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Effect of different mulches on yield attributes and economics of direct seeded hybrid rice (*Oryza sativa* L.)

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Abstract
The field experiment was conducted at Agronomy Farm, College of Agriculture, Dapoli, Dist. Ratnagiri (M.S.) during *kharif* season of 2017. This experiment was laid out in a randomized block design with ten treatments which were replicated thrice. Results revealed that, the hybrid rice grown under 25 micron silver polythene mulch (M_{10}) recorded significantly higher yield attributes and yield followed by 25 micron black polythene mulch (M_9) and 7 micron silver polythene mulch (M_8). Use of 25 micron silver polythene mulch (M_{10}) recorded significantly higher cost of cultivation (₹ 112738.68 ha^{-1}) and gross return (₹ 105114.07 ha^{-1}). However, 7 micron silver polythene mulch (M_8) recorded significantly higher net returns (₹ 21736.53 ha^{-1}) and benefit cost ratio (1.27).

Keywords: Mulches, micron, direct seeded hybrid rice, yield, economics

Introduction
Rice (*Oryza sativa* L.) is the most important staple food grain crop of the world which constitutes the principle food for about 60 per cent of the world's population. Rice contributes 43 per cent of total food grain production and 46 per cent of total cereal production in India. Rice based production system provides the income and employment for more than 50 million households. More than 90 per cent of the world's rice is produced and consumed in Asia where it is an integral part of culture and tradition. India is the world's second largest rice producer and consumer next to China. In the world, rice is grown in 114 countries on an area about 158 million hectares with annual production of 527 million tones, constituting nearly 11 per cent of the world's cultivated land. Rice is an important cereal food crop of Maharashtra state, which contributes 3.6 percent of area and 2.8 percent of production of rice at national level. Total area, production and productivity of rice were 14.71 lakh hectares, 25.17 lakh tones and 1.71 tones ha^{-1} respectively. In Konkan region, rice occupies an area of 3.79 lakh hectares with production 9.94 lakh tones and productivity of 2.61 tones ha^{-1}.

The word mulch has probably derived from the German word "Molsh" means soft to decay, which apparently referred to the process or practice of covering the soil or ground to make more favourable condition for plant growth and development and efficient crop production. Mulching is usually done with the organic materials like green leaves, dry leaves, straw, rice husk, sugarcane trash, dry grasses, weeds, etc. During last 60 years, the advent of synthetic material has altered the method and benefits of mulching. When compared to other mulches, plastic mulches are completely impermeable to water; therefore it prevents direct evaporation of moisture from the soil and thus limits the water losses and soil erosion. Polythene mulch is the new technology developed in Japan and mostly used in China. It increases the soil temperature by 2.2 to 3.6 ^{0}C than the normal cultivation (Tang and Xu, 1986) [14]. There is early germination under polythene mulch and initial crop growth is also better. It is creating better micro environment and better retention of soil moisture, increase in temperature leading ultimately to higher yield. Better germination and early corn initiation and flowering were also observed under polythene mulch (Mahale *et al.* 2002) [9].

Material and methods
The experiment was conducted during *Kharif* season of the year 2017-18 at Department of Agronomy, College of Agriculture, Dapoli to study the effect of different mulches on yield attributes, yield and economics in direct seeded hybrid rice. The experimental plot was uniform, levelled and well drained.

The soil of the experimental plot was sandy clay loam in texture, acidic in pH and medium in organic carbon content. It was low in available nitrogen, medium in available phosphorus and available potassium. The mean rainfall during crop growing season was 3582.4 mm of rainfall which received in 106 days. The mean maximum temperatures ranged from 27.4 ^{0}C to 31.8 ^{0}C and mean minimum temperatures from 22.7 ^{0}C to 25.2 ^{0}C during the crop growing season in the years 2017. The relative humidity during entire crop growing season ranged from 86 to 98% during morning and 73 to 91% during afternoon, respectively in 2017. This experiment was laid out in Randomized Block Design. It comprises ten treatments which were replicated thrice. The treatments are No mulch and no weed management (Unweeded control) (M_1), No mulch with weed management (Weed free) (M_2), Paddy straw mulch @ 5 t ha^{-1} at 20 DAS + 1 HW at 40 DAS (M_3), *Glyricidia maculata* leaves mulch @ 5 t ha^{-1} at 20 DAS + 1 HW at 40 DAS (M_4), Black Polythene mulch (7 micron) (M_5), Silver polythene mulch (7 micron) (M_6), Transparent Polythene mulch (7 micron) (M_7), Black Polythene mulch (25 micron) (M_8), Silver polythene mulch (25 micron) (M_9) and Transparent Polythene mulch (25 micron) (M_{10}). Thus, the gross and net plot size was 5.10 m X 3.90 m and 4.50 m X 3.38 m respectively. The sowing of hybrid rice variety Sahyadri-3 was done on 15th June, 2017 by dibbling method at a spacing of 20 cm X 15 cm. the recommended dose of fertilizer was 150:50:50 NPK kg ha^{-1}. The recommended cultural operations and plant protection measures were carried out as per the recommendation during experiment.

Result and Discussion

Effect of different mulches on yield attributes of hybrid rice

An assessment of data presented in Table 1 resulted that the 25 micron silver polythene mulch recorded higher number of panicles m^{-2}, length of panicle, number of filled grains panicle^{-1} over rest of the treatments except 25 micron black and 7 micron silver polythene mulch. Similarly 25 micron silver polythene mulch.

The higher values of yield attributes were recorded in silver and black polythene mulch. The possible reason for higher values of yield attributing characters may be traced due to the increased dry matter production, which might have resulted in greater synthesis of photosynthates contributing to an increase in yield attributes. The promotional effect of polyethylene mulch on the yield attributes may be due to low weed population, causing a reduction in competition for nutrients and partly for a better water availability due to moisture conservation by mulching. The beneficial effect of polythene mulch on yield attributes have been also noticed by Mahajan *et al.* (2007) [8] in baby corn, Liu *et al.* (2013) [7] in rice and Ehsanullah *et al.* (2014) [4] in aerobic rice.

Effect of different mulches on yield of hybrid rice

The higher grain, straw and biological yield obtained under silver and black polythene mulch may be due to significant increase in growth and yield attributes in polythene mulch (Table 2). Yield is a function of growth and yield attributes per plant/hill^{-1}. It depends upon the dry matter production per unit area therefore; high production of total dry matter is the first prerequisite for higher yield which showed the progressive increase in total dry matter accumulation as the crop attained maturity. Also, crop yield is a manifestation of various yield attributes like number of panicles m^{-2}, length of panicle, number of filled panicle^{-1} and test weight. A unit increase in these components increased the grain and straw yield of rice. The beneficial effect of silver and black polythene mulch on growth and yield attributes of rice finally enhanced the yield of rice. These results corroborate the findings of Mahajan *et al.* (2007) [8] in baby corn, Singh (2010) [13] in pea, Liu *et al.* (2013) [7] in rice, Ehsanullah *et al.* (2014) [4] aerobic rice, Mutetwa and Tuarira (2014) [10] in cucumber, Shah *et al.* (2014) [12] in maize, Ahmad *et al.* (2015) [1] in cotton, Qamar *et al.* (2015) [15] in wheat, Ali *et al.* (2016) [2] in rice and Helaly *et al.* (2017) [6] in husk tomato.

Effect of different mulches on economics

In case of economics (Table 3), it was observed that significantly higher cost of cultivation was incurred in treatment M_9. This was due to increased cost of polythene mulch due to increase in thickness. Similar findings were reported by Liu *et al.* (2013) [7]. Similarly higher gross return was recorded in treatment 25 micron silver polythene mulch (M_9). This was due to higher yield obtained in this treatment,which ultimately resulted in higher gross return.

Hybrid rice grown on 7 micron silver polythene mulch (M_6) recorded significantly higher net returns and benefit cost ratio over all other treatments except M_5, M_4, M_3 and M_2 for benefit cost ratio. This was due less expenditure incurred in purchase of thin polythene much *i.e.* 7 micron as compared to thick polythene mulch *i.e.* 25 micron. Similarly both 7 and 25 micron silver polythene mulch gave statistically at par yield. Therefore the net returns and benefit cost ratio was higher in 7 micron silver polythene mulch. These finding are in accordance with Gosavi (2006) [5] in sweet corn, Pinjari (2007) [11] in sweet corn, Choudhary and Bhambri (2012) [3] in capsicum and Shah *et al.* (2014) [12] in maize.

Table 1: Yield attributes of hybrid rice as influenced by different treatments.

Treatments	Number of panicles m^{-2}	Length of panicle (cm)	Number of filled grains panicle^{-1}	Number of unfilled grains panicle $^{-1}$	Test weight (g)
M_1	260.67	21.60	105.80	30.40	26.03
M_2	462.00	25.73	128.87	24.13	26.40
M_3	401.00	24.83	117.40	25.87	26.30
M_4	425.00	25.60	122.47	25.27	26.38
M_5	527.67	25.93	132.07	24.13	26.42
M_6	533.33	26.27	132.73	23.40	26.47
M_7	368.67	24.40	114.43	29.93	26.08
M_8	535.67	26.33	133.20	23.13	26.74
M_9	537.00	26.67	133.53	22.93	27.01
M_{10}	379.00	24.43	116.13	27.60	26.19
S.Em±	2.06	0.25	0.6	0.44	0.13
CD at 5%	5.71	0.70	1.65	1.23	N.S.
General mean	443.00	25.18	123.66	25.68	26.40

Table 2: Grain yield, straw yield, biological yield (q ha^{-1}) and harvest index (%) of hybrid rice as influenced by different treatments.

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
M_1	18.23	28.11	46.39	39.40
M_2	53.51	74.35	127.86	41.87
M_3	54.64	71.24	125.88	43.41
M_4	54.02	72.52	126.53	42.68
M_5	58.70	76.41	135.12	43.43
M_6	59.10	76.86	135.96	43.43
M_7	49.42	67.92	117.35	42.13
M_8	59.60	77.43	137.03	43.47
M_9	60.13	77.63	137.75	43.65
M_{10}	50.28	69.84	120.12	41.80
S.Em±	0.52	0.46	0.67	-
CD at 5%	1.45	1.26	1.85	-
General mean	51.77	69.23	121.00	42.53

Table 3: Economics of hybrid rice as influenced by different treatments.

Treatments	Gross returns (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C
M_1	32859.87	55948.31	-23088.44	0.59
M_2	94604.20	79799.03	14805.17	1.19
M_3	95661.60	79975.27	15686.33	1.20
M_4	94988.17	79015.53	15972.64	1.20
M_5	102750.63	81580.52	21170.11	1.26
M_6	103430.33	81693.81	21736.53	1.27
M_7	87225.43	78992.99	8232.44	1.10
M_8	104290.67	112601.44	-8310.78	0.93
M_9	105114.07	112738.68	-7624.61	0.93
M_{10}	88880.90	110033.15	-21152.25	0.81
S.Em±	20.89	3.56	85.83	0.05
CD at 5%	57.90	9.86	237.91	0.15
General mean	90980.59	87237.87	3742.71	1.05

Conclusion

From the results of the present experiment, it can be concluded that, hybrid rice (Sahyadri-3) should be grown under 7 micron silver polythene mulch (M_8) for obtaining higher yield and economic returns.

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