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Effect of plastic mulch on suppression of weeds in transplanted ginger

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Abstract
Ginger is one of the earliest known oriental spices of the family Zingiberaceae. The conventional propagation methods of rhizomes being slow, a suitable method of raising ginger seed material in portrays has been devised by Indian Institute of Spices Research. The conventional propagation method using ginger rhizome being slow, a suitable method of raising ginger seed material in portrays has been devised by Indian Institute of Spices Research. The advantages of this technology are production of healthy uniform planting materials and reduction in seed rhizome quantity which eventually reduced cost on rhizomes. The experiment was carried out in the Instructional Farm, College of Agriculture, Vellayani during April 2016 to January 2017. The ginger variety used was Karthika. Field experiment was laid out in split plot design with four levels of mulches in main plots and fertilizer levels in sub plots with four replications..Two nodded rhizome bits of ginger cultivar was raised in protrays were transplanted at 55 days in beds taken in the interspaces of coconut. The results of the study indicated that plastic mulch can effectively reduce the weed growth in ginger to a great extend followed by mulching @30 t $ha^{-1.}$

Keywords: Ginger, mulch, weed, rhizome

Introduction
Ginger (*Zingiber officinale* Rosc) is one of the earliest known oriental spices of the family Zingiberaceae is being cultivated in India for underground modified stem called rhizomes which is used both as fresh vegetable and as a dried spice, since time immemorial. Ginger is mainly used as spice and flavoring agent in a wide variety of foods. India is a leading producer of ginger in the world producing 10.25 lakh tonne **(**Anon., 2016) [1] among the major spices grown in the country ginger. In conventional planting, the seed rhizome of 1500 to 2500 kg/ha is used depending on seed size and spacing. The conventional propagation methods of rhizomes being slow, a suitable method of raising ginger seed material in portrays has been devised by Indian Institute of Spices Research. Apart from the conventional method, this technique has been found to be cost effective and on par in yield. The advantages of this technology are production of healthy uniform planting materials and reduction in seed rhizome quantity which eventually reduced cost on seeds. In the view of this, the present experiment was conducted to see the effect of mulch and fertilizer in transplanted ginger. As a part of this experiment the efficacy of plastic mulches in transplanted ginger needs to be investigated. The practice of the extent to which organic mulches can be reduced and the economic use of plastic mulch in ginger cultivation needs to be investigated.

Material and Methods
The experiment was carried out in Instructional Farm, of the College of Agriculture, Vellayani during April 2016 to January 2017. The ginger variety used was Karthika. Field experiment was laid out in split plot design with four levels of mulches (M_1, M_2, M_3, M_4 in main plots and fertilizer levels in sub plots with four replication. The levels of mulches included organic mulches @ 30, 15, and 7.5 t ha^{-1} (M_1, M_2, M_3 respectively) and plastic mulch (M_4). For M_1 and M_2, half the quantity of organic mulch was applied at the time of transplanting and the remaining at two months after transplanting (MAT). For M_3, full quantity of mulch was applied at the time of transplanting. The sub plot treatments were T_1 (75:50:50 kg of NPK ha^{-1}), T_2 (150: 100: 100 kg ha^{-1}), T_3 (T_1 + foliar application of 19:19:19 @ 0.5% applied at 1, 3, 4 MAT and T_4 (100:75:75 kg ha^{-1} + foliar application of 19:19:19 @ 0.5% applied at 1, 3, 4 MAT) and absolute control (C_1) was also included. Two nodded rhizome bits of ginger cultivar was raised in protrays filled with *Trichoderma viridae* enriched coir pith compost and FYM in the ratio 2:1 for treatments and were transplanted at 1 ½ - 2 months age in beds taken in the interspaces of coconut. FYM @ 30 t ha^{-1} was applied uniformly to all plots except absolute control.

Weed count and dry weight of weed was done by counting the total number of weeds present in 1 m^2 area at 45th day, 90th day, and 120th day. Dry weight of weeds was recorded by oven driying to a constant weight at 70° ± 5° C. Statistical analysis was done using split plot design.

Results and Discussion

Weed count

Weed count differed significantly between all periods of observation (Table 1) and highest weed count was recorded from 7.5 t ha^{-1} on all periods. Weed count of 43.31 was obtained in the 120th day of observation and least weed count was observed in plastic mulch and recorded 9.21 in 120th days of observation. Chandra and Govind (2001) reported that application of mulch enhanced the sprouting of ginger rhizomes and minimized weeds and total weed biomass production was highest in unmulched plots compared to mulched plots. Mohanty (1991) [6] reported that application of mulch delayed the emergence of weeds and would have also had a smothering effect on them. This quick and better establishment of the plants along with reduced competition by weeds had a favourable effect on all growth parameters of turmeric. In sub plot, 150:100:100 kg ha $^{-1}$ treatment recorded highest weed count on all periods of observation and was significantly different from other treatments and weed count of 33.19 was obtained in the 120th day followed by 100:75:75 kg ha^{-1} + foliar application of 19:19:19 @0.5% and recorded 31.25 in 120th day of observation. This may be due to the increased fertilizer application which resulted in increase in weed count. Among the interaction mulching @ 7.5 t ha^{-1} and fertilizer dose of 150:10:100 kg ha^{-1} recorded highest weed count on all periods of observation. Less amount of mulch along with the higher dose of fertilizer have resulted in higher weed count in plots. Treatment effects varied significantly with absolute control. Manhas *et al.* (2011) [4, 5] reported that weed population were significantly lower with 6.25 t/ha mulch than with no mulch. Polythene mulch resulted in maximum growth, yield and quality as well as reduction in weed population in strawberry Kumar *et al.* (2018) [2]

Dry weight of weed

A significant variation in dry weight of weed per unit area was observed among the mulch treatment. (Table 2) The mulch treatment of 7.5 t ha^{-1} recorded highest dry weight of weed of 161.01g/m^2 in 120th day. Manhas *et al.* (2011) [4, 5] reported that weed dry matter were significantly lower with 6.25 t/ha mulch than with no mulch. The effect of different organic mulches and plastic mulches on weed suppression and yield of ginger revealed that application of paddy straw @ 6 t ha^{-1} along with green leaf mulch of 7.5 t ha^{-1} at 45 and 90 days after planting and application of dried coconut leaves at the time of planting @ 5.4 t ha^{-1} recorded higher weed control efficiency, higher economic returns compared to application of *Glycosmis pentaphylla* leaf mulch (Thankamani *et al.*, 2016) [9] In subplot 150:100:100 kg ha^{-1} resulted in highest dry weight of weed all periods of observation. Higher level of fertilizer resulted in increase in weed dry matter production compared to other treatments. Among the combination mulching @ 7.5 t ha^{-1} and fertilizer dose of 150:100:100 kg ha^{-1} recorded highest dry weight of weed on all periods. The combination of higher level of nutrients along with lower amount mulch have resulted in higher dry weight of weeds treatment effects varied significantly from absolute control (C_1).

Benefit Cost Analysis

The treatment of 30 t ha^{-1} of mulches applied in two split doses with a fertiliser dose of 150: 100: 100 kg of NPK ha^{-1} (m_1t_2) along with 30 t ha^{-1} of FYM generated a higher net profit compared to all other treatment and had a BC ratio of 1.87 (Table 3). The cost of cultivation was more for all the combinations (m_4t_1, m_4t_2, m_4t_3, m_4t_4) which used plastic mulch. All the treatment combinations except the combination of plastic mulch and fertilizer dose of 75:50:50 kg ha^{-1} (m_1t_1) resulted in higher BC ratio than control C_1 which the crop was raised as direct sowing of rhizomes and nutrients applied as per recommended package of practises of KAU. Nath and Karla (2000) [7] calculated economics of ginger and found maximum net profit and cost benefit ratio of ginger with application of 100:50:50 kg ha^{-1} NPK along with biofertilizers. There was a significant increase in net return and B: C ratio with each increase in mulch level and the maximum net return and B: C ratio were obtained with 9.38 t ha^{-1} mulch, significantly higher than mulch application at 6.25 t ha^{-1} and no mulch. (Manhas, 2011) [4, 5]. The economic evaluation of different treatments showed 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 and concluded that use of mulching material in ginger is beneficial with regard to yield as well as economics as compared to no mulch (Kushwah *et al.*, 2013) [3]. In a study on traditional ecological knowledge adaption practice in ginger, bio mulching using oak leaves increases yield by 43% and net returns by 61% compared to no mulching was reported by Singh *et al.* (2014) [8]. As revealed from the present study raising ginger plants in portray and transplanting with the application of 30 t of FYM ha^{-1} and 30 t ha^{-1} of mulch with the fertilizer dose of 150:100:100 kg ha^{-1} increased net returns.

Conclusion

The study highlights that plastic mulch can effectively reduce the weed growth in ginger to a great extend followed by mulching @30 t ha^{-1}. The decrease in amount of weed can effectively contribute to the increase in yield in transplanted ginger.

Table 1: Effect of mulch and nutrients on weed count

Treatments	45 th day	90 th day	120 th day
(Mulches) M_1	11.06	20.5	30.38
M_2	17.63	25.25	34.5
M_3	25.25	35.75	43.31
M_4	4.06	7.24	9.21
CD	0.545	0.294	0.659
(Fertilizers) T_1	14.19	21.81	29.75
T_2	15.00	24.19	33.19
T_3	14.16	22.5	30.81
T_4	14.21	22.63	31.25
CD	0.734	0.515	0.441

(Interaction) m_1t_1	11.50	20.50	30.30
m_1t_2	10.80	22.00	31.5
m_1t_3	11.30	19.80	29.80
m_1t_4	10.80	19.8	30.00
m_2t_1	19.30	24.50	34.30
m_2t_2	18.30	26.50	35.80
m_2t_3	18.30	25.50	33.50
m_2t_4	14.80	24.50	34.50
m_3t_1	22.30	34.50	39.50
m_3t_2	24.20	35.80	44.00
m_3t_3	27.80	37.30	46.50
m_3t_4	25.80	35.50	43.30
m_4t_1	3.75	7.75	12.40
m_4t_2	3.75	10.50	9.50
m_4t_3	4.75	7.50	11.50
m_4t_4	4.00	8.21	9.78
CD	1.478	1.020	0.892
C_1	7.00	11.25	14.75
C_1 Vs Treatment	S*	S*	S*

Table 2: Effect of mulch and nutrients on dry weight of weed (g m^{-2})

Treatments	**45 th day**	**90 th day**	**120 th day**
(Mulches) M_1	52.39	67.08	85.39
M_2	69.18	81.51	142.77
M_3	80.87	92.79	161.01
M_4	21.58	28.54	32.72
CD	1.542	0.808	4.896
(Fertilizers) T_1	53.82	68.54	107.00
T_2	57. 31	73.4	113.28
T_3	55.61	71.73	106.99
T_4	57. 27	71.58	111.39
CD	1.115	0.802	6.238
(Interaction) m_1t_1	48.63	64.05	82.90
m_1t_2	58.13	69.25	87.23
m_1t_3	50.85	68.15	85.05
m_1t_4	51.98	66.85	86.40
m_2t_1	67.88	79.33	130.60
m_2t_2	71.50	82.60	135.50
m_2t_3	67.15	81.63	157.23
m_2t_4	70.18	82.48	147.75
m_3t_1	77.90	92.15	163.50
m_3t_2	83.65	94.70	168.00
m_3t_3	82.55	91.33	153.15
m_3t_4	79.38	93.00	159.40
m_4t_1	20.88	38.65	52.10
m_4t_2	20.08	42.08	54.83
m_4t_3	21.90	52.50	52.55
m_4t_4	23.45	42.28	59.58
CD	2.231	1.605	12.467
C_1	63.13	71.53	106.78
C_1 Vs Treatment	S*	S*	S*

Treatment	**Fresh yield (kg/ha)**	**Value (Rs)**	**Cost of cultivation(Rs)**	**Profit (Rs)**	**B:C ratio**
m_1t_1	17545.8	877290	490982	386308	1.79
m_1t_2	18644.4	932220	499367	432853	1.87
m_1t_3	18045.3	902265	490992	411273	1.84
m_1t_4	18138.6	906930	494778	412152	1.83
m_2t_1	16756.8	837840	474432	363408	1.77
m_2t_2	17717.1	885855	482817	403038	1.83
m_2t_3	17196.9	859845	474442	385403	1.81
m_2t_4	17293.8	864690	478228	386462	1.81
m_3t_1	15931.8	796590	477082	319508	1.67
m_3t_2	16923.3	846165	485467	360698	1.74
m_3t_3	16208.7	810435	477092	333343	1.70
m_3t_4	16476.9	823845	480878	342967	1.71
m_4t_1	16750.2	837510	532657	304853	1.57
m_4t_2	18135.3	906765	541042	365723	1.68
m_4t_3	17377.2	868860	532667	336193	1.63
m_4t_4	18006.3	900315	536453	363862	1.68
C_1	8770.8	438540	468000	-29460	0.94

Benefit cost analysis

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