EFFECTS OF DIFFERENT AGROCLIMATIC ENVIRONMENTS AS INDUCED BY MULCHING ON LEAF CURL VIRUS DISEASE SEVERITY AND FRUIT YIELD OF TOMATO

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Abstract: Both high and low temperatures are detrimental for growth and yield of tomato. Low temperature depresses germination and fruit set of tomato. High temperature adversely affect fruit-set and accompanied by high humidity it favours development of several diseases. Use of mulch and manipulating transplanting dates could produce appropriate agroclimatic environment and lesser disease incidence which would help to produce maximum fruit per unit area. In view of this, field experiment was conducted in Instructional Farm, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, during the winter season of 2007-08, to evaluate the influence of different mulching treatments, viz. rice straw mulch, black plastic mulch and control (farmers' practice) and two dates of transplanting, viz. 23rd November and 7th December on yield, yield components and leaf curl disease severity of tomato. Results revealed that yield and yield components and incidence of leaf curl virus disease were affected significantly due to variation in mulching materials used and transplanting dates followed. Fruit yield, number of seeds per fruit and number of fruits per plant were significantly more in crops transplanted on 23rd November than those transplanted on 7th December. Fruit yield and number of fruits per plant recorded from crops mulched with rice straw and black polythene were greater than control plots. Black polythene mulch appeared to be more efficient than straw mulch for increasing fruit yield, numbers of fruits per plant and number of seeds per fruit. Application of black polythene mulch increased 22.3 % more fruit yield, 22 % more number of fruits per plant and 15.7 % more number of seeds per fruit over the crops grown under control (farmers' practice). Crops grown under straw mulch treatment showed higher values of humidity than those grown with plastic mulch. Crops grown under first date of transplanting (23rd November) required more growing degree day to complete different phenological phases than those needed by the crops grown under second date of transplanting (7th December). Crops grown under straw and black plastic mulching had lesser leaf curl disease severity than those grown under no mulch treatment. Relationships between GDD and leaf curl severity % revealed that GDD accounted for 33 to 65 % variation in total disease severity %. It is concluded that higher production of tomato can be obtained when the crop is transplanted on 23rd November and grown with plastic mulch in the New Alluvial Zone of West Bengal. Larger yield and yield components in crops using black plastic mulch were associated with higher soil temperature and GDD and lesser canopy temperature and leaf curl disease severity.

Keywords: Tomato, mulch, fruit yield, dates of transplanting, leaf curl disease severity.

Introduction: Tomato is an important vegetable crop cultivated in the different parts of the country. In India 60-70% of the tomato is used as vegetables and the rest in the preparation like puree, ketchup, Jam, jelly etc. The crop is highly sensitive to pest and disease attack which reduce the productivity to a considerable extent. Growth, yield and disease incidence in tomato are affected by weather conditions. The onset and spread of disease greatly depends on the weather parameters during the growing periods. So by altering the planting date and application of mulching over soil surface could alter crop microclimate to such extent that might be useful for maximum fruit yield and comparatively lesser leaf curl disease, which appears to be an important disease of the crop. The present study was conducted to evaluate the effects of mulching and dates of transplanting on incidence of leaf curl disease severity and fruit yield of tomato grown in the Gangetic plains of west Bengal.

Materials And Methods: A field experiment was conducted at the Instructional Farm, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, during the winter season of 2007-08, to study the influence of mulching and transplanting dates on yield and disease of tomato (*Lycopersicon esculentum*). The experimental farm is located in new alluvial zone of West Bengal at 22°56′ N latitude, 8 8°32′ E longitude and at an altitude of 9.75 m above mean sea level. The experimental treatments consisted of three types of mulching, viz. rice straw mulch, black plastic mulch and control (farmers' practice) and two dates of transplanting, viz. 23rd November and 7th December in 2007 and laid out factorial randomized block design with three replications. The tomato fruit was harvested from each plot separately on different dates and the weights so recorded were summed up and expressed in kg/plot, which was lastly converted into q/ha. Five plants were randomly selected and the total number of fruits was counted and then average number of fruits/plant was calculated. Five fruits

were randomly selected in each plot and number of seeds in each fruit was counted and summed up and then average numbers of seeds/fruit were computed. Numbers of plant infested by leaf curl were counted at weekly interval from all the treatments. Percentage of disease was calculated for each treatment. Growing degree day (GDD) was calculated with the following expression:

GDD = (T max + T min)/ 2 – base temperature

Where, Tmax. is the maximum temperature of the day, Tmin. is the minimum temperature of the day. The base temperature considered was 5 ^{o} C.

Results And Discussion

Effects of dates transplanting and mulching on yield and yield components:

Fruit yield: Mean ripe fruit yields have been presented in Table 1 and illustrated in Fig. 1. Fruit yields were significantly affected by dates of transplanting. The highest fruit yield (370 q/ha) was obtained from crop transplanted on 23 November, whereas the crop transplanted on 7 December produced fruit yield of 321.58 q/ha. Thus, the delay in transplanting by 14 days beyond 23 November caused a reduction in fruit yield to the tune of 16 %.

Due to application of mulch, fruit yields of tomato significantly increased. On an average, the fruit yield was highest (381.74 q/ha) when the crop was grown with black polythene mulch, whereas the crop raised without any mulch produced fruit yield of 312.01 q/ha. Thus, due to application of black polythene mulch there was 22.3 % increase in fruit field over the crop grown without any mulch. Crops transplanted on 23 November and grown with black polythene mulch produced the highest fruit yield; while the crop transplanted on 7 December and grown without any mulch produced the least (Fig.1). Tewari et al. (1998) reported that highest fruit yield (70.28 t/ha) was recorded under black polythene mulch and when it was grown under rice husk and rice straw mulch, yield declined by 7 and 10 %, respectively. Fruit yield of tomato was highest with silver polythene mulch (76.4 t/ha) followed by black polythene mulch (73.5 t /ha). Mulching of tomato with plastic (25 u thickness) resulted in the highest yield of 12735 kg/ha which was 28.4 % higher over unmulched condition. According to Gutal et al. (1992) black polythene mulch of 25 u thickness increased fruit yield of tomato by 55% as compared to the controlled condition. In another study, it was reported that mulching enhanced growth and yield of tomato compared to bare ground and results further emphasized the need for early and rapid growth of late season tomato before the onset of terminal drought .

The interaction between dates of transplanting and mulching treatments in respect of total fruit yield (Table 1) was significant and the crop transplanted on 23 November and covered with black polythene mulch produced the highest amount of fruit (415.35 q ha^{-1}).

Fruit weight: Mean fruit weights have been presented in Table 1 which showed that the variation in dates of transplanting and mulching treatments significantly influenced fruit weight of tomato. On an average, fruit weight of crop transplanted on 23 November (54.98 g) was more than that in crop transplanted on 7 December (45.27 g). In terms of percentage, due to early sowing, there was 21.4 % advantage in fruit weight. Fruit weights in mulched plots were more than control. Black polythene mulch had resulted in 23.9 % increase in fruit weight over control condition.

The interaction between dates of transplanting and mulching treatments in respect of average weight fruit^{-1} (Table 1) was found to be significant at 5 % level of significance and the crop transplanted on 23 November and covered with black polythene mulch enabled to obtain the highest weight of fruit (59.67 g fruit $^{-1}$).

Number of fruits/plant: Number of fruits per plant (Table 1) was also significantly affected by differential mulching and date of transplanting treatments. The crop transplanted on 23 November produced greater number of fruits/plant (55.5) than the crop transplanted on 7 December (47.7) and in terms of percentage the gain in fruit number per plant was 16.4 %. Both straw and black polythene mulches helped to increase significantly more fruits than that done by the crop having no mulch. While the black polythene mulch showed 22 % increase in number of fruits per plant over control.

On the other hand, the interaction between dates of transplanting and mulching treatments in respect of number of fruits plant^{-1} (Table 1) appeared to be significant and the crop transplanted on 23 November and covered with black polythene mulch produced the highest number of fruits per plant (62.5 plant^{-1}).

Number of seeds/fruit: Mean number of seeds per fruit has been given in Table 1, from which it is evident that both varied dates of transplanting and mulching treatments significantly influenced the number of seeds per fruit. The early date of sowing (23 November) produced greater number of seeds per fruit than that produced by late transplanted crop (7 December) and the gain in percentage due to early transplanting was 14.2 %. The application of rice straw and black polythene on soil surface caused a larger number of seeds per fruit than that produced by the crop raised without any mulch. Owing to the use of black polythene mulch, there was 15.7 % increase in number of seeds per fruit over the control treatment.

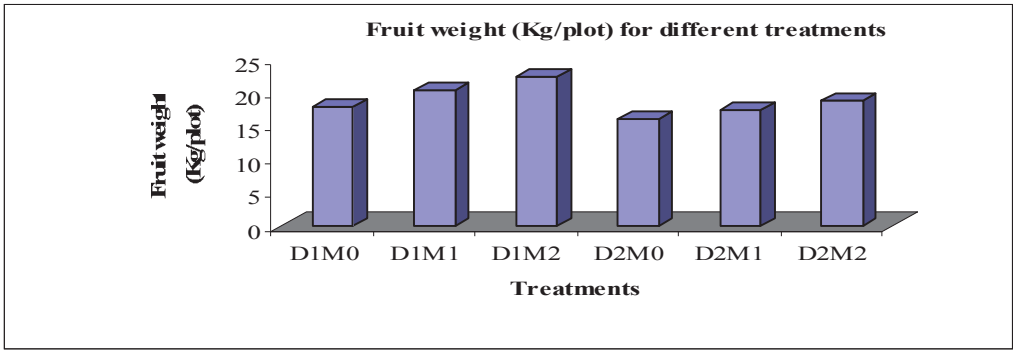
In case of interaction between dates of transplanting

and mulching treatments, the mean number of seeds fruit^{-1} (Table 1) was significant at 5 % level and the crop transplanted on 23 November and covered with black polythene mulch produced the highest number of seeds per fruit (115 fruit^{-1}).

Table 1. Effects of mulching and dates of transplanting on yield and yield components of tomato

Treatments	Fruit yield (q/ha)	Average weight (g/fruit)	No. of fruit/plant	No. of seeds/fruit
23 Nov (D1)	373.00	54.98	55.5	106.33
7 Dec (D2)	321.58	45.27	47.66	93.08
S. Em. ±	1.04	0.06	0.11	0.07
C.D. at 5 %	3.22*	1.84*	1.91*	1.86*
Control (MO)	312.01	45.07	46.5	92.37
Rice straw (M1)	348.12	49.47	51.5	99.87
Polythene (M2)	381.74	55.84	56.75	106.87
S. Em. ±	1.27	0.08	0.14	0.09
C.D. at 5 %	3.16*	0.20*	0.35*	0.24*
D1xMo	329.6	50.09	49.0	97.0
D1xM1	374.05	55.2	55.0	107.0
D1xM2	415.35	59.67	62.5	115.0
D2xMo	294.42	40.05	44.0	87.75
D2xM1	322.19	43.75	48.0	92.75
D2xM2	348.14	52.02	51.0	98.75
S. Em. ±	1.80	0.11	0.20	0.13
C.D. at 5 %	4.47*	0.28*	0.50*	0.33*

Fig. 1. Variation in fruit yield (kg/plot) of tomato as influenced by different treatments



Effect of dates of planting and mulching on Leaf curl diseases incidence: Severity (%) of leaf curl disease infestation as influenced by different treatments and recorded on different dates starting from 30 to 107 DAT have been presented in Table 2. It is apparent from the results that due to variation in dates of transplanting there were no remarkable variations in leaf curl disease incidence. However, the disease severity was, on an average, lesser in late transplanted crop (7 December) than in early transplanted crop (23 November). The crops grown under mulching had lesser disease severity than those grown under no mulch treatment. Tomato yellow leaf curl virus (TYLCV) incidence was reduced by 5 – 20 % depending on the colour of the mulch. Less number of White fly (*Bemisia tabaci*) adults / leaf was observed in mulched plots (Muqit et al.,2006). Suwan et al. (1998) reported that TYLC virus was reduced by the application of plastic mulch

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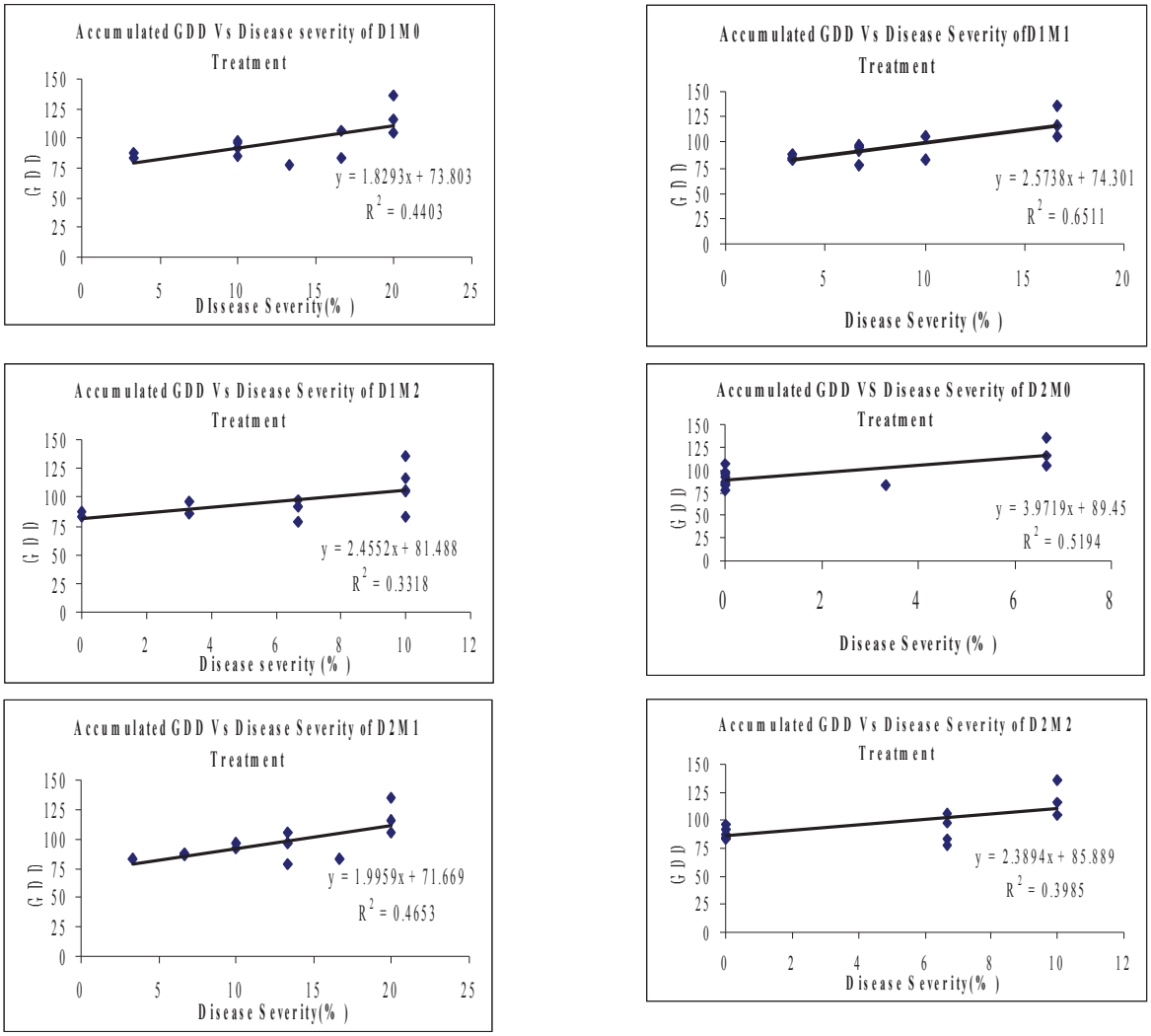
Table 2. Leaf curl disease percentage during different times during season								
Days after transplanting	Disease severity (%)							
	23 November (D1)				7 December (D2)			
	Control (MO)	Rice straw (M1)	Polythene (M2)	Mean	Control (MO)	Rice straw (M1)	Polythene (M2)	Mean
30	3.33	3.33	0.00	2.2	0.00	3.33	0.00	1.1
37	3.33	3.33	0.00	2.2	0.00	6.67	0.00	2.2
44	10.00	3.33	3.33	5.6	3.33	6.67	0.00	3.3
51	10.00	6.67	3.33	6.7	3.33	10.00	0.00	4.4
58	10.00	6.67	6.67	7.8	6.67	10.00	0.00	5.6
65	10.00	6.67	6.67	7.8	6.67	13.34	6.67	8.9
72	13.34	6.67	6.67	8.9	10	13.34	6.67	10.0
79	16.66	10.00	10.00	12.2	13.34	13.34	6.67	11.1
86	16.66	10.00	10.00	12.2	16.66	16.66	6.67	13.3
93	20.00	16.66	10.00	15.6	16.66	20.00	10.00	15.6
100	20.00	16.66	10.00	15.6	20.00	20.00	10.00	16.7
107	20.00	16.66	10.00	15.6	23.33	20.00	10.00	17.8
Mean	12.8	8.9	6.4	9.4	10.0	12.8	4.7	9.2

Fig. 2. Relationship between disease severity (%) of leaf curl and growing degree days (GDD) in tomato.



Relationships between Growing degree days and percent disease severity of leaf curl in tomato :

Relationships between GDD and leaf curl disease severity has been presented in Figs. 3 which revealed that GDD accounted for 33 to 65 % variation in total leaf curl disease severity %. In case of crops grown under first date of planting (23 November) , values of coefficient of determination (R2) varied from 0.33 to 0.65, whereas in case of crops grown under second date of transplanting (7th December) the R2 values ranged from 0.39 to 0.52. Thus consideration of GDD seems to be a useful tool to explain leaf curl disease severity in tomato crop.

It is concluded that higher production of tomato can be obtained when the crop is transplanted on 23 November and grown with plastic mulch in the New Alluvial Zone of West Bengal. Larger yield and yield components in crops using black plastic mulch were associated with higher soil temperature and GDD and lesser canopy temperature and leaf curl disease severity.

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