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Effect of mulching materials on growth and yield attributes and enhancing farm income through ginger cultivation under rainfed rice based production system

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Ginger (*Zingiber officinale* Rosc) is an important crop. Its rhizomes is used as fresh and dried form. The aroma of ginger is pleasant and spicy and the flavour penetrating, pungent and slightly biting due to antiseptic and pungent compounds present in it that is why, it is used for manufacturing various products like ginger oil, oleoresin, ginger candy, ginger preserve or 'murabba', ginger pickle etc. In Ayurvedic medical system, ginger is considered to be carminative, stimulant, aphrodisiac, anti-flatulent, appetizer and good for heart. It reduces Kapha and Vatha (Pruthi 1998). A well-distributed rainfall during growing season and dry period before harvesting are required for large scale-cultivation of the crop. In areas receiving less rainfall, the crop needs regular irrigation. Moisture is one of the major biotic factors, which affect production of crop. Long dry spells during rainy season and few or no irrigation facilities after rains, often reduces crop yield drastically. Traditional crop like paddy though offer a low risk and require less technical input, yields low economic returns. Ginger besides being higher yielding crop, fetches great price in market, thereby provides more income to the growers. However, cultivation of ginger under rainfed conditions involves high risk and need some moisture conservation techniques to reduce moisture losses specifically during the crop period after the rains. Covering of soil with organic and inorganic materials prevents the extreme changes in soil temperature and creates a micro environment such in which moisture loss through evaporation comes down. Besides, mulching control weed infestation, reduce run off and soil loss, improves physical, chemical and biological properties of soil which leads to better yield of crop (Singh *et al*., 1976, Aggarwal *et al*., 2002) and Subrahmaniyan *et al*., 2011) Keeping the above facts in view, trials were conducted to examine the efficacy of different mulching materials to affect the growth and yield of ginger.

Trials were conducted for two consecutive years during 2001-03 in farmers' field in the Kymore plateau region (Jabalpur) of Madhya Pradesh. Five treatments consisting of mulching with paddy straw, palas leaves, dry grass, polyethylene sheet and control (without mulch) were laid in randomized block design with five replications. Mulch materials viz., paddy straw (4cm thick layer), palas (*Butea*) leaves (3cm thick layer), dry grass (4cm thick layer) and polyethylene sheet (200 gauge thick) were spread between the rows. A common dose of 15 t FYM+120kg N+80kg P_2O_5 + 120kg K_2O/ha was applied. Ginger variety Suprabha was planted at a spacing of 45cm×15cm. Seed rhizome of about 20-25g in weight were placed at 4-4.5cm depth and covered with soil. Planting was done at the onset of monsoon (in 3rd week of June) and crop was harvested in the 2nd week of January. Observations were recorded on plant height, number of tillers, number of leaves per plant, leaf area per plant, length of rhizome, weight of rhizome per plant and rhizome yield per hectare. Data were analysed statistically as per standard procedure. Economic evaluation of different treatments was done on the basis of local prices of the produce and inputs at the time.

The findings (Table 1) revealed significant effect of mulching material on growth attributes of ginger during both the year of experiment. Maximum plant height was recorded in mulching with leaves of palas, which was significantly superior over other materials during both years. Mulching with paddy straw secured second place followed by polyethylene and dry grass. Though, the difference between paddy straw and polyethylene was not significant. Minimum plant height was recorded in case of no mulch. These findings are in line with those of Singh *et al*. (2005) in tomato.

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Table 1: Effect of mulching material on growth parameters in ginger

Treatment	Plant height (cm)		No. of tillers/hill		No. of leaves/plant		Leaf area (dm^2)	
	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03
Paddy straw	59.12	54.23	6.58	6.45	74.13	70.26	46.96	45.83
Palas leaves	66.35	61.48	7.91	7.64	79.82	75.66	53.48	52.10
Dry grass	52.26	47.52	5.83	5.52	64.93	59.31	36.61	34.92
Polythene	56.84	52.81	6.27	6.15	69.58	65.43	40.05	39.56
Control (without mulch)	39.51	35.28	4.38	4.20	55.36	50.13	22.14	21.20
SEm±	1.52	1.46	0.08	0.07	1.35	1.32	1.06	1.12
$CD_{5\%}$	4.56	4.19	0.24	0.20	4.05	3.79	3.18	3.21

Number of tillers was highest with application of palas leaves mulch followed by paddy straw, polyethylene and dry grass in descending order. Minimum number of tillers was recorded under control. All the treatments differed significantly with each other during both year of experiment. Highest number of leaves was observed in case of mulching with leaves of palas, which was followed by paddy straw, polyethylene and dry grass in descending order with significant difference. Lowest number of leaves was observed in ginger plants grown without mulching.

Leaf area is directly related with number of leaves and has major role with respect to photosynthesis in plants. The data of both years experiment revealed maximum leaf area with application of palas leaves mulch, which was significantly superior over other treatments. Mulching with paddy straw ranked second followed by polyethylene and dry grass. Lowest leaf area was recorded under no mulch. Higher number of tillers and leaves might have resulted in more leaf area per plant under mulched plots. Favourable effect of mulching on leaf area in ginger has also been reported by Gupta and Awasthi (1997).

The results (Table2) revealed significant effect of mulching material on yield parameters and yield of rhizome in ginger during both the year of experiment. Mulching with leaves of palas produced rhizome of maximum length, which was followed by mulching with paddy straw, polyethylene and dry grass. Shortest rhizomes were produced in case of no mulch. All the treatments differed significantly with each other. Average weight of rhizome per plant revealed maximum values in case of mulching of ginger with palas leaves, which was followed by paddy straw, polyethylene and dry grass. Though, during 2002-03 the difference between paddy straw and polyethylene mulch was not significant. Lowest weight of rhizome per plant was recorded in control. All the treatments showed significant difference to each other during both the year of experiment.

Highest growth parameter and yield attributes consequently resulted in maximum rhizome yield with application of palas leaves mulch, which was significantly superior over other treatments. Mulching with paddy straw recorded second place with regard to rhizome yield, which was followed by polyethylene, dry grass and no mulch treatment. Though, during 2002-03, the difference between paddy straw and polyethylene mulch was not significant. These results may be attributed to the varied effectiveness of different mulching materials for moisture conservation and modifying temperature regime in the crop environment resulting in increased growth parameters, production of more assimilates and their transportation to sink (rhizome). Similar findings have been reported by Roy and Wamanan (1988), Dixit and Mazumdar (1995) and Singh *et al*. (2005). Though, Subramaniyan *et al*. (2011) reported superiority of plastic mulches over straw mulch in rape seed due to their soil warming and weed controlling efficiency.

Table 2: Effect of mulching material on yield parameters and yield in ginger

Treatment	Length of rhizome (cm		Weight of rhizome per plant (g)		Rhizome yield (q/ha)	
	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03
Paddy straw	13.65	13.25	165.28	161.35	162.45	158.38
Palas leaves	15.84	15.62	188.35	184.50	173.52	170.62
Dry grass	11.15	10.87	149.50	145.66	140.83	137.51
Polythene	12.88	12.21	156.80	153.45	151.32	150.26
Control	9.32	9.24	121.53	120.21	105.26	98.85
SEm±	0.29	0.31	2.14	2.16	3.45	3.81
$CD_{5\%}$	0.86	0.89	6.41	6.47	10.34	10.93

Table 3: Economics of mulching in ginger in comparison to paddy cultivation

Treatment	Yield (q/ha)		Total expenditure (Rs/ha)		Total income (Rs/ha)		Net return (Rs/ha)		Input :Output ratio	
	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03
Paddy straw	162.45	158.38	64838	65255	129960	158380	65122	93125	1:2.00	1: 2.42
Leaves of Palas	173.52	170.62	62198	63450	138816	170620	76618	107170	1: 2.23	1:2.68
Dry grass	140.83	137.51	64438	64850	112664	137510	48226	72660	1: 1.75	1: 2.12
Polythene	151.32	150.26	68879	69560	121056	150260	52177	80700	1: 1.76	1: 2.16
Control	105.26	98.85	54198	54980	84208	98850	30010	43870	1: 1.55	1: 1.76
Paddy	52	38.51	12385	13950	20800	20410.3	8415	6460.3	1: 1.68	1: 1.46

Economic evaluation of different treatments showed (Table 3) that cost of cultivation was maximum with polyethylene mulch whereas highest total income, net return and Input : Output ratio were obtained with application of palas leaves. Minimum total income, net return as well as receipt per rupee investment was realized with no mulch. Lesser cost of material has resulted in better economic performance of palas leaves mulch. In general, there was lesser yield during 2002-03 under all the treatments probably due to unfavourable climatic condition particularly less and erratic rainfall. Whereas higher total expenditure, total income, net income and Input : output ratio during 2002-03 may be ascribed to higher prices of the inputs as well as produce. However, ginger cultivation under all the treatments recorded higher economic parameters as compared to paddy cultivation during both the years except Input : Output ratio in case of ginger cultivation without mulch during 2001-02.

Thus it could be concluded that use of mulching material in ginger is beneficial with regard to yield as well as economics as compared to no mulch. Further, highest growth and yield as well as net return and Input :Output ratio could be realised with application of palas leaves. It was also found that ginger cultivation is more beneficial as compared to paddy cultivation.

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