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# Effect of transplanting dates and mulching on growth and yield of tomato (*Solanum lycopersicum* L.)

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## Abstract

The effect of different dates of transplanting and various kinds of mulching materials was evaluated on growth attributes and yield of tomato (*Solanum lycopersicum* L.) under open field conditions. Different dates of transplanting and application of mulch significantly influenced the number of primary branches per plant at 30, 60 and 90 days after transplanting, number of secondary branches per plant at 60 and 90 days after transplanting, fruits per plant, fruit weight and the total fruit yield during both the years of experiments. Different dates of transplanting and application of mulch significantly influenced the plant height at all the growth stages except at 10 DAT. The maximum values of number of primary branches per plant at 30, 60 and 90 days after transplanting (8.78, 13.94 and 14.26, respectively), number of secondary branches per plant at 60 and 90 days after transplanting (9.45 and 11.65, respectively), fruits per plant (32.76), fruit weight (49.81g) and the total fruit yield (374.90 q/ha) during both the years recorded transplanting on 31st October with bio-mulch (Paddy straw), whereas the minimum values of number of primary branches per plant at 30, 60 and 90 days after transplanting, number of secondary branches per plant at 60 and 90 days after transplanting, fruits per plant, fruit weight and the total fruit yield during both the years of experiments recorded with crop transplanted on 30th November without mulch.

**Keywords:** Tomato, mulch, sowing date, plant growth

## Introduction

Vegetables are the vital part of the balanced diet of human the role of vegetables has been recognized worldwide in solving the problem of food and nutritional security. From the economic point of view, vegetables constitute a main segment of our agricultural system. Fresh vegetables are rich source of essential vitamins, minerals, dietary fibers and contain fair amount of carbohydrates and proteins. The constituents of vegetables have both the nutritional and therapeutic values due to their antcarcinogenic and antioxidant properties (Singh and Kalloo 2000). Tomato (*Solanum lycopersicum* L.) belongs to family Solanaceae and is considered as one of the most widely grown vegetable crop worldwide. It has its origin in Peruvian and Mexican region. It is a warm season crop reasonably resistant to heat and drought and can be grown under wide range of soil and climatic conditions. Tomato is also known as "Poor man's apple". Tomato fruits are eaten raw or cooked. Tomato, in large quantities, is used to produce soup, juice, ketchup, puree, paste and powder. It supplies vitamin C and adds variety of colors and flavors to the food. Green tomatoes are also used for pickles and preserves. Tomato is also rich in medicinal values. The pulp and juice are digestible, mild aperients, a promoter of gastric secretion and act as blood purifier. It is reported to have antiseptic properties against intestinal infestations. Due to antioxidant property of ascorbic acid and lycopene content of tomato fruits, it is gaining more medicinal importance now-a-days. As tomato is day neutral plant, many varieties are planted round the year. But there is a need to ascertain appropriate transplanting date to achieve higher quantitative and better qualitative yield. Temperature and light intensity play a vital role in plant growth, fruit setting, number of seeds per fruit and thereby the shape of fruits. It becomes very essential to find out the best date of transplanting for the seedlings to expose the plants to the most conducive atmosphere for growth, fruit setting, seed setting and development and other quality characters. Any deviation from it may result in poor yield and ill shaped fruits. Mulching contributes to crop production by way of influencing soil productivity, control of weeds etc. depending upon the type of mulch. Polythene mulch has stimulating effect

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on above ground growth experienced in early flowering, branching, early and total yields and nutrient concentration in tops. Use of plastic mulch also increases the nitrogen content of the soil (Hundal et al. 2000). The present experiments were conducted to find out an appropriate date of transplanting and to know the effect of different mulching materials on plant growth and yield potential of tomato crop.

## Materials and Methods

The field experiments were conducted at Vegetable Farm, Department of Vegetable Science, Kalyanpur, Chandra Shekhar Azad University of Agricultural and Technology, Kanpur during two consecutive *Rabi* seasons of the year 2016-17 and 2017-18. Geographically the experimental site lies under sub-tropical climate of Indo-Gangetic plains having alluvial soil and is located at 260 492 N latitude and 800 302 E longitudes and an altitude 113 meters above mean sea level. The study was consisted of four different dates of transplanting ($D_1$-15$^{th}$ October, $D_2$-31$^{st}$ October, $D_3$-15$^{th}$ November and $D_4$-30$^{th}$ November) and four different types of mulches ($M_1$-black polyethylene, $M_2$- white polyethylene, $M_3$-bio-mulch, i.e., paddy straw and $M_4$-control/without mulch). The experiments were laid out in RBD with tomato cultivar Azad T-6.

## Results and Discussion

**Growth parameters:** The observations recorded on plant height of tomato under different dates of transplanting (at 10, 30, 60 and 90 DAT) and different mulch conditions are presented in Table 1. The perusal of table revealed that different dates of transplanting and application of mulch significantly influenced the plant height at all the growth stages except at 10 DAT during both the experimentation years. Data presented in Table 1 shows that different dates of transplanting and use of mulch, both significantly influenced the plant height at all the growth stages except at 10 DAT. The maximum plant height at 10, 30, 60 and 90 DAT (11.76, 20.90, 90.34 and 94.10 cm, respectively) were recorded when the crop was transplanted on 31$^{th}$ October along with use of paddy straw as mulch, i.e., $D_2M_3$, which was statistically *at par* with plant height of crop transplanted on 31$^{st}$ October by using white polythene as a much at all the growth stages ($D_2M_2$). At all the growth stages of plant (except 10 DAT), treatment combination $D_2M_3$ was significantly superior to all other treatments except treatment combination $D_2M_2$ at 30 DAT. Pooled data also revealed that the minimum plant height at 10, 30, 60 and 90 DAT (9.39, 13.62, 59.35 and 61.51 cm, respectively) was recorded in treatment $D_4M_4$, i.e., crop transplanted on 30$^{th}$ November without any mulch. The data regarding primary branches (30, 60 and 90 DAT) and secondary branches (60 and 90 DAT) per plant of tomato is presented in Table 2.

Data revealed that the highest number of primary branches per plant at 30, 60 and 90days after transplanting (8.78, 13.94 and 14.26, respectively) was recorded in the treatment $D_2M_3$, i.e., crop transplanted on 30$^{th}$ October under bio-mulch (paddy straw) condition. However, minimum number of primary branches per plant at 30, 60 and 90 days after transplanting (5.74, 9.12 and 9.33, respectively) was recorded in crop transplanted on 30$^{th}$ November without using any mulch, i.e., treatment combination $D_4M_4$. Similar pattern of maximum and minimum numbers for secondary branches was observed in pooled data of

Table 1: Plant height (cm) at different days after transplanting

| Dates of transplanting | Mulching materials | Plant Height (10 DAT) | Plant Height (30 DAT) | Plant Height (60 DAT) | Plant Height (90 DAT) |
|---|---|---|---|---|---|
| 15 October | Black Polythene | 09.95* | 15.54* | 67.65* | 70.08** |
| | White Polythene | 10.29* | 16.39* | 71.32** | 73.88** |
| | Bio Mulch (Paddy Straw) | 10.81* | 17.47** | 76.05** | 78.78** |
| | Control (No Mulching) | 09.53 | 14.47 | 63.00 | 65.27 |
| 31 October | Black Polythene | 11.47* | 18.57* | 80.82* | 83.72** |
| | White Polythene | 11.62* | 19.63** | 85.45** | 88.51** |
| | Bio Mulch (Paddy Straw) | 11.76* | 20.90** | 90.34** | 94.10** |
| | Control (No Mulching) | 10.27 | 17.33 | 75.45 | 78.16 |
| 15 November | Black Polythene | 09.49* | 17.37* | 75.62* | 78.37** |
| | White Polythene | 09.79* | 18.36* | 79.89** | 83.59** |
| | Bio Mulch (Paddy Straw) | 10.00* | 19.55* | 85.02** | 86.44** |
| | Control (No Mulching) | 09.74 | 16.23 | 70.65 | 71.49 |
| 30 November | Black Polythene | 09.90* | 14.62* | 63.65* | 66.92** |
| | White Polythene | 10.05* | 15.42* | 67.15** | 70.04** |
| | Bio Mulch (Paddy Straw) | 10.55* | 16.40** | 71.37** | 72.89** |
| | Control (No Mulching) | 09.39 | 13.62 | 59.35 | 61.51 |
| CD at 5% | | 2.03 | 2.20 | 5.55 | 1.92 |
| C.V. | | 9.22 | 6.03 | 3.48 | 5.33 |

both the years. The highest number of secondary branches per plant at 60 and 90 days after transplanting (9.45 and 11.65, respectively) was recorded when the crop transplanted on 30th October by using paddy straw as mulching material, i.e., $D_2M_3$; followed by the crop transplanted on 31st October with white polythene mulch, i.e., $D_2M_2$ (8.91 and 11.63, respectively). However, the minimum number of secondary branches per plant at 60 and 90 days after transplanting (6.19 and 8.14, respectively) was recorded when the crop was transplanted on 30th November without any mulch, i.e., $D_4M_4$. The maximum plant height and the maximum number of branches (primary and secondary) per plant were recorded with 31st October transplanted crop during both the years of investigation. It might be due to availability of longer and favorable growing period for plant growth and utilization of sufficient nutrients from the soil, which resulted in quick and vigorous growth of the plants. The results of present investigation are in conformity with the findings of earlier workers, Abdalbagi et al. (2010), Islam et al. (2010), Singh et al. (2013), Ali et al. (2014) and Singh et al. (2015) in tomato. Gandhi and Bains (2006) reported that the tomato crop grown with straw mulch produced higher number of branches (8.70) as compared to crop grown without any mulch (8.10). Similar observations were also recorded by Choudhary et al. (2012) and Tolasa and Eshetu (2014) in capsicum.

**Yield parameters:** Observations recorded for total yield (q/ha) and different yield related parameters viz. number of fruits per plant and fruit weight (g) of tomato under different dates of transplanting and different mulching materials used, are presented in Table 3. The mean values indicated that all the treatment combination with different dates of transplanting using mulch were significantly superior to treatments in which no mulch was used. Data revealed that the crop transplanted on 31st October along with paddy straw as a bio-mulch, i.e., $D_2M_3$ produced significantly maximum number of fruits per plant (32.76), followed by treatment $D_2M$-$_2$, i.e., crop transplanted on 31tst October by using white polythene as a mulch (30.83). Whereas the minimum number of fruits per plant were recorded in treatment $D_4M_4$, i.e., crop transplanted on 30th November without any mulch (22.37). The maximum fruit weight (49.81 gm) and total fruit yield (374.90 q/ha) were observed when crop transplanted on 31st October by using paddy straw as mulch, i.e., $D_2M_3$, followed by treatment $D_2M_2$, i.e., crop transplanted on 31st October under white ploythene mulch (46.87 gm fruit weight and 352.84 q/ha total yield). However, the minimum fruit weight (34.00 gm) and total fruit yield (255.97 q/ha) were recorded with crop transplanted on 30th November without any mulch, i.e., $D_4M_4$.

The number of fruits per plant, fruit weight, and total fruit yield per hectare were significantly influenced by different planting dates which might be due to the availability of long period for vegetative growth and reproduction in early planted crop, as the plants accumulated more assimilates. In late transplanted crop, the temperature at flowering stage exceeded 35ºC, which impaired fruit set in tomato due to elongation of style, poor pollen production, poor pollen germination, slow pollen tube growth, lack of anthers dehiscence due to absence of endothesium layer and lack of pollination and fertilization, which led to poor fruit set and finally

Table 2: Number of primary and secondary branches per plant

| Dates of transplanting | Mulching materials | No. of Primary Branch (30 DAT) | No. of Primary Branch (60 DAT) | No. of Primary Branch (90 DAT) | No. of Secondary Branch (60 DAT) | No. of Secondary Branch (90 DAT) |
|---|---|---|---|---|---|---|
| 15 October | Black Polythene | 6.55* | 10.41* | 10.63* | 7.05* | 09.28* |
| | White Polythene | 6.90* | 10.96* | 11.22* | 7.44* | 09.79* |
| | Bio Mulch (Paddy Straw) | 7.34* | 11.70* | 11.97* | 7.93* | 10.44* |
| | Control (No Mulching) | 6.11 | 09.70 | 09.93 | 6.58 | 08.66 |
| 31 October | Black Polythene | 7.84* | 12.44* | 12.73* | 8.44* | 11.10* |
| | White Polythene | 8.27* | 13.14* | 13.44* | 8.91* | 11.63* |
| | Bio Mulch (Paddy Straw) | 8.78* | 13.94* | 14.26* | 9.45* | 11.65* |
| | Control (No Mulching) | 7.31 | 11.60 | 11.87 | 7.87 | 10.36 |
| 15 November | Black Polythene | 7.32* | 11.62* | 11.89* | 7.88* | 10.37* |
| | White Polythene | 7.71* | 12.25* | 12.53* | 8.30* | 10.93* |
| | Bio Mulch (Paddy Straw) | 8.22* | 13.05* | 13.35* | 8.73* | 11.65* |
| | Control (No Mulching) | 6.80 | 10.79 | 24.54 | 7.32 | 09.64 |
| 30 November | Black Polythene | 6.14* | 09.75* | 09.97* | 6.61* | 08.70* |
| | White Polythene | 6.49* | 10.31* | 10.55* | 6.99* | 09.21* |
| | Bio Mulch (Paddy Straw) | 6.90* | 10.96* | 11.21* | 7.43* | 09.78* |
| | Control (No Mulching) | 5.74 | 09.12 | 09.33 | 6.19 | 08.14 |
| | CD at 5% | 1.83 | 02.87 | 03.60 | 1.96 | 2.48 |
| | C.V. | 11.88 | 11.78 | 04.62 | 11.83 | 5.27 |

Table 3: Number of fruits/ plants, Fruit weight (gm) and Total yield (q/ha)

| Dates of transplanting | Mulching materials | No. of fruits per plant | Fruit weight (gm) | Total yield (q/ha) |
|---|---|---|---|---|
| 15 October | Black Polythene | 24.82* | 38.74** | 284.01** |
| | White Polythene | 26.15** | 38.75** | 299.26** |
| | Bio Mulch (Paddy Straw) | 27.90** | 42.43** | 319.35** |
| | Control (No Mulching) | 23.16 | 35.22 | 265.07 |
| 31 October | Black Polythene | 28.52* | 45.13** | 339.69** |
| | White Polythene | 30.83** | 46.87** | 352.84** |
| | Bio Mulch (Paddy Straw) | 32.76** | 49.81** | 374.90** |
| | Control (No Mulching) | 27.17 | 41.31 | 309.43 |
| 15 November | Black Polythene | 27.24* | 41.41* | 311.79** |
| | White Polythene | 28.72** | 43.67** | 328.71** |
| | Bio Mulch (Paddy Straw) | 30.06** | 45.70** | 344.01** |
| | Control (No Mulching) | 25.76 | 39.18 | 294.86 |
| 30 November | Black Polythene | 23.30* | 35.43* | 266.69** |
| | White Polythene | 24.09* | 36.62* | 275.65** |
| | Bio Mulch (Paddy Straw) | 25.63** | 38.98** | 293.35** |
| | Control (No Mulching) | 22.37 | 34.00 | 255.97 |
| CD at 5% | | 2.39 | 3.28 | 2.46 |
| C.V. | | 4.18 | 3.73 | 3.72 |

decreased the total fruit yield. The results of present study were like the findings of earlier research workers namely Singh and Kumar (2005), Singh et al. (2005) and Hossain et al. (2013, 2014). Norman et al. (2011) recorded the higher mean fruit weight of okra under dry grass mulch and the maximum mean fruit weight of pepper under sawdust mulch than the control. The increased number of fruits per plant, fruit weight and fruit yield with the application of bio-mulch was probably associated with conservation of moisture and improved micro-climate both beneath and above the soil surface. The suitable condition enhanced the plant growth and development and increased number of fruits bearing nodes resulting in a greater number of fruits per plant. Similar findings were also reported by Dzomeku et al. (2009).

## Conclusion

From the findings of present experiment, it can be concluded that the crop transplanted on 31st October significantly increases the growth and yield traits viz. plant height and number of primary & secondary branches, number of fruits per plant, fruit weight, and total fruit yield. Among various mulch treatments, application of bio-mulch significantly enhances the plant growths, fruiting traits and yield of tomato.

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टमाटर की वृद्धि घटकों और उपज मूल्यांकन पौध रोपण के विभिन्न तिथियों एवं विभिन्न प्रकार के पलवार सामग्री के प्रभाव का अध्ययन प्रक्षेत्र वातावरण में किया गया। विभिन्न तिथियों और विभिन्न पलवारों के प्रयोग में पौध रोपण के 30, 60 और 90 दिनों उपरान्त प्रति पौध प्राथमिक शाखाओं की संख्या, पौध रोपण के 60 और 90 दिनों उपरान्त प्रति पौध माध्यमिक शाखाओं की संख्या, प्रति पौध फलों की संख्या, फल वजन और कुल उपज लगातार दो वर्षों के परीक्षण में सार्थक रूप से प्रभावी पाया गया। विभिन्न तिथियों और विभिन्न पलवार के प्रयोग में पौध रोपण के हेतु 10 दिनों उपरान्त सभी चरणों में पौधों की ऊँचाई प्रभावित हुई। सामान्यतः 31 अक्टूबर को जैव–पलवार (धान की पुआल) के साथ रोपाई के 30, 60 और 90 दिनों बाद प्रति पौध प्राथमिक शाखाओं की संख्या क्रमशः (8.78, 13. 94 एवं 14.26) रोपाई के 60 और 90 दिनों बाद प्रति पौध माध्यमिक शाखाओं की संख्या क्रमशः (9.45 एवं 11.65), फलों की संख्या प्रति पौध (32.76), फल वजन (49.81 ग्राम) और कुल फल उपज (774.90 कु./हे.) को प्रयोगों के दोनों वर्षों के दौरान अधिकतम पाया गया, जबकि 30 नवम्बर को बिना पलवार (नियंत्रण उपचार) में रोपाई के 30, 60 और 90 दिनों बाद प्रति पौध प्राथमिक शाखाओं की संख्या, रोपाई के 60 और 90 दिनों बाद प्रति पौध माध्यमिक शाखाओं की संख्या, फलों की संख्या प्रति पौध, फल वजन और कुल फल उपज को प्रयोगों के दोनों वर्षों के दौरान न्यूनतम पाया गया।

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