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Growth, yield and economics of banana crop as influenced by organic and inorganic mulches

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Abstract

An experiment was conducted at Agriculture Research Station, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Achalpur (M.S.), India to evaluate the effect of various organic and inorganic mulches on banana crop. Maximum plant height, stem girth, total number of leaves, length of fruit, girth of fruit, number of fruits bunch⁻¹, fruit weight, bunch weight and 114.69 t yield ha⁻¹ were noticed in banana by mulching of black polyethylene (50 μ) followed by dry grass. However, significantly minimum plant height, stem girth, number of leaves, number of fruits, weight of fruit, length of fruit, girth of fruit and bunch weight and 94.47 t yield ha⁻¹ were recorded with the no mulching treatment. Maximum gross return, net profit and B: C ratio ha⁻¹ (Rs. 931283, Rs. 600534 and 2.82) were obtained under treatment black polyethylene (50 μ) inorganic mulch followed by dry grass (Rs 882563, Rs. 560584 and 2.74) organic mulch.

Keywords: Mulching, straw, polyethylene, banana plant parts

Introduction

Banana is one of the important fruit crop grown in India. Area where round the year water source available, gives first priority to grow banana crop. Human body requires banana fruits as it gives instant energy.

The estimated global cultivated area under banana is around 54.90 lakh hectares and production is 113.28 million tonnes. India is one of the world leading country in banana production. Total area under banana in India is 8.5 lakh hectares with a production of 29.12 million MT, out of which 81.34 thousand ha area is in Maharashtra state with a production of 3888.90 thousand MT (Anonymous, 2018) [2]. Maharashtra's 60 percent area is in Jalgaon district i.e. 49.28 thousand ha with production of 2266.74 thousand MT (58 percent).

Geographical, climatic and soil condition are favorable for growing banana in Vidarbha. Area of banana is increasing in Amravati (Anjangaon Surji, Achalpur and Chandur Bajar), Yavatmal (Pusad, Umardhed and Mahagaon) and Buldhana (Sangrampur, Jalgaon Jamod and Mehekar) district of Vidarbha. Therefore, it is necessary to give precision farming to banana grower of Vidarbha region. Mulching is one of the parts of precision farming. Among different conservation practices, mulching is an important practice of crop production. According to Jacks *et al.* (1995) [5], the english word mulch probably was derived from the German word 'Molsch' meaning 'soft to decay'.

Mulching plays an important role in conservation of soil moisture during the dry periods, as well as improves physical, biological and chemical properties of soil. It is a practice, which helps in proper growth and development of the plants by modifying soil temperature, providing better nutrient availability and by better moisture conservation (Kher *et al.* 2010) [6]. Organic mulches derived from plant and animal materials such as straw, hay, husks, compost, sawdust, wood chips, etc. are efficient in reduction of nitrates leaching, improve soil physical properties, prevent soil erosion, supply organic matter, regulate temperature and water retention, improve nitrogen balance, take part in nutrient cycle as well as increase the biological activity (Muhammad *et al.* 2009; Sarolia and Bhardwaj, 2012) [7, 13]. The effective use of polyethylene and organic mulches was evaluated for improving the growth, yield and quality of the Coorg mandarin (Mustaffa, 1989) [8], Assam lemon (Nath and Sharma, 1993) [10], Nagpur mandarin (Shirgure *et al.* 2003) [14] and acid lime (Shirgure, 2012) [15]. The information on mulching materials and its effect on growth and yield of banana suitable for Vidarbha conditions were lacking.

Therefore, an investigation was done to find out the effect of various organic and inorganic mulching materials on plant growth, fruit yield, quality and economics in banana.

Materials and Methods

The experiment was conducted during 2016-17, 2017-18 and 2019-20 at Agriculture Research Station, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Achalpur (21.30° N latitude, 77.50° E longitude and 394.69 m altitude) with five treatment viz. soybean straw @ 5 kg plant⁻¹, banana plant parts (leaves) @ 10 kg plant⁻¹, dry grass @ 5 kg plant⁻¹, black polyethylene (50 µ) and Control (No Mulching) which were planted in randomized block design (RBD) and replicated four times. Tissue culture plant of banana variety Grand Naine were planted during July, 2016, 2017 and 2019 at 1.5 x 1.5 m spacing and all plants given uniform dose of NPK (200:40:200g plant⁻¹). Mulching was performed after one month of banana transplantation. Observations were recorded on growth and yield regularly and statistics analysed as per the methods given by Panse and Sukhatme (1969) [11].

Results and Discussion

Experimental data presented in Table 1 and 2, that there were significant mulching differences in respect of growth and yield attributes.

Growth attributes

The pooled data of three years indicated that, the different organic and inorganic mulches to banana had recorded significant differences in respect of plant height, stem girth and number of leaves. Significantly the maximum plant height, girth of stem and number of leaves was noticed in black polyethylene (50 µ) mulching viz., Grand Naine (215.17 cm, 53.50 cm and 30.42) followed by dry grass @ 5 kg/plant (212.00 cm, 52.25 cm and 29.25).

This difference can be attributed to moisture conservation, higher soil temperature, weed control, and increased mineral nutrient uptake in the mulched plot through improved root temperatures, as reported by Orozco *et al.*, (1994) [9].

The results obtained in respect of growth attributes are in agreement with the results of Srinivas and Hegde (1994) [16], Bananuka *et al.*, 2000 [4], Agrawal and Agrawal (2005) [1] and Paul *et al.* (2008) [12].

Yield attributes

The pooled data indicated that, the various organic and inorganic mulching of banana had recorded significant

differences in respect of fruit length, girth of fruit, number of fruits bunch⁻¹, fruit weight, bunch weight and yield ha⁻¹.

Significantly the maximum fruit length, girth of fruit, number of fruits bunch⁻¹, fruit weight, bunch weight and yield ha⁻¹ was noticed in black polyethylene (50 µ) mulching (18.88 cm, 12.65 cm, 151.48, 170.75 g, 25.89 kg and 114.69 t ha⁻¹) followed by dry grass 5 kg plant⁻¹ (17.71 cm, 12.27 cm, 146.40, 168.00 g, 24.63 kg and 108.69 t ha⁻¹).

The increase in the fruit yield was attributed to the sufficient soil moisture in the root zone and minimum evaporation loss due to mulching. The extended retention of moisture and availability of moisture also leads to higher uptake of nutrients for proper growth and development of fruits which resulted in higher yield as compared to the control. Organic mulches return organic matter and plant nutrients to the soil and improve the physical, chemical and biological properties of the soil after decomposition, which in turn increases crop yield. The increase in yield plant⁻¹ might be due to increased uptake of nutrients which resulted in enhanced synthesis of hormones like auxins and gibberellins.

The results obtained in respect of yield and yield attributes are in agreement with the results of Srinivas and Hegde (1994) [16], Bananuka *et al.*, 2000 [4], Agrawal and Agrawal (2005) [1], Paul *et al.* (2008) [12] and Balic *et al.* (2018) [3].

Economics

The economic data presented in Table 2 indicated that, maximum gross return, net profit and B: C ratio ha⁻¹ (Rs. 931283, Rs. 600534 and 2.82) were obtained under treatment black polyethylene of 50 micron mulch followed by dry grass 5 kg plant⁻¹ mulch (Rs 882563, Rs. 560584 and 2.74).

Comparative economics presented in Table 3 indicated that highest additional income of Rs 160126/- was recorded with black polyethylene mulch of 50 micron, while it was lowest with application of soybean straw 5 kg ha⁻¹ mulch (Rs 79982). However, the ratio between additional expenditure and additional return was highest with black polyethylene mulch of 50 micron (3.80).

From the above study it can be concluded that, significantly the maximum plant height, stem girth, number of leaves, length of fruit, girth of fruit, fruit weight, bunch weight and yield ha⁻¹ were noticed in black polyethylene (50 µ) mulch in banana followed by dry grass @ 5 kg plant⁻¹ variety Grand Naine. Keeping in view, banana cv. Grand Naine can be planted on black polyethylene (50 µ) inorganic mulch or dry grass @ 5 kg plant⁻¹ organic mulch.

Table 1: Growth and yield attributes as influenced by different mulching

Sr. No.	Name of Genotype	Plant Height (cm)				Stem Girth (cm)				Number of leaves			
		2016-17	2017-18	2019-20	Pooled	2016-17	2017-18	2019-20	Pooled	2016-17	2017-18	2019-20	Pooled
1	Soybean straw 5 kg plant ⁻¹	207.50	208.50	209.00	208.33	50.50	51.55	52.50	51.52	27.75	29.75	27.50	28.33
2	Banana plant parts (leaves) 10 kg plant ⁻¹	209.50	210.50	211.25	210.42	51.00	52.00	52.50	51.83	28.00	30.00	27.75	28.57
3	Dry grass 5 kg plant ⁻¹	210.75	211.75	213.50	212.00	51.50	52.50	52.75	52.25	28.50	30.50	28.75	29.25
4	Black polyethylene 50 micron	213.25	214.25	218.00	215.17	52.00	53.00	55.50	53.50	28.75	30.75	31.75	30.42
5	Control (No Mulching)	203.00	204.00	208.00	205.00	47.00	48.00	48.75	47.92	26.00	28.00	28.25	27.42
	F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	SE m ±	0.64	0.64	1.35	0.66	0.57	0.57	1.15	0.54	0.33	0.28	0.94	0.38
	C.D. 5%	1.98	1.98	4.15	2.03	1.76	1.76	3.54	1.67	1.02	0.75	2.91	1.16
		Length of fruit (cm)				Girth of fruit (cm)				Number of fruits bunch ⁻¹			
1	Soybean straw 5 kg plant ⁻¹	15.50	16.75	16.50	16.25	10.50	10.94	12.06	11.17	142.25	147.75	138.50	142.83
2	Banana plant parts (leaves) 10 kg plant ⁻¹	16.00	17.25	17.00	16.75	11.50	11.75	12.13	11.79	143.50	149.88	140.00	144.46
3	Dry grass 5 kg plant ⁻¹	17.00	18.13	18.00	17.71	12.00	12.44	12.38	12.27	144.50	151.71	143.00	146.40
4	Black polyethylene 50 micron	18.00	19.13	19.50	18.88	12.50	12.88	12.56	12.65	150.75	156.94	146.75	151.48
5	Control (No Mulching)	15.00	16.50	16.00	15.83	10.50	10.88	11.63	11.00	137.50	139.25	130.25	135.67

	F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	SE m ±	0.26	0.24	0.40	0.23	0.32	0.17	0.19	0.17	0.83	1.21	1.06	0.57
	C.D. 5%	0.79	0.75	1.23	0.71	0.97	0.51	0.60	0.52	2.56	3.72	3.25	1.77
		Fruit weight (g)				Bunch weight (kg)				Fruit yield of Banana (t ha ⁻¹)			
1	Soybean straw 5 kg plant ⁻¹	161.00	176.25	161.00	166.08	22.65	26.04	22.30	23.66	101.77	114.57	98.11	104.82
2	Banana plant parts (leaves) 10 kg plant ⁻¹	161.75	177.20	161.75	166.90	23.28	26.26	22.65	24.06	103.46	115.52	99.64	106.21
3	Dry grass 5 kg plant ⁻¹	162.50	179.00	162.50	168.00	23.48	27.16	23.24	24.63	104.35	119.49	102.24	108.69
4	Black polyethylene 50 micron	163.00	180.75	168.50	170.75	24.58	28.37	24.73	25.89	109.21	126.07	108.80	114.69
5	Control (No Mulching)	156.25	161.75	158.25	158.75	19.50	22.45	20.61	20.85	95.46	98.76	90.68	94.97
	F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	SE m ±	1.21	0.85	1.70	0.75	0.43	0.24	0.28	0.19	1.23	1.06	1.21	0.67
	C.D. 5%	3.73	2.63	5.25	2.31	1.31	1.85	0.85	0.60	3.77	3.27	3.73	2.06

Table 2: Economics of different types of mulches in Banana cv. Grand Naine

Sr. No.	Treatments	Yield (t ha ⁻¹)	Gross Income (Rs ha ⁻¹)	Cost of Mulch in (Rs ha ⁻¹)	Cost of Cultivation (Rs ha ⁻¹)	Total Cost of production (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	Benefit: cost Ratio
1	Soybean straw 5 kg plant ⁻¹	104.82	851138	27775	288649	316424	534714	2.69
2	Banana plant parts (leaves) 10 kg plant ⁻¹	106.21	862425	66660	288649	355309	507116	2.43
3	Dry grass 5 kg plant ⁻¹	108.69	882563	33330	288649	321979	560584	2.74
4	Black polyethylene 50 micron	114.69	931283	42100	288649	330749	600534	2.82
5	Control (No Mulching)	94.97	771156	00	306149	306149	465007	2.52

Banana fruit selling rate Rs 8120 ton⁻¹, Soybean straw Rs 1.25 kg⁻¹, Banana plant parts and Dry Grass Rs 1.50 kg⁻¹ and black polyethylene sheet of 50 micron Rs 39600 + Rs 2500 spreading charges. (Rs 2200 bundle, 18 bundle of 400 m length)

Table 3: Comparative economics of use of different types of mulch in Banana

Sr. No.	Treatments	Increased yield over control (t ha ⁻¹)	Additional income (Rs ha ⁻¹)	Additional expenditure due to mulching (Rs ha ⁻¹)	Ratio of additional expenditure to additional returns
1	Soybean straw 5 kg plant ⁻¹	09.85	79982	27775	2.88
2	Banana plant parts (leaves) 10 kg plant ⁻¹	11.24	91269	66660	1.37
3	Dry grass 5 kg plant ⁻¹	13.72	111406	33330	3.34
4	Black polyethylene 50 micron	19.72	160126	42100	3.80
5	Control (No Mulching)	00.00	00	00	00.00

Banana selling rate Rs 8120 ton⁻¹.

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