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Short communication

Organic mulches affecting yield, quality and diseases of ginger in mid hills of North Eastern Himalayas

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ABSTRACT

Field experiments were conducted during 2004-09 at ICAR Sikkim Centre, Tadong at an altitude of 1,400 m AMSL to identify suitable organic mulch material for higher yield and dsisease suppression in local ginger cv. Bhaisey. Green leaves of *Artemisia vulgaris*, *Schima wallichii*, *Eupatorium odoratum*, *Alnus nepalensis* and *Datura* spp. were used as organic mulches. Among the different tree leaf mulches used in ginger, the maximum yield was recorded for *Schima wallichii* (35,388.40 kg/ha) which was followed by *Datura* spp. (21766.80 kg/ha). The highest incidence of bacterial wilt (38%), soft rot (48%), and leaf spot (40%) was recorded in the control plots, whereas the lowest incidence of bacterial wilt (8%), soft rot (12%) and leaf spot (35%) was recorded under *S. wallichii* treatment followed by *Datura* spp. mulching. *Schima wallichii* mulch recorded significantly higher number of leaves (22.40), rhizome length (9.00 cm), and No. of fingers/plant (41.00) as compared to all other organic mulching materials. Highest B:C ratio (4.88) was found in mulching with *S. wallichii* followed by *Datura* spp. mulching (3.0) in organic ginger production.

Key words: Disease, economics, organic mulch, *Zingiber officinale*, yield.

Ginger has been the major horticultural cash crop of Sikkim for more than two decades with high returns which resulted in non-traditional areas being brought under this crop. New cultivation practices were introduced and adopted by a large section of ginger growers. But at later stage, many farmers gave up ginger cultivation while others are still struggling to survive because, over the last 15 to 20 years diseases severely affected the crop resulting in a decline in the yield ratio from 1 'seed' rhizome to 8–10 harvested rhizomes to only 1 to 2-3 (Gurung and Gurung, 4).

Ginger in Sikkim commonly suffers from diseases such as soft rot (*Pythium aphanidermatum*), bacterial wilt, (*Pseudomonas* [Ralstonia] *solanacearum*), leaf spot (*Phyllosticta zingiberi*) and storage rot caused by pathogenic saprophytic fungi and bacteria (Dake, 3). Best combined chemical treatments against *Pythium aphanidermatum* were soil drenches with zinc ethylenebis or manganese ethylenebis (dithocarbamate) (polymeric) complex with zinc salt following rhizome treatment with methyl benzimidazol-2-yl carbonate and incorporation of 6, 7, 8, 9, 10, 10-Hexachloro-1, 5, 5a, 6, 9, 9a-hexahydro-6, 9-methano-2, 4, 3-benzodioxathiopin-3-oxide dust into the soil (Srivastava, 14), which is not permitted under organic production system.

Mulching the ginger beds with green leaves is a common practice amongst the farmers of Sikkim to enhance germination, reduce soil erosion and control weeds (Rahman *et al.*, 10). It also adds organic matter to the soil and conserves moisture during the later part of the cropping season after the withdrawal of South-West monsoon. Some of the locally available trees (*Schima wallichii* and *Alnus nepalensis*) and shrubs (*Artemisia vulgaris*, *Eupatorium odoratum*, *Datura* spp.) possess anti-microbial properties (Taylor *et al.*, 15). Mulching material with anti-microbial property can reduce the problem of ginger diseases to some extent along with control of weeds and soil run-off. Very little information is available on the effect of organic mulching for Sikkim conditions. Hence, this study was carried out with the objective of identifying the best organic mulch for higher yield and low disease incidence in the mid hills of Sikkim Himalayas.

Field experiments were conducted during 2004-09 at ICAR Sikkim Centre, Tadong, at an altitude of 1,400 m AMSL. Uniform crop rotation and well drained soils were selected for planting in the month of March during the five years. Healthy rhizome of local ginger cv. Bhaisey of ≥ 50 g size was planted at the spacing of 30 cm x 45 cm in well drained soil with pH 5.3, OC 1.36%, available nitrogen 221.8 kg/ha (alk. $KMnO_4$), available P_2O_5- 28.5 kg/ha (Bray P_1) and available K 194.7 kg/ha. The experiment was laid out in RBD with six treatments and four replications in 10 sqm. plots. The six mulching treatments were control/no mulching (T_1), *Schima wallichii* (T_2), *Artemisia vulgaris* (T_3), *Eupatorium odoratum* (T_4), *Alnus nepalensis* (T_5) and *Datura* spp. (T_6). Mulch was applied @ 15 t/ha in two

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splits (first application at the time of planting, *i.e.*, last week of March and second application after earthing up) in all the treatments at the time of planting. Yield attributing parameters recorded were plant height, number of leaves/ plant, leaf length, leaf width and stem diameter at the height of 5 cm from ground level in the month of September. Rhizome length, width and number of fingers/ plant, rhizome fresh weight, weight of mother rhizome and yield were also recorded at the time of harvest in the month of November. Common diseases, bacterial wilt, soft rot and leaf spot were diagnosed on the basis of symptoms produced in the field in the month of July-August. Isolation and identification of the bacterial pathogen was done on TZC medium, while the fungal pathogens were cultured on OMA and PDA medium on randomly selected five plants. Disease severity was recorded as per cent infection of bacterial wilt, soft rot and leaf spot. The data were analyzed statistically following the method of Panse and Sukhatme (8). The test of significance was considered at 5 and 1% levels of probability.

Results of the study (Table. 1) indicated significant difference from each other and over control under the influence of various mulching materials. Plant height varied from 59.8 cm in control to 91.4 cm in *Datura* spp. The plant height in *Schima wallichii* (91.2 cm) was significantly different from other mulching treatments and *at par* with *Datura* spp. (91.4 cm). The highest numbers of leaves per plant were found for mulching with *Schima wallichii* (22.4), which was significantly different from all the other mulches but *at par* with mulching of *Eupatorium odoratum*. Mulching with *Datura* spp. produced the longest leaves (24.2 cm) which was *at par* with *S. wallichi* (23.8 cm), *Eupatorium odoratum* (23.0 cm) and *Alnus nepalensis* (22.8 cm) but significantly different from other treatments. Maximum leaf width was recorded in *A. nepalensis* mulching (3.2 cm), which was on par with *Datura* spp. (3.1 cm) and *S. wallichii* (3.0 cm) but significantly higher than other treatments. Maximum stem diameter was observed in *Artemisia vulgaris* mulching (0.82 cm) which was at par with *Datura* spp. (0.78 cm) and significantly different from other mulches. Maximum rhizome length was found in *S. wallichii* and *Artemisia vulgaris* (9.0 cm, respectively) which were significantly different from other mulches. Mulches of *A. nepalensis* produced maximum rhizome width (4.7 cm) which was significantly different from other treatments. Maximum number of fingers per plant was observed in *S. wallichii* (41.0) which was on par only with *Datura* spp. (37.6) but significantly different from other mulch materials. Significantly higher values were recorded for mulching with *S. wallichii* probably due to higher efficiency in disease reduction besides providing the soil nutrients through higher supplementation of N being a N_2-fixing species, reduced soil temperature and increased soil moisture (Kun *et al.*, 7).

The association of micro-organisms like *Ralstonia solanacearum*, *Pythium* spp., *Fusarium oxysporum*, *Phyllosticta* sp. and nematode species with ginger has been reported from all the ginger growing areas of the world (Kim *et al*., 6; Srivastava *et al*., 13; Dake, 3). In Sikkim also the ginger crop suffers mainly due to soft rot (c.o. *Pythium aphanidermatum*), bacterial wilt (c.o. *Ralstonia solanacearum*) and leaf spot (c.o. *Phyllosticta* spp.). The chemicals like metalaxyl and carbendazim in different formulations alone and in combination treatments with mancozeb gave significant control of the diseases (Chauhan and Patel, 2; Rathaiah, 11; Srivastava, 14). The state being declared organic, the conventional disease management strategies have to be replaced with organic strategies incorporating bio-agents, botanicals and like components.

All treatments comprising of organic mulches were found more or less susceptible to the major diseases of ginger in the state, *viz*., bacterial wilt, soft rot and leaf soft. However, major difference was found in the level of susceptibility among the mulches used (Table 2). *Schima wallichii* was found very effective

Table 1. Effect of mulching on yield attributing parameters of ginger cultivar Bhaisey.

Treatment	Plant height (cm)	No of leaves/ plant	Leaf length (cm)	Leaf width (cm)	Stem diameter (cm)	Rhizome length (cm)	Rhizome width (cm)	No. of fingers/ plant
T_1	59.80	19.80	21.00	2.70	0.40	6.20	4.24	23.80
T_2	91.20	22.40	23.80	3.00	0.74	9.00	4.46	41.00
T_3	71.80	21.40	22.00	2.80	0.82	9.00	4.62	34.40
T_4	71.20	21.20	23.00	2.80	0.70	6.20	4.26	31.00
T_5	73.20	22.00	22.80	3.20	0.72	7.60	4.70	30.20
T_6	91.40	21.20	24.20	3.10	0.78	7.80	4.32	37.60
LSD (P = 0.05)	1.60	0.98	1.58	0.38	0.04	0.51	0.40	4.56

against the bacterial wilt and soft rot of ginger as compared to other mulches. Minimum incidence of bacterial wilt and soft rot of ginger was observed in *S. wallichii* mulching (8 and 12%, respectively) followed by *Datura* spp. (10 and 14%, respectively). However, maximum disease incidence was observed in control plots (38 and 48%, respectively) which significantly reduced the yield. Mulching with the leaves and twigs of *Schima wallichi*, *Eupatorium* spp. and *Alnus nepalensis* @ 5 to 10 t/ha resulted in increased germination, reduced weed growth and soft rot incidence (Patiram *et al*., 9). Similarly, Taylor *et al*. (15) found *Eupatorium odoratum* to have antimicrobial activity against *Bacillus subtilis* and some other bacterial species of *Staphylococcus* and *Streptococcus*. There was no significant difference in the incidence of leaf spot among the various treatments, however, *Schima wallichii* plots found to be minimally affected (35%) and control plot was affected the maximum by this disease (40%).

Mulching with *Schima wallichii* gave significant reduction of the three diseases *viz.* bacterial wilt, soft rot and leaf spot in ginger over the control. The major diseases, bacterial wilt and soft rot were significantly managed by the other organic mulches. However, impact of other mulches apart from *S. wallichii* on leaf spot disease was not significant.

The rhizome yield given in Table 3 ranged from 17568.50 to 35388.40 kg/ha and all the mulching treatments resulted in significantly different rhizome yields among themselves and significantly over the control. Among all the mulching treatments the highest rhizome weight per plant was recorded for *Schima wallichii* (1220 g) which was significantly higher from all other mulches. However, no significant difference was observed in weight of mother rhizome yield which perhaps could be related to higher control of the three diseases as stated above. The highest yield was observed for *S. wallichii* (35,388.40 kg/ha) which was significantly different from all other mulch materials and the lowest yield was recorded in control plots (17,568.50 kg/ha). The treatment with *S. wallichii* was the best among the mulching materials under evaluation. The findings are in close conformity with Patiram *et al*. (9), and Chandra and Govind (1). Pests and diseases are factors limiting production of ginger (ISPS, 5). By controlling diseases, the production of ginger was increased.

Table 2. Effect of mulching on disease severity in ginger cv. Bhaisey.

Treatment	Bacterial wilt (%)	Soft rot (%)	Leaf spot (%)
T_1	38.0	48.0	40.0
T_2	8.0	12.0	35.0
T_3	20.0	30.0	38.0
T_4	15.0	18.0	36.0
T_5	18.0	20.0	39.0
T_6	10.0	14.0	38.0
LSD (P = 0.05)	2.39	3.54	4.03

Table 3. Effect of mulching on yield and economics of ginger cv. Bhaisey cultivation.

Treatment	Rhizome weight (g)/plant	Weight (g) of mother rhizome/ plant	Rhizome yield (kg/ha)	Benefit* (Rs, in lakhs/ha)	B:C ratio**
T_1	580.0	52.0	1,7568.5	3.51	2.42
T_2	1220.0	53.0	35,388.4	7.08	4.88
T_3	600.0	52.8	18,151.0	3.63	2.50
T_4	650.0	52.6	19,542.7	3.91	2.70
T_5	640.0	52.6	19,265.4	3.85	2.66
T_6	730.0	53.0	21,766.8	4.35	3.00
LSD (P = 0.05)	108.77	3.2	2,271.49		

*Calculated @ Rs 2,000/q for sale price of fresh rhizome

**Cost of cultivation @ Rs 1,45,000 (Planting material - 30 q @ Rs. 3,000/q, FYM-10 T @ 1,000/T, Field preparation-50 man days @100/day, Sowing, harvesting and cultural practices-150 man days@100/day and Miscellaneous/ contingency- Rs.10,000.)

The B:C ratio in different mulching materials varied from 2.42 to 4.88. Highest ratio (4.88) was obtained in mulching with *Schima wallichii* followed by *Datura* spp. (3.0) mulching. The lowest B:C ratio was recorded for control/ no mulching treatment (2.42). Therefore, for getting better production and income under organic system, mulching of ginger with *S. wallichii* should be practiced. This is due to the lowest incidence of bacterial wilt, soft rot and leaf spot recorded for *S. wallichii* followed by *Datura* spp. Active constituents of the leaves of *S. wallichii* need to be studied in detail against the bacterial wilt and soft rot pathogens of ginger.

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