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Response of soil covers on guava cv. L-49

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ABSTRACT

The experiment was carried out at the Horticulture Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal ,during the year 2007 to evaluate the effect of organic and inorganic mulching materials on growth, fruiting and fruit quality of guava, grown on new alluvial zone of West Bengal. Different soil covers i.e. T_1- Cover crops (cowpea), T_2- Sugarcane trash (10 cm thickness), T_3- Saw dust (5 cm thickness), T_4- Dry leaves (guava leaves -10 cm thickness), T_5- Paddy straw (10 cm thickness), T_6- Black polythene (250 gauge) and T_7- White polythene (250 gauge) were used for the experiment with no mulching as control (T_8). In mulching, the treatment T_6 i.e., plants under black polythene produced maximum number of fruits (347.95) as well as highest yield (47.05 kg) per plant. However, different treatments under study showed increased in fruit weight and size, higher TSS, total sugar, reducing sugar, non- reducing sugar, TSS / Acid ratio and vitamin C content of fruits and reduced acidity over control, but paddy straw was found to be effective to improve the fruit quality of guava.

Key words: Fruiting, fruit quality, growth, guava, mulching and soil covers.

Guava (*Psidium guajava* L.) is one of the most popular fruit in India due to its nutritive value, high yielding capacity, hardness, good processing quality and wide adaptability all over the tropics and subtropics. It is native to Central America. In India, Uttar Pradesh has the largest area and production and Allahabad produces the best quality guava in the country as well as in the world. Mulching is an important soil management practice of covering the soil surface around the base of plants to make conditions more favourable for growing and to conserve the available soil moisture. The other well known effects of mulching are regulation of soil temperature, improvement of soil aeration, control of weed population, increase in organic matter content (organic mulch) and also increase the activity of soil micro-organisms. The use of material as mulch depends on its availability and mostly economic in nature. The commonly used mulch materials in fruit orchards include pruned materials in fruit orchards, fallen leaves, paddy straw, saw dust, hay etc. However, use of plastic mulch is becoming very popular. The usual practice of using mulches is to spread the material evenly over the soil surface between the rows and around the plants. The thickness of the mulches varies depending on the kind of the mulching materials used mainly. All these materials used as mulch (except polythene paper) have some value in supplying organic matter to the soil. Due to the beneficial effects of mulching practice in fruit cultivation, it always ensure the better quality fruit production with high yield and better return to the grower. The present investigation was, therefore undertaken to study the influence of soil covers on growth, yield and fruit quality of guava cv. Sardar (L-49) grown in West Bengal condition.

MATERIALS AND METHODS

The experiment was carried out at the Horticulture Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, during the year 2007. The soil of the experimental orchard is sandy loam in nature with soil pH 6.5 – 6.9. Soil depth is sufficient, moderately fertile and having good drainage system. Soil nutrient status is as follows- available nitrogen- 185.12 (kg ha^{-1}), available P_2O_5- 29.34 (kg ha^{-1}) and available K_2O- 324.23 (kg ha^{-1}).

The climatic condition of this research station is sub – tropical humid climate. Different soil covers *i.e.* T_1- Cover crops (cowpea), T_2- Sugarcane trash (10 cm thickness), T_3- Saw dust (5 cm thickness), T_4- Dry leaves (guava leaves-10 cm thickness), T_5- Paddy straw (10 cm thickness), T_6- Black polythene (250 gauge) and T_7- White polythene (250 gauge) were used for the experiment with no mulching as control (T_8). Before mulching, the entire plants basin was cleaned thoroughly. Mulching was provided during the first week of April 2007. The mulching was given up to the distance of 90 cm from the trunk. The selected plants with uniform growth (14 years old) were studied with these eight treatments with three replications, under randomized block design. The observations regarding the vegetative growth, flowering- fruiting and physico-chemical characteristics of fruits of guava were taken and analyzed statistically by analysis of variance method as suggested by Panse and Sukhatme (1978).

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RESULTS AND DISCUSSION

Vegetative growth

The data presented in table 1 and fig.1, 2, 3 and 4 revealed that mulching irrespective of treatments showed an increase in vegetative growth over control. The maximum increase in plant height, basal girth and canopy spread in both directions (East – West and North - South) were recorded with paddy straw (T_5) as compared to control (T_8). The percentage increase in plant height was recorded highest (5.02 %) between February and April, 7.46 % between April and June and 1.60 % between June and August by the treatment with paddy straw mulch. The maximum increase in plant girth (0.94 cm) was recorded under mulching with paddy straw (T_5) while it was only 0.48 cm in control plants. In East - West direction, the total increase in spread was significantly influenced by different treatments and the plants under paddy straw mulch (T_5) showed maximum increase of 0.76 m as compared with only 0.37 m in unmulched control plants. Canopy growth pattern in North – South followed the same trend as East – West directions and the highest increase (0.74 m) was recorded in the treatment with paddy straw (T_5) as compared to only 0.40 m in control.

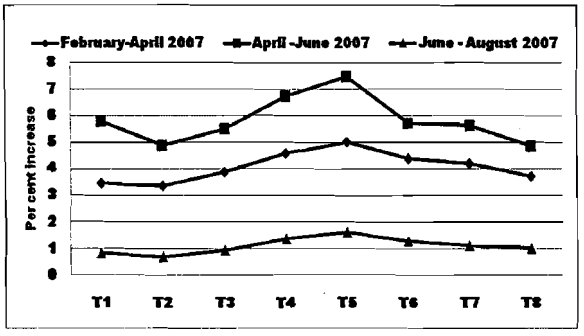

Fig. 1: Effect of mulching on plant height (at three months intervals).

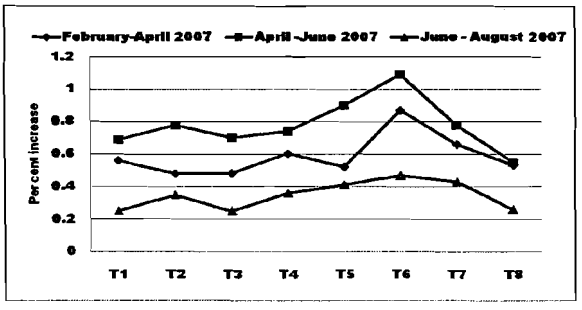

Fig. 2: Effect of mulching on basal girth of plant (at three months intervals).

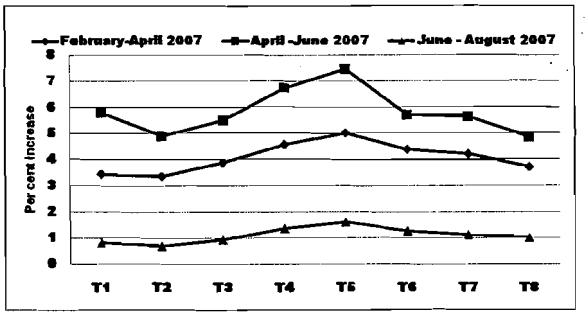

Fig. 3: Effect of mulching on plant spread (East-West).

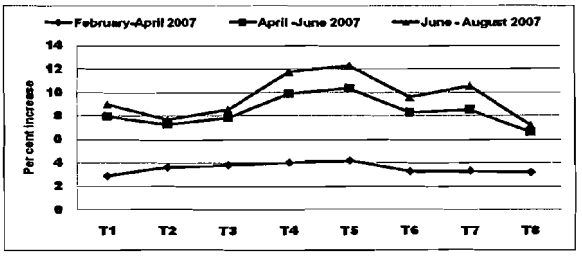

Fig. 4: Effect of mulching on plant spread (North-South).

Yield attributes

The highest flower drop (36.82%) was noted in case of unmulched control plants compared to mulching practices while minimum in paddy straw mulching (17.85%). As a result, mulching in general increased fruit set of the plants significantly. The highest fruit set (82.15 %) was recorded by the treatment with paddy straw while it was only 63.18 % (lowest) in control. But the minimum fruit drop (40.02 %) or maximum fruit retention (59.62 %) was noted with black polythene. Different mulching treatments resulted a significant variation in producing number of fruits per plant. The soil cover treatment with black polythene caused maximum (347.95) number of fruits per plant, while it was lowest (245.21) in control. It is clear that all the mulching treatments significantly increased fruit yield over the control. The lowest fruit yield was recorded only 27.72 kg /plant in control while it was maximum (47.05 kg /plant; 13.08 t /ha) by mulching with black polythene followed by white polythene (44.67 kg/tree; 12.42 t/ha).

Fruit quality

Data presented in table 3 revealed that plants under paddy straw mulch produced the fruits with maximum length (6.03cm) and diameter (6.40 cm).The average fruit weight showed significant variation due to different mulching treatments. The maximum fruit weight of 154.97 gram was noted from plants under paddy straw mulch while minimum (113.07 gram) was recorded in unmulched control.

Mulching also significantly improved the chemical compositions of fruits over control. Among the mulching treatments, paddy straw mulch was found most effective in increasing the total soluble solids content of fruits (8.53 ^{0}Brix) followed by dry leaves. The mulching treatments also had significant effect to reduce the acidity of the fruits and it was the lowest (0.32%) with white polythene while it was highest (0.38 %) in control. Plants mulched with paddy straw produced the fruits containing maximum (6.53%) total sugar, reducing (3.8%) and non-reducing sugar (2.72%). It was also revealed that different mulches had significant effect on vitamin-C content of fruits. The highest (149.26mg/100g fruit pulp) vitamin-C content of the fruit was recorded by paddy straw mulch, while it was lowest (113.77 mg/100g fruit pulp) in control.

It is revealed from the present investigation that mulching treatments in general, had greatly influenced the vegetative growth of the plants in terms of plant height, basal girth and canopy spreading. Similar effect of mulching on plant growth was also recorded earlier by Borthakur and Bhattacharyya (1996a) in guava, Chattopadhyay and Patra (1992) in pomegranate, Farre *et al.* (1999) in citrus. Borthakur and Bhattacharyya (1996b) recorded that mulching treatments resulted in significantly higher level of leaf nitrogen content in guava due to greater diffusion of nitrogen into the roots of plant grown under mulching that also maintained higher moisture regime for mitigating the shrinkage of roots and increased in contact surface between the roots and soil solution. Higher level of leaf nitrogen content produces extra protein by conversion of synthesized carbohydrates into amino acids in the leaf to enable them to grow larger in order to have a larger surface area for carbon assimilation and thus, probably have resulted in better plant growth of guava and better fruit yield.

Different mulching treatments also showed increase in weight of individual fruit, number of fruits per plant, yield of fruit per plant as well as per hectare in the present investigation. These results are in full conformity with the findings of Borthakur and Bhattacharyya (1998) in guava, Reddy and Khan (2000) in sapota. Mulching treatments had been reported to increase phosphate uptake by crop, principally because it encouraged surface rooting of the crop, kept the surface soil moist for a longer time and avoided fixation of applied phosphorous leading to higher phosphate uptake from surface soil by surface rooting under mulches (Robinson and Hosegood, 1965). Phosphorous being an essential constituent of biologically active macro – molecules (nucleic acids, co- enzyme NAD, NADP, ATP etc), is the integral part in important plant process like photosynthesis, glycolysis, respiration , fatty acid synthesis etc, contributing to the overall better performance of a plant (Devlin,1969). Hence the increased level of phosphorous uptake under mulched condition might have possibly increased the overall growth of fruit yield of guava plant.

Overall improvement in fruit quality of guava had been recorded in the present study with mulching treatments. Borthakur and Bhattacharyya (1996b) obtained higher yield and better quality of guava fruits by mulching and they also noted that there was a highly significant positive correlation between leaf potash content and yield and quality of fruits. Russell (1975) reported higher uptake of potassium under mulched plots due to higher moisture regime, maintenance of optimum level of soil temperature, reduction in temperature fluctuation, stimulation of surface rooting, efficient exploitation of surface soil and utilization of soluble potassium from the mulching materials (organic). Again, potassium is an activator for enzyme involved in protein and carbohydrate metabolism and influences the rate of photosynthesis. Thus, the mulching treatment possibly had lead to higher yield and better quality of fruits.

So, from the present study it is clear that mulching is better for plant growth and fruit production by maintaining soil moisture, temperature and soil nutrients. Although, mulching treatments in general showed a positive response to plant growth, fruit yield and superior quality of fruits, but in the present investigation use of paddy straw as mulch in guava orchard has been found most effective followed by black polythene as compared to others.

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Table 1: Effect of soil covers on plant height, basal girth and canopy spread of guava

Treatment	Plant height (m)						Basal girth(cm)					
	Initial height Feb.	Per cent increase			Final (Aug.)	Total increase	Initial girth Feb.	Per cent increase			Final (Aug.)	Total increase
		Feb-April	April - June	June – Aug.				Feb-April	April - June	June – Aug.		
T_1	5.50	3.45	5.79	0.82	6.08	0.57	45.49	0.56	0.69	0.25	46.05	0.68
T_2	5.37	3.35	4.88	0.69	5.84	0.47	40.01	0.48	0.78	0.35	40.66	0.65
T_3	4.91	3.87	5.49	0.93	5.42	0.51	40.34	0.48	0.7	0.25	40.92	0.58
T_4	5.26	4.57	6.73	1.36	5.95	0.69	47.43	0.6	0.74	0.36	48.21	0.72
T_5	4.98	5.02	7.46	1.60	5.71	0.73	51.26	0.52	0.9	0.41	52.20	0.94
T_6	5.71	4.38	5.7	1.27	6.35	0.67	48.34	0.87	1.09	0.47	49.49	1.19
T_7	5.72	4.20	5.63	1.11	6.36	0.64	46.51	0.66	0.78	0.43	47.58	0.87
T_8	4.58	3.71	4.84	1.00	5.03	0.45	42.37	0.53	0.55	0.26	42.85	0.48
SEm (±)						**0.014**						**0.017**
LSD(0.05)						**0.04**						**0.05**

Table 1: Effect of soil covers on plant height, basal girth and canopy spread of guava. **(Contd.....)**

Treatment	Canopy spread(m) (East- west)						Canopy spread(m) (North- South)					
	Initial (Feb.)	Per cent increase			Final (Aug.)	Total increase in spread (m)	Initial (Feb.)	Per cent increase			Final (Aug.),	Total increase
		Feb-April	April - June	June – Aug.				Feb-April	April - June	June – Aug.		
T_1	5.04	3.25	5.48	0.97	5.54	0.50	5.66	2.89	5.05	1.03	6.23	0.59
T_2	5.78	2.45	3.76	0.54	6.22	0.41	5.65	3.64	3.67	0.38	6.11	0.48
T_3	5.49	3.15	4.46	0.9	5.99	0.48	5.83	3.83	4.02	0.69	6.34	0.51
T_4	5.37	3.8	6.9	1.4	6.03	0.67	5.58	4.01	5.88	1.84	6.20	0.68
T_5	5.09	4.99	7.94	1.45	5.84	0.76	5.81	4.19	6.17	1.92	6.55	0.74
T_6	5.09	3.62	7.11	1.3	5.69	0.63	6.81	3.28	5.03	1.26	7.48	0.67
T_7	5.70	2.86	6.06	0.86	6.23	0.53	6.41	3.33	5.19	1.99	7.05	0.64
T_8	5.29	3.39	3.56	0.77	5.68	0.37	5.45	3.18	3.43	0.57	5.85	0.40
SEm (±)						**0.015**						**0.015**
LSD(0.05)						**0.05**						**0.05**

Table 2: Effect of soil covers on flower drop, fruit set, fruit drop, final fruit retention and yield of guava

Treatments	Flower drop (%)	Fruit set (%)	Total fruit drop (%)	Final fruit retention (%)	Number of fruits/ plant	Yield (kg /plant)	Yield (t / ha)
T_1	28.74 (32.42)	71.26 (57.58)	45.71 (42.54)	54.29 (47.46)	277.51	36.67	10.20
T_2	30.71 (33.65)	69.29 (56.35)	49.86 (44.92)	50.38 (42.22)	267.85	34.03	9.46
T_3	23.33 (28.88)	76.67 (61.12)	45.81(42.59)	54.19 (47.41)	252.19	32.90	9.15
T_4	27.74 (31.78)	72.26 (58.22)	48.30 (44.02)	51.70 (45.98)	275.21	38.77	10.77
T_5	17.85 (24.99)	82.15 (65.01)	40.31 (39.41)	59.62 (50.55)	286.26	44.39	12.34
T_6	19.02 (25.85)	81.06 (64.21)	40.02 (40.41)	57.98 (49.59)	347.95	47.05	13.08
T_7	21.69 (27.75)	78.31 (62.25)	42.12 (40.47)	57.88 (49.53)	340.17	44.67	12.42
T_8	36.82 (37.36)	63.18 (52.64)	51.33 (45.76)	48.67 (44.24)	245.15	27.72	7.71
SEm (±)	**0.311**	**0.315**	**0.258**	**0.267**	**3.274**	**1.851**	**0.514**
LSD(0.05)	**0.94**	**0.96**	**0.78**	**0.81**	**5.62**	**5.62**	**1.56**

Figures in the parentheses are the angular transformed values.

Table 3: Effect of soil covers on dimension and biochemical compositions of fruits of guava

Treatments	Fruit diameter (cm)	Fruit length (cm)	Fruit weight (g)	TSS (^{0}Brix)	Acidity (%)	TSS : Acidity	Total sugar (%)	Reducing sugar (%)	Non – reducing sugar (%)	Vitamin C (mg/100 g pulp)
T_1	5.60	5.71	132.20	7.67	0.35	22.26	5.20	3.04	2.16	126.83
T_2	5.47	5.63	127.07	7.47	0.35	21.19	5.42	3.12	2.30	123.29
T_3	5.42	5.53	130.53	7.73	0.36	21.40	5.93	3.26	2.67	133.65
T_4	6.03	5.95	140.87	8.40	0.33	25.27	6.01	3.33	2.68	139.98
T_5	6.40	6.03	154.97	8.53	0.33	26.21	6.53	3.81	2.72	149.26
T_6	5.67	5.73	135.23	7.73	0.33	24.32	6.35	3.69	2.66	146.32
T_7	5.60	5.78	133.90	7.53	0.32	23.41	6.08	3.56	2.52	144.07
T_8	5.20	5.20	113.07	7.07	0.38	18.42	5.07	3.01	2.06	113.77
SE.m (±)	**0.161**	**0.169**	**6.68**	**0.211**	**0.010**	**0.225**	**0.045**	**0.116**	**0.036**	**1.285**
LSD(0.05)	**0.49**	**NS**	**20.27**	**0.64**	**0.03**	**0.68**	**0.138**	**0.35**	**0.11**	**3.90**

NS- Not significant