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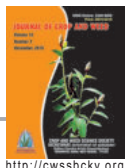

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Efficacy of floor management using banana biomat mulch and leguminous cover crop on yield and quality of guava cv. Sardar (L-49)

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ABSTRACT

An experiment was conducted at the ICAR-AICRP on fruits, BCKV, Mohanpur, Nadia, West Bengal during 2018 to 2020 in Randomized Block Design with six treatments (T_1 : Banana biomat mulch (BBM) @ 30 kg fresh m^{-2} Leguminous cover crop (LCC) @ 3g seeds m^{-2} + Recommended dose of fertilizer (RDF) @ 0 %, T_2, : T_1 + 25% RDF, T_3 : T_1 + 50% RDF, T_4 : T_1 + 75% RDF, T_5 : T_1 + 100 % RDF and T_6 : Control RDF @ 100%) with 4 replications. An outcome clearly affirms a significant effect of BBM and LCC along with varying dose of fertilizers and the application of BBM (webbed leaf-sheath of banana @ 30 kg fresh m^{-2}), LCC (@ 3g m^{-2}; black gram cv. Kalindi in winter, mung bean cv. Samrat in summer) and RDF @ 75%, twice a year (August, 2018 & January, 2019), followed by incorporation of leguminous cover crops into the soil at 50-60 days after sowing showed better results with respect to weed growth suppression, soil moisture conservation, nitrogen content in orchard soil, yield and quality of guava and higher B: C of the cultivation.

Keywords: Banana biomat mulch, fertilizer, guava, leguminous cover crop, orchard

Guava *(Psidium guajava* Linn.*),* a tropical fruit belongs to the Myrtaceae family, having chromosome number 2n=18. It comes under fifth important fruit with respect to both area and production, productivity, nutrition and as remunerative crop (Kumari and Choudhary, 2019). In West Bengal guava is cultivated in around 15.67 thousand hectare and the production is around 202.95 thousand tonnes during 2017-18 (Anon, 2018-19a, Anon, 2018-19b). The farmers of West Bengal were facing the problem of moisture deficit during June-July months, while problem of weeds occur throughout the year, especially during rainy season. Hence, the guava growers in West Bengal have two important issues related to the orchard floor management, viz., suppression of weed growth and soil moisture conservation during rainy season and dry period. These two major issues are directly related with the plant growth, yield and economics of guava in West Bengal. Flower abscission in guava cultivar Lucknow 49 (53.40%) and deterioration of fruit quality is observed due to moisture stress condition (Singh, 2007). Yield loss in fruit crops due to weeds varies from 23.7% to 82% and that could be minimize by mulching (Hussein *et al*., 2007). Application of organic source of nutrients and soil health maintainance are considered much important for sustainability of orchard productivity (Lalrintluangi *et al*., 2019). These two issues are directly related with the plant growth, yield and quality of fruits. The mulching practice in guava with inorganic material, viz., black polythene was effective to suppress weed growth and soil moisture conservation (Maji and Das., 2008). Organic mulches break down into organic matter nourishes the soil and the fungi, insect and worms and have beneficial effects on both physical and chemical properties of soil (Mahata *et al*., 2008). Organic mulching helps to increase fruit yield, quality as well as soil moisture content of litchi (Das *et al*., 2016). Fruit weight percentage can be increased with the cover crop as compared with the crop where treatment has given with conventional weed control. And also conventional organic mulching along with cover crop resulted in maximum suppression of weed growth in orchard of fruit crops (Matos *et al*., 2009). Highest benefit:cost ratio can be obtained from the plant with banana biomat mulch and leguminous cover crops as compared with the black polythene mulch (Bhattacharjee and Debnath, 2019). Organic mulching along with cover crops helps to suppress weeds by allelopathic and smothering effect (Bahadur *et al*., 2015). In view of this situation of guava growers, the experiment was carried out to investigate the effect of banana biomat mulch (BBM), leguminous cover crop (LCC) along with recommended dose of fertilizer on weed growth suppression and weed control efficiency, soil moisture and organic carbon content,

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available nitrogen content, yield, quality and B: C ratio of guava as compared with conventional practices i.e., use of 100% RDF but no BBM and LCC.

MATERIALS AND METHODS

The investigation was carried out at ICAR-AICRP on Fruits, Bidhan Chandra Krishi Viswavidhyalaya, Mondouri, Nadia, West Bengal, during the year 2018-2020. The field was located at 9.75m above mean sea level, latitude 29°56'10.90" N and longitude 88°30'31.55" E. The experiment in guava plant was conducted at the 5 years old guava orchard of cv. Sardar (L-49) under high-density planting (1111 ha^{-1}) with a spacing of 3m × 3m in the square system. The treatment consists of banana biomat mulch (BBM), leguminous cover crop (LCC) and recommended dose of fertilizer (T_1 : BBM + LCC + 0% RDF, T_2 : T_1 + 25% RDF, T_3 : T_1 + 50% RDF, T_4 : T_1 + 75% RDF, T_5 : T_1+ 100 % RDF and T_6 : Control – conventional practices with 100% RDF. The experiment was laid out in a randomized block design with four replications for guava. The recommended dose of fertilizer used in the experiment of guava was 25 kg FYM, N-260gm + P_2O_5-320gm + K_2O-260gm. Application of treatments was done after soil cultivation . Power tiller operation was done in the orchard soil of guava. Recommended dose of fertilizer was applied to the guava field as per treatment layout and after fertilizer application irrigation was provided. The overnight soaked leguminous cover crop (LCC) seed of black gram var. Kalindi was sown during winter and spring months and moong bean var. Samrat was sown during summer and rainy months @ 3g m^{-2} in the ground area of plants as per the treatment, about 48-36 hours after irrigation. The stem of banana was collected from the harvested banana field. Strips were prepared by cutting the banana stem into 5 ft. long and 4 to 6 inches wide. The banana biomat mulch (BBM) was prepared by weaving the strips of pseudo-stem and were spread onto the ground area of each plant @ 30 kg fresh m^{-2}, as per treatment. In between the two banana strips moong bean seed along with vermicompost was broadcasted. The grown up LCC was incorporated in soil during 50 to 60 days after sowing. The data obtained from the experiment was analyzed statistically by the analysis of variance method for RBD (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that treatments with BBM and LCC with varying dose of fertilizer on guava cv. Sardar caused significant variations in fresh weight and dry weight of weed. The minimum fresh weight (174.08 gm^{-2}) and dry weight (31.24 gm^{-2}) of weed was recorded under T_1 treatment i.e., mulching with BBM + LCC + 0% RDF and maximum fresh weight (424.19 gm^{-2}) dry weight (57.73 gm^{-2}) of weed was observed in T_6 treatment i.e., 100% RDF + no BBM & LCC. However, the effects of T_2 treatment and T_5 treatment were statistically at par. All treatments with mulching significantly increased the weed control efficiency compared with control treatment. The minimum weed control efficiency (0.00%) was found under T_6 treatment i.e., 100% RDF + no BBM & LCC and maximum weed control efficiency (78.09 %) was recorded under T_5 treatment. The treatment with banana biomat mulch (BBM) and leguminous cover crops (LCC) with varying dose of fertilizer effectively suppressed the weed growth in guava orchard (Bhattacharjee and Debnath, 2019; Nath and Sharma., 1992).

The data recorded in Table 2 revealed that all the mulching treatments had significant effect on soil moisture conservation in different months during the period of investigation. The average soil moisture content ranged from 19.03 to 21.54 %. The minimum average moisture content (19.03 %) in soil was recorded under T_6 treatment and maximum average soil moisture content (21.54%) was found under T_5 treatment during January-February months. However, the effects of T_3 treatment and T_4 treatment were statistically at par. Likewise, the minimum average content of soil moisture (19.94%) was recorded under T_6 treatment and maximum average soil moisture content (22.62%) was recorded under T_5 treatment during June-July months. The different mulching treatments with varying dose of fertilizer significantly improved the organic carbon content in soil. The minimum organic carbon content (0.78%) was found under T_1 treatment and maximum organic carbon (0.84%) was recorded under T_5 treatment. However, the effects of T_6 treatment and T_2 treatment was statistically at par. The minimum available nitrogen content (209.63 kg ha^{-1}) was recorded under T_1 treatment and maximum nitrogen content (217.83 kg ha^{-1}) was recorded under T_5 treatment i.e., mulching with BBM & LCC + 100% RDF. However, the effects of T_2 treatment and T_6 treatment were statistically at par. Conservation of soil moisture was also found less (Bhattacharjee and Debnath, 2019; Das *et al.,* 2010 and Bakshi *et al.,* 2015) due to less population of weed growth and evaporative soil loss resulting in less competition between crop and weeds and hence, increased nitrogen content in soil and improved organic carbon content of soil and soil moisture conservation compared with the conventional practices. Hence, the effect of banana biomat mulch (BBM) and leguminous cover crop (LCC) along with varying dose of fertilizer caused significant effect on nutrient (nitrogen) content

Table 1: Effect of banana biomat mulch and leguminous cover crops on fresh weight, dry weight and weed control efficiency in guava orchard

Treatments	Fresh weight of weeds ($g\ m^{-2}$)	Dry weight of weeds ($g\ m^{-2}$)	Weed control efficiency (%)
T_1	174.08	31.24	82.63
T_2	174.29	31.61	83.45
T_3	174.44	31.81	83.92
T_4	174.67	31.95	84.54
T_5	174.94	32.07	84.61
T_6	424.19	57.73	0.00
SEm (±)	**1.580**	**1.201**	**1.520**
LSD (0.05)	**3.372**	**2.557**	**3.258**

*BBM- banana biomat mulch, LCC- leguminous cover crops, T1- Mulching with BBM & LCC + 0% RDF, T2- Mulching with BBM & LCC + 25% RDF, T3- Mulching with BBM & LCC + 50% RDF, T4- Mulching with BBM & LCC + 75% RDF, T5- Mulching with BBM & LCC + 100% RDF, control(T_6)- conventional practice (100% RDF and no mulching and cover crops).

Table 2: Effect of banana biomat mulch and leguminous cover crops on average soil moisture content, organic carbon content and available nitrogen content in guava orchard

Treatments	Avg. soil moisture (%)		Organic carbon (%)	N ($Kg\ ha^{-1}$)
	Ambe bahar	Mrig bahar		
T_1	21.99	21.22	0.78	209.63
T_2	21.95	21.32	0.79	211.63
T_3	22.24	21.42	0.80	213.97
T_4	22.52	21.47	0.82	216.25
T_5	22.62	21.54	0.84	217.83
T_6	19.94	19.03	0.79	211.22
SEm (±)	**NS**	**NS**	**NS**	**NS**
LSD (0.05)	**NS**	**NS**	**NS**	**NS**

Table 3: Effect of banana biomat mulch and leguminous cover crop on average fruit yield, average fruit weight, TSS and acidity of guava

Treatments	Avg. fruit yield ($Kg\ plant^{-1}$)		Avg. fruit weight (g)		TSS (°B)		Acidity (%)	
	Mrig	Ambe	Mrig	Ambe	Mrig	Ambe	Mrig	Ambe
T_1	13.14	12.48	176.44	166.47	11.63	10.59	0.25	0.25
T_2	13.49	12.85	178.45	167.11	12.25	11.08	0.27	0.26
T_3	14.63	13.47	180.28	167.93	12.44	11.43	0.28	0.27
T_4	15.65	13.83	183.78	168.18	13.23	12.07	0.29	0.28
T_5	17.08	14.05	185.98	169.15	13.63	12.71	0.30	0.29
T_6	13.46	12.84	178.08	167.00	11.96	10.79	0.27	0.26
SEm (±)	**1.073**	**0.317**	**1.073**	**0.915**	**0.583**	**0.520**	**0.009**	**0.003**
LSD (0.05)	**2.280**	**0.662**	**2.280**	**1.940**	**1.236**	**1.120**	**0.015**	**0.017**

in orchard soil due to atmospheric nitrogen fixation by legume crops. The BBM was applied as organic mulch (@ 30 kg fresh m^{-2}), decomposed in orchard soil and was served as organic source of nutrient (Blanco-Canqui and Lal, 2007) and plant nutrient (Blanchart *et al.,* 2006). The leguminous cover crop (LCC) was also grown as a cover crop and properly mixed in orchard soil after 50-60 days after broadcasting and hence, it supplies 30-40 kg nitrogen ha^{-1} (Peoples *et al.,* 2009).

In Table 3, treatments with mulching significantly increased per plant. The minimum fruit yield (13.14 kg $plant^{-1}$) was recorded under T_1 treatment and maximum

Table 4: Effect of banana biomat mulch and leguminous cover crops on productivity and B:C ratio of guava orchard

Treatments	Productivity (t ha^{-1})		B: C ratio	
	Mrig bahar	Ambe bahar	Mrig bahar	Ambe bahar
T_1	14.11	12.87	3.11	2.47
T_2	14.98	13.91	3.17	2.66
T_3	16.25	14.29	3.25	2.98
T_4	17.38	15.27	3.32	3.05
T_5	18.98	15.81	3.45	3.12
T_6	14.55	13.67	3.67	2.56
SEm(±)	**0.426**	**0.692**	**0.100**	**0.251**
LSD(0.05)	**0.891**	**1.476**	**0.214**	**0.539**

(17.08 kg plant^{-1}) was found under treatment T_5 during mrig bahar. However the effects of T_6 treatment and T_2 treatment were statistically at par. The minimum average fruit weight (12.48 kg plant^{-1}) was recorded under T_1 treatment and the maximum (14.05 kg plant^{-1}) was recorded under T_5 treatment during ambe bahar. However the effects of T_2 treatment and T_5 treatment were statistically at par. The minimum TSS (11.63° Brix) and the maximum TSS (13.63° Brix) was recorded under T_1 treatment and under T_5 treatment respectively during mrig bahar. The effects of T_5 treatment and T_4 treatment were statistically at par. The minimum TSS (10.59° Brix) was recorded under T_1 treatment and maximum TSS (12.71° Brix) was recorded under T_5 treatment during ambe bahar. The minimum acidity (0.25 %) was recorded under T_1 treatment and maximum acidity (0.30%) was recorded under T_5 treatment during mrig bahar. Although the effects of T_2 treatment and T_6 treatment were statistically at par. The minimum acidity (0.25%) was recorded under T_1 treatment and maximum acidity (0.29%) was recorded under T_5 treatment i.e., mulching with BBM & LCC + 100% RDF. Although the effects of T_2 treatment and T_6 treatment were statistically at par. The effect of banana biomat mulch (BBM) and leguminous cover crop (LCC) along with varying dose of fertilizer caused significant effect on fruit yield and quality during different bahars compared with conventional practices i.e., application of only 100% RDF with no BBM and LCC. The results are in full conformity with the earlier finding by Das *et al*. (2010) in guava, Tachibana and Yahata (1998) in Satsuma mandarin and Mandal and Chattopadhyay (1993) in custard apple.

In this experiment mulching with different levels of RDF showed significant differences in productivity of guava plant (Table 4). The minimum productivity (14.11 t ha^{-1}) was recorded under T_1 treatment and maximum productivity (18.98 t ha^{-1}) was recorded under T_5 treatment during winter season harvest. However the effects of T_6 treatment and T_2 treatment were statistically at par. The minimum productivity (12.87 t ha^{-1}) was recorded under T_1 treatment and maximum productivity (15.81 t ha^{-1}) was recorded under T_5 treatment during rainy season harvest. Although, the effects of T_4 treatment and T_5 treatment is statistically at par. The ambe bahar fruit productivity is lesser as compared with the mrig bahar due to high incidence of fruit flies and heavy rainfall resulting in insipid, watery and poor quality fruit. The minimum (3.11) B: C ratio was calculated under T_1 treatment and maximum (3.45) B: C ratio was calculated under T_5 treatment during mrig bahar. However, the effect of T_4 treatment and T_5 treatment is statistically at par. The minimum (2.47) B: C ratio was calculated under T_1 treatment and maximum B:C ratio (3.12) was calculated under T_5 treatment during ambe bahar. However, the effect of T_4 treatment and T_5 treatment is statistically at par. The similar finding of benefit: cost (B:C ratio) was observed by Rajput *et al*., 2014 and Nath and Sharma (1992) from leguminous cover crop and organic mulching in their experiment.

Hence, the effect of banana biomat mulch (BBM) and leguminous cover crop (LCC) along with varying dose of fertilizer caused significant effect on weed growth suppression, soil moisture conservation and increased nutrient (nitrogen) content in orchard soil due to atmospheric nitrogen fixation by legume crops resulting in increased fruit yield and quality and higher B:C ratio of guava cultivation compared with conventional practices i.e., application of only 100% RDF with no BBM and LCC.

CONCLUSION

It may be said that the guava growers in the Gangetic Alluvium areas of West Bengal may apply banana biomat mulch (webbed leaf-sheath of banana @ 30 kg fresh m^{-2}), leguminous cover crops (@ 3g m^{-2}; black gram cv. Kalindi in winter, mung bean cv. Samrat in summer) and 75% of recommended dose of fertilizer, twice a year in guava (August, 2018 & January, 2019),

followed by incorporation of leguminous cover crops into the soil at 50-60 days after sowing for better management of orchard floors of guava, with beneficial effects on weed growth suppression, soil moisture conservation, improvement of soil health (organic carbon and available nitrogen) and higher fruit yield, better fruit quality and higher B:C ratio of cultivation.

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