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Effect of silver color plastic mulch on vegetative growth and yield of ginger (*Zingiber officinale* Rosc.) Under drip irrigation system

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Abstract
A field trial was conducted at the Krishi Vigyan Kendra, Raisen, Madhya Pradesh for two consecutive years during 2016-2017 & 2017-2018 to determine the influence of different mulch materials on vegetative growth and yield of ginger (*Zingiber officinale* Rosc.) under drip irrigation system. The research trials for the consecutive two years showed that plastic mulch resulted significantly higher in plant height, No. of tillers clump^{-1}, Number of leaves clump^{-1}, No. of primary rhizomes, Length of primary rhizome (cm), Diameter of primary rhizome (cm), Number of secondary rhizome, Length of secondary rhizome (cm), Diameter of secondary rhizome (cm), Rhizome yield plant^{-1} (g) and Rhizome yield (t) ha^{-1},whereas days to maturity were lower in the treatment of control. The highest yield plant^{-1} and ha^{-1} was observed under the treatment of plastic mulch (434.13 gm plant^{-1} & 34.730 t ha^{-1}) with 124.20% increase in yield as compared to control without mulch (193.80 gm plant^{-1} & 15.49 t ha^{-1}). Followed by yield plant^{-1} and yield ha^{-1} were observed under the treatment of *Butea monosperma* and Paddy straw almost at par for both treatment (293.53 gm plant $^{-1}$, 23.480 t ha^{-1} & 272.617 gm plant^{-1}, 21.807 t ha^{-1}, respectively).

Keywords: Ginger, Drip irrigation, Mulching, Highest yield

Introduction
Ginger is a high value cash crop and requires lot of management practices for increasing its production and productivity. Mulching the fields with green manure is the most important operations carried out for successful ginger production. In the dry months, it conserves the moisture in the soil and enhances soil temperature for proper germination of the rhizome. In addition, it checks weed growth and enriches the fertility of the soil after decomposition of the weeds. Further it prevents washing out of soil and nutrients during heavy rains (Randhawa 1969 and Mohanty 1977) [6, 4]. Mulching has been found to increase the yield of ginger (A Aclan, F. 1976 and Mohanty and Sharma, 1978) [1]. Ginger being a crop with high water requirement, assured water supply throughout its growth period of 8 to 9 months is essential. Increasing scarcity of water often encountered in many parts of Madhya Pradesh regions necessitates alternative means to provide adequate water to the crop without wastage. Irrigation plays a paramount role in increasing the use of inputs and enhancing cropping intensity as well as productivity of a crop. However, water is becoming increasingly scare worldwide due to various reasons. Drip irrigation is an irrigation technique which saves water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone. Farmers look towards the Ginger crop as a cash crop with drip irrigation technique, now a day's inline drip tubes used instead of online dripper from last few years. Hence, the present study was taken up in ginger cv. Suprabha with the objective of studying the impact of different mulch materials on vegetative growth and yield of ginger under drip irrigation system.

Material and Methods
The field experiments were conducted at Krishi Vigyan Kendra, Raisen, Madhya Pradesh during 2016-2017 & 2017-2018 on plain land having medium black soil. Four treatments were

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used namely T_1-silver plastic film of 50µ thickness (200 gauge), T_2-green leaves of *Butea monosperma*, T_3 - one year old of paddy straw and T_4 - control (without mulch). The drip irrigation system was installed and operated daily to provide the sufficient moisture to the plants. The lateral lines were laid parallel to the crop rows and each lateral served two rows of crop. Emitters were fixed 0.3 m apart to serve the irrigation water requirement of plants. Standard agronomic practices such as fertilization and plant protection measures were applied during the entire crop period. The FYM 20 t ha^{-1} was applied as basal dose and 100 kg each of N, P and K ha^{-1} was applied in split doses through drip irrigation. The experiment was conducted in a randomized block design with three replications. Ginger rhizomes were sown at a spacing of 40 cm x 25 cm in the last week of April in both the years. Observations were recorded on plant height (cm), No. of tillers/clump, Number of leaves/clump, Days to maturity, No. of primary rhizomes, Length of primary rhizome (cm), Diameter of primary rhizome (cm), Number of secondary rhizome, Length of secondary rhizome (cm), Diameter of secondary rhizome (cm), Rhizome yield /plant (g) and Rhizome yield/ hectare (t). The number of sprouts were counted from each treatment at 50 DAP. Growth parameters were recorded in the first week of November. The crop was harvested in the last week of December and yield per hectare was estimated.

Results and Discussion

The experimental results shows the pooled values of both year treatment-wise observations of the crop were recorded from April 2016 to December 2017. In the Table 1, table 2 and table 3 shows the pooled values of both year observation highly significant value of plant height (68.697cm), no. of tillers $clump^{-1}$ (16.100), no. of leaves $clump^{-1}$ (136.557), no. of primary rhizomes (8.863), length of primary rhizomes (7.237cm), diameter of primary rhizomes (3.507cm), Number of secondary rhizome (12.387), length of secondary rhizome (4.547), diameter of secondary rhizome (3.043), rhizome yield $plant^{-1}$ and rhizome yield ha^{-1} (434.133 gm $plant^{-1}$ & 34.730 t ha^{-1}) under the treatment T_1 as compared to the treatment of T_4 (38.20 cm, 6.52, 55.74, 4.29, 3.04 cm, 1.49 cm, 4.47, 1.60 cm, 1.17 cm, 1.173 gm $plant^{-1}$ and 15.497 tha^{-1}, respectably). This could be due to plastic mulch have fully suppressed the weeds growth, check the soil erosion, Greater uptake of nutrients and water availability to plants and thus minimized the crop-weed competition as compared to non mulched condition, while in case of days to maturity plastic mulch was found higher (241.620 days) as compared to without mulch (200.870 days) similar result was found (Kalyankar *et al.*, 2011 and Reddy *et al.*, 2017) [3, 7]. Followed by result shows that yield was $plant^{-1}$(gm) and yield ha^{-1}(t) at par of both treatment T_2 & T_3 (293.53gm, 23.480 t & 272.61 gm, 21.80 t, respectably) as compared to without mulch (1.173 gm $plant^{-1}$ and 15.497 t ha^{-1}). Tree leaf and paddy straw as mulch have been reported to increase the yield of ginger in Bihar (Jha *et al*. 1986). The higher rhizome yield with organic mulches was due to the improved growth attributes, reduced competition by weeds and improved soil conditions. The increased the yield in treatment of plastic mulch (T_1) 124.20% as compared to control (15.49 t ha^{-1}). There was significant increase in yield under drip in combination with plastic mulch as compared to drip with organic mulch and drip alone without mulch.

Conclusion

Treatments1 silver color of plastic mulch materials with drip irrigation showed highest value of plant height, no. of tillers $clump^{-1}$, number of leaves $clump^{-1}$, days to maturity, number of primary rhizomes, length & diameter of primary rhizomes, number of secondary rhizomes, length & diameter of secondary rhizomes, rhizomes yield $plant^{-1}$ and ha^{-1} under the treatment T_1 and lowest under the treatment T_4.

Table 1: Effect of mulch materials on growth parameter in ginger

Treatment	Plant height (cm)	No. of tillers/clump	Number of leaves/clump	Days to maturity
T_1	68.697	16.100	136.557	241.620
T_2	50.990	12.577	92.177	230.923
T_3	44.920	12.307	84.700	234.740
T_4	38.200	6.523	55.747	200.870
C.D. (P=0.05)	13.864	2.785	17.679	4.676
SE(m)	3.930	0.789	5.011	1.325
SE(d)	5.558	1.116	7.087	1.874
C.V.	13.425	11.513	9.405	1.011

Table 2: Effect of mulch materials on rhizome yield parameter in ginger

Treatment	No. of primary rhizomes	Length of primary rhizome (cm)	Diameter of primary rhizome (cm)	Number of secondary rhizome
T_1	8.863	7.237	3.507	12.387
T_2	6.487	5.433	2.527	8.540
T_3	5.630	5.050	2.027	7.533
T_4	4.297	3.043	1.497	4.477
C.D. (P=0.05)	2.724	2.307	1.044	1.817
SE(m)	0.772	0.654	0.296	0.515
SE(d)	1.092	0.925	0.419	0.728
C.V.	21.159	21.817	21.455	10.834

Table 3: Effect of mulch materials on rhizome yield parameter in ginger

Treatment	Length of secondary rhizome (cm	Diameter of secondary rhizome (cm)	Rhizome yield /plant (g)	Rhizome yield/ hectare (t)
T_1	4.547	3.043	434.133	34.730
T_2	2.403	2.197	293.533	23.480
T_3	2.143	1.937	272.617	21.807
T_4	1.603	1.173	193.803	15.497
C.D. (P=0.05)	1.578	NS	63.944	5.116
SE(m)	0.447	0.384	18.126	1.450
SE(d)	0.633	0.543	25.634	2.051
C.V.	28.981	31.880	10.517	10.519

T_1 - Silver color plastic mulch, T_2 - Green leaves of Butea monosperma, T_3 - Paddy straw, T_4 – Without mulch (control)

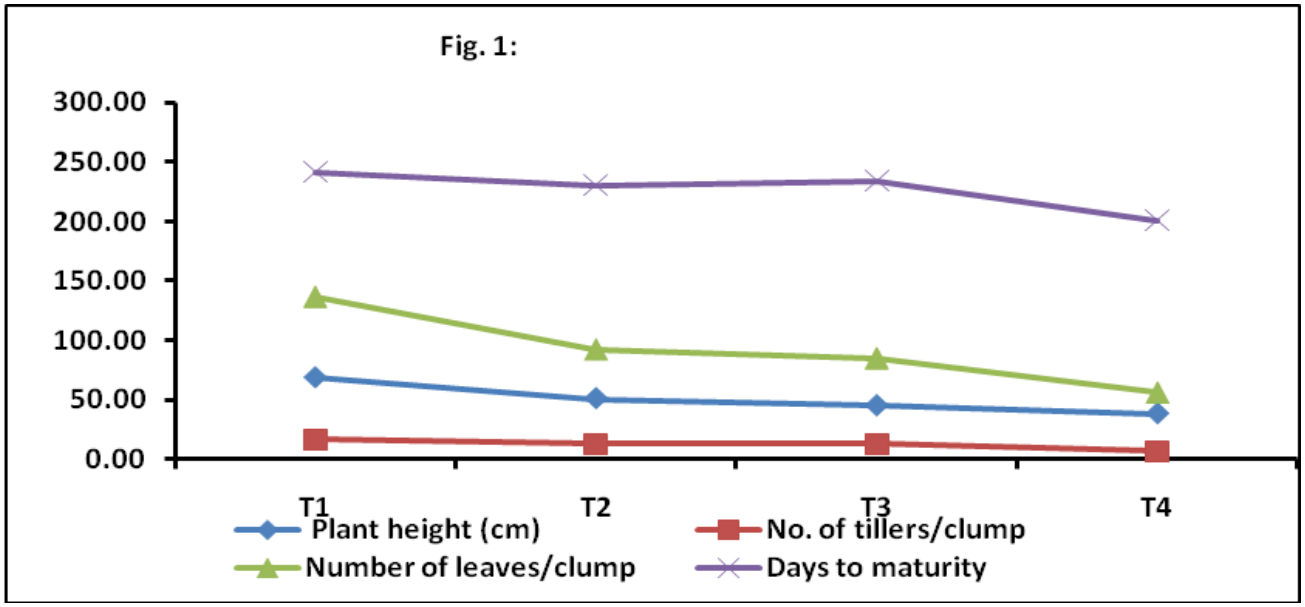
Fig. 1:
300.00
250.00
200.00
150.00
100.00
50.00
0.00
T1
T2
T3
T4
Plant height (cm)
No. of tillers/clump
Number of leaves/clump
Days to maturity

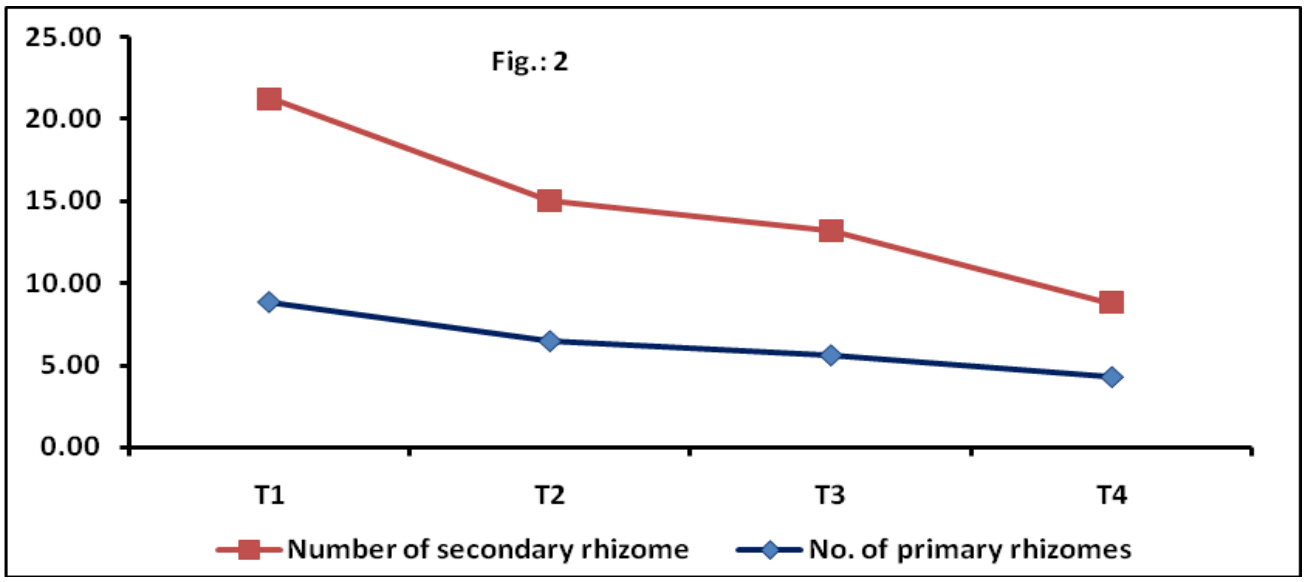
Fig.: 2
25.00
20.00
15.00
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5.00
0.00
T1
T2
T3
T4
Number of secondary rhizome
No. of primary rhizomes

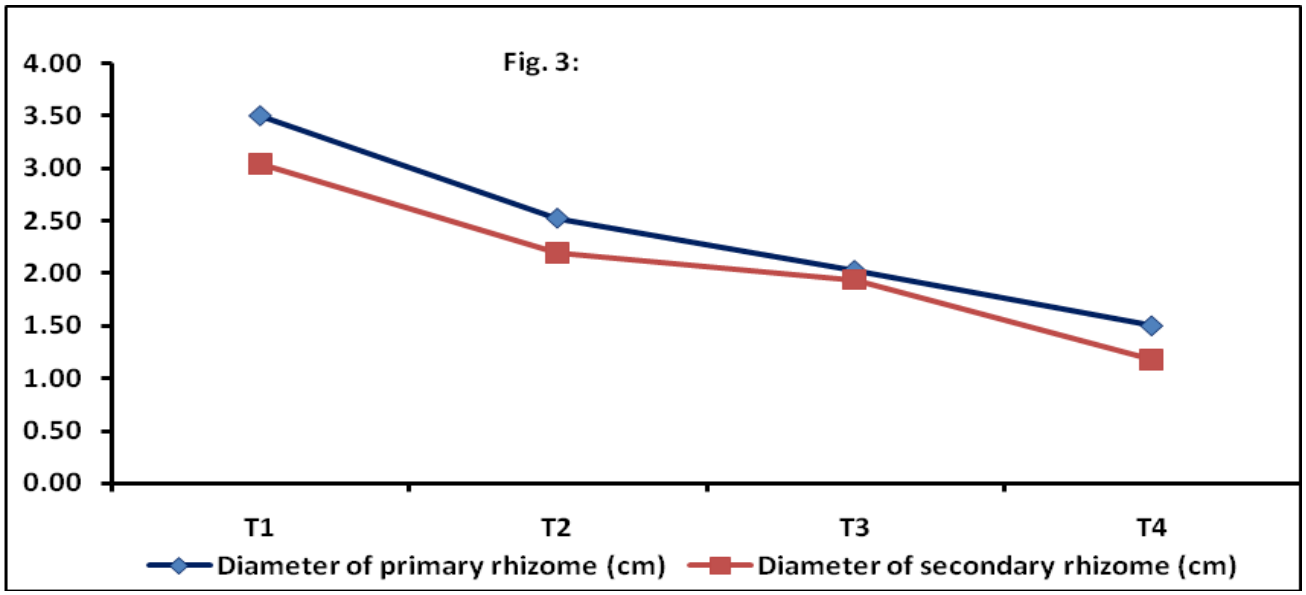
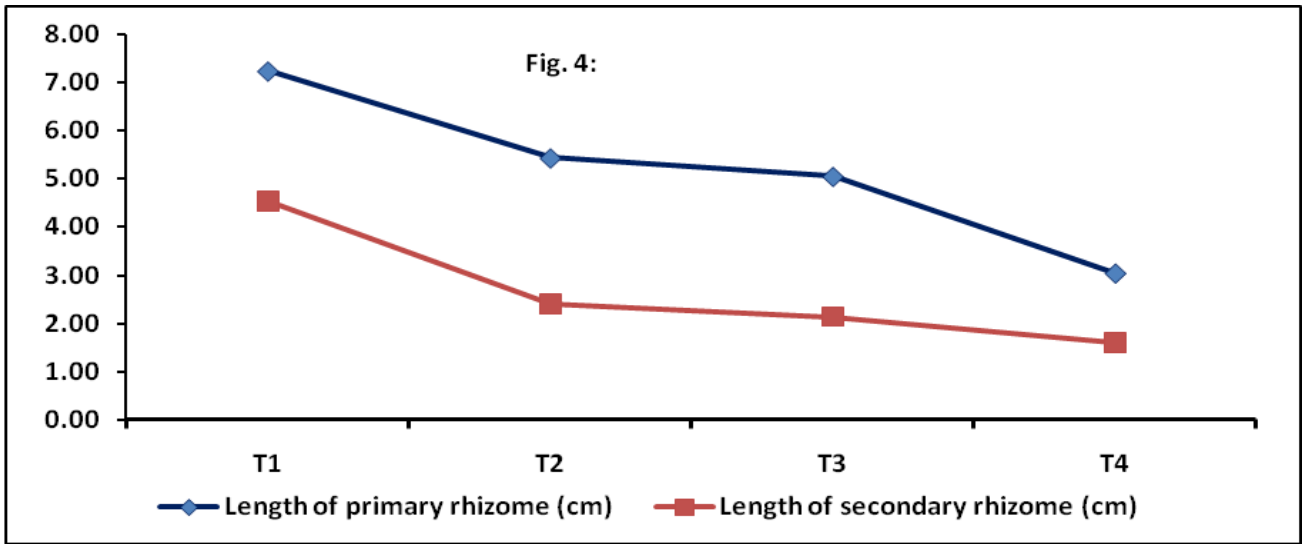
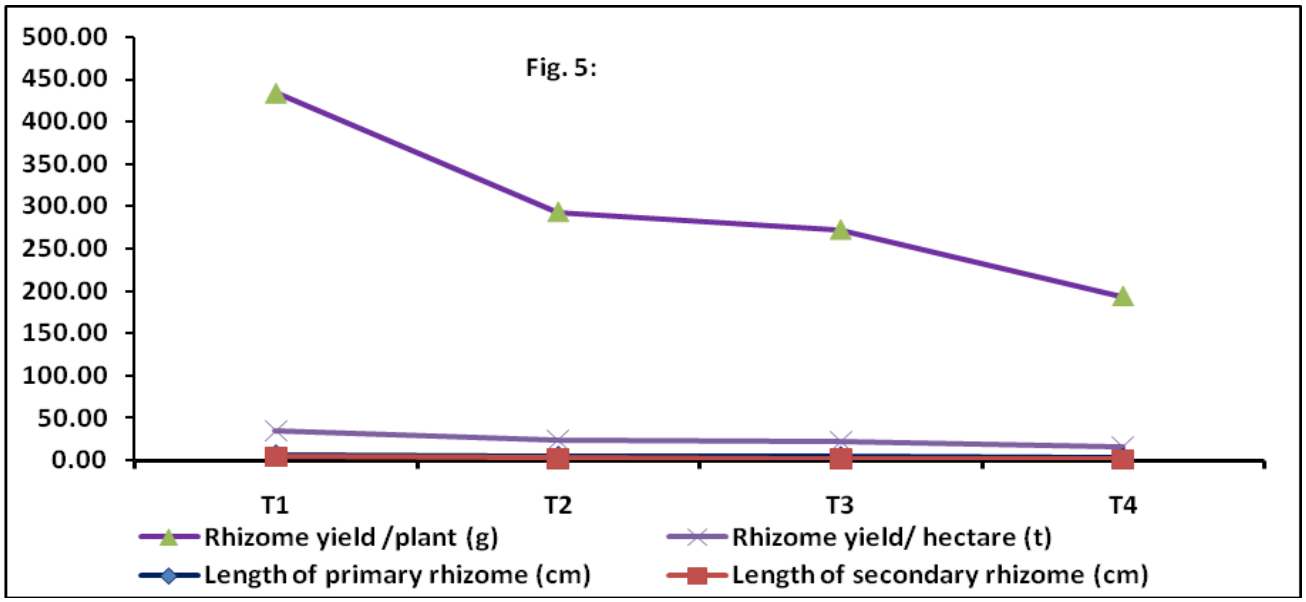


Fig. 3:
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
T1
T2
T3
T4
Diameter of primary rhizome (cm)
Diameter of secondary rhizome (cm)





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