 50% flowering, average fruit weight (gm) and total fruit yield (q/ha). The mulches were spread after twenty days of the transplanting of tomato seedlings in 10 cm thick layer. The result of the experiment indicates that organic mulches reduced soil temperature and weed infestation. All these enhanced the growth and fruit yield of tomato as well as weed control, soil moisture conservation and temperature modification resulted good crop growth with more quality fruit yield.

Keywords: Morphology; organic; mulch and tomato; Lycopersicon esculentum; crop residue.

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1. INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is a common and important fruit vegetable. Tomato fruits are rich in Vitamin A and B as well as Iron. It is grown for fresh market and tops the list of canned vegetables [1]. Green tomatoes are also used for pickles and preserve. Its many forms are adapted to wide range of soils and climates and culture extends from the tropics to a few degrees with in the Arctic Circle. By virtue of its many attributes tomato is also a favourite crop for research on various morphological, physiological and other traits. Indian agriculture is facing several challenges. It is now depending on the heavy use of fertilizer, pesticides and other several inputs which are constantly degrading and polluting the quality of soil. The primary benefits are the consequences of the pesticides' effects – the direct gains expected from their use. Tremendous benefits have been derived from the use of pesticides in forestry, public health and the domestic sphere – and, of course, in agriculture, a sector upon which the Indian economy is largely dependent [2,3]. The farmers use excess doses of fertilizers and pesticides to increase the yield of the crop but these over doses of fertilizers and other chemicals are hazardous for soil as well as our health also. In order to minimize degradation of soil, water and other natural resources and for environmental protection, we should adopt the conservation practices [4]. These are more essential to obtain sustained and consistent yield, conservation of soil, water and other natural resources. Mulching is one of the conservation practices by which theses goals can be achieved. Use of organic mulching is one of the suitable methods which could help the horticultural growers to increase the production with good quality of produce. Looking to the water scarcity and the challenges that arise due to climate change, adoption of organic mulching at large scale by the Indian farmers would help the farmers to overcome several problems considering the advantages of organic mulching [4-6].

Mulching is an effective method of manipulating micro climatic condition to increase yield and improve fruit quality by suppressing weed growth, ameliorating soil temperature, conserving soil moisture, reducing soil erosion, improving soil structure and enhancing organic matter content in soil [7,8,9]. The weed control efficiency of different types of mulch in *Cayenne pepper* production range from 27 to 97 % [9].

2. MATERIALS AND METHODS

A field experiment was conducted under National Horticulture Mission programme at farm of Krishi Vigyan Kendra, Jalalgarh in Purnea district during 2015 and 2016 in Zaid season. The soil of experimental field was sandy loam, low available nitrogen, P_2O_5 and high in K_2O with neutral in reaction. The recommended package of practices recommended by Bihar Agricultural University, Sabour, Bhagalpur, Bihar were adopted during conducting the experiment. The experiment was laid out in Randomised Block Design with four treatments and five replications. The treatment were without mulch as control (T_1), Pea straw mulch (T_2), Dry neem leaves (T_3) and Paddy straw (T_4).

An experimental plot of 150 m^2 was prepared and seedlings were transplanted at the spacing of 45cm x 45cm, the transplanted seedling was watered immediately and recommended dose of fertilizers N:P:K::120:100:100 kg per hectare were applied to all the experimental plots in the form of Urea, Diammonium phosphate and muriate of potash. Whole quantity of phosphorus, potash and half of nitrogen were applied as basal dressing and rest of nitrogen was applied in two equal doses at 30 and 45days after transplanting as top dressing. The recorded on plant height (cm), No. of branches per plant, days to 50% flowering, Average fruit weight (g) and fresh fruit yield (q/ha). The collected data was analysed by using randomised block design.

Table 1. Preliminary physico-chemical status of soil at experimental plot

Soil properties	Value
Texture:	
Sand (%)	56
Silt (%)	33
Clay (%)	11
Textural class:	
Sandy loam	
pH	6.5
EC (dS m^{-1})	0.31
Nitrogen (g $100g^{-1}$)	0.12
Available Phosphorus (mg $100g^{-1}$)	4.47
Potassium (mg $100g^{-1}$)	117.0
Organic matter (mg $100g^{-1}$)	0.64

3. RESULTS

Plant height (cm): Application of different mulch materials had significant effect on the plant height during the experimental period (Table 2).

The plant height of tomato was significantly influenced by paddy straw which was statistically taller (109.49 cm) followed by dry neem leaves (98.34 cm), Pea straw (94.98 cm) and without mulch (68.91 cm) as control.

Number of branches per plant: Number of branches per plant was significantly increased among all treatments (Table 2). The highest mean value (11.08) was obtained from the plants mulched with pea straw followed by mulched with dry neem leaves (10.53) and mulched with paddy straw (8.88) while the least mean value (5.66) was observed in the plot having without mulch.

Days to 50 per cent flowering: The mean days to 50 per cent flowering of tomato is presented in Table 2. The days obtained 50 per cent flowers were noted with the treatment (T_2) pea straw, which is significantly influenced more i.e. 34.83 days flowering followed by mulched with dry neem leaves and Paddy straw with the mean value of 36.40 days and 38.14 days, respectively while the least mean value (50.22 days) was observed in control during the experimental period.

Average fruit weight (g): The mean average fruit weight of tomato is presented in Table 2. The average fruit weight of tomato were recorded significantly higher with treatment T_2 with mean value of 57.01g followed by T_4 with mean value (39.48 g) and treatment T_3 with mean value (38.52 g) while lower mean value (28.11 g) were noted with the plots left un-mulched (control) during study period.

Total fruit yield (q/ha): The total fruit yield of tomato influenced by different organic mulches is shown in Table 2. The total fruit yield of the tomato was significantly increased with the treatment T_2 with mean value (190.82 q/ha) followed by T_4 and dry neem leaves (T_3) with the mean value of (162.29 q/ha) and (119.49 q/ha), respectively. The least fruit yield i.e.62.02 q/ha was obtained from un-mulched plot (control) during both the experimental years.

Table 2. Effect of different organic mulches on growth and yield of tomato (Pooled)

Treatment	Plant height (cm)	No. of branches per plant	Days to 50% flowering	Average fruit weight (gm)	Fruit yield (q/ha)
T1	68.91	5.66	50.22	28.11	62.02
T2	94.98	11.08	34.83	57.01	190.82
T3	98.34	10.53	36.40	38.52	119.49
T4	109.49	8.88	38.14	39.48	162.29
C.D.	**6.532**	**3.317**	**4.384**	**2.777**	**4.297**
SE(m)	**1.401**	**0.711**	**0.94**	**0.596**	**0.922**
SE(d)	**1.982**	**1.006**	**1.33**	**0.842**	**1.304**
C.V.	**2.132**	**11.131**	**3.333**	**2.066**	**0.975**

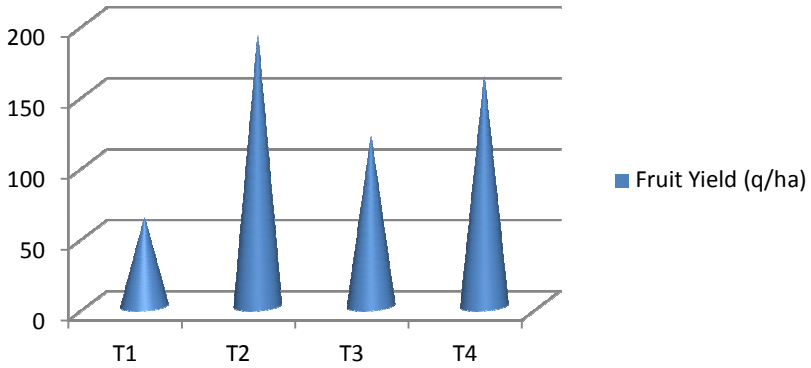

Fig. 1. Effect of different organic mulches on fruit yield of tomato

4. DISCUSSION

The mulches enhanced the growth of tomato plant in both the experimental years. The results agreed with previous studies which showed the superiority of mulched plants [7,10,9] and the report that tomato benefitted from mulching [8]. The increased morphological characters and tomato fruit yield under the mulches may be explained by the conservation of moisture and reduction of temperature in the top soil, and suppression of weed growth. The later resulted to reduced crop-weed competition. The best fruit yield obtained under (T_2) pea straw in this study confirmed to earlier report that the pea straw, having high C:N ratio was slowly decomposed compared with other organic mulches during study period (Rose 1996). Therefore, pea straw provides longer cover over the soil than paddy straw and dry neem leaves. Among the mulches, weed control was best under the pea straw. This confirms to the report that hard and late degradable mulch with high C:N ratio has most effectively controls weeds [11].

The weed control efficiency of pea straw that was better than other mulches can be explained by the decomposition caused by high C:N ratio. The preponderance of broad-leaved (Dicot) weed species is a factor of geographical location of study site, which is in the rainforest-dried type ecological zone [12] characterised by high rain fall.

Less moisture depletion under the mulches was a result of prevention of contact between the soil and dry air, which reduced water loss into the atmosphere through evaporation. Also mulches reduced impact of rain drops and splash, thereby preventing soil compaction, reducing surface runoff and increasing water infiltration [13]. All these combined to increase the soil moisture content and reduced moisture depletion. As moisture depletion is least under the plastic mulch, so the rate of moisture recharging ability would be more in organic mulches because water infiltration will be open [8].

The slightly higher water depletion in mulched plot than un-mulched (control) plot may be indicate that water loss into the atmosphere through transpiration from crop and weeds is higher than combined water loss through evaporation from the exposed soil surface and transpiration from the crop.

The result of the experiment indicates that organic mulches reduced soil temperature and weed infestation. All these enhanced the growth and fruit yield of Tomato [8] also reported that the primary objectives of mulching are weed control, soil moisture conservation and temperature modification resulted good crop growth with more yields.

5. CONCLUSION

Mulching increases growth and fruit yield of tomato through modification of the crop growing environment by suppressing weed infestation, soil moisture depletion and ameliorating soil temperatures. Organic mulches like pea straw, paddy straw, dry neem leaves etc. are easily available in farm, these are the crop residues of the cultivated crops. These are the cheap materials, so the cost of mulching is economical. The organic mulch offers a more beneficial opportunity for farmers. Hence, there is wide scope for the practise and usage of organic mulching material in crop production system with the conservation of natural resources including soil and water. This helps to reduce herbicides usage, thus prevents environment pollution and ensures production of organic food.

From this present study, it is clearly evident that pea straw mulch found best among all treatments by following appropriate scientific practices to achieve maximum yield with good quality of tomato fruits.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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