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ORGANIC MULCHING STRATEGIES FOR ENHANCING GROWTH, YIELD, AND SOIL NUTRIENT STATUS IN STRAWBERRY (*FRAGARIA × ANANASSA*) CV. CHANDLER UNDER MANIPUR CONDITION

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ABSTRACT

Experiment was carried out during 2023–2024 at the Horticultural Research Field, Department of Horticulture, College of Agriculture, CAU, and Imphal. The study aimed to assess the impact of various organic mulches on growth performance, yield characteristics, and post-harvest soil nutrient availability in strawberry (*Fragaria* × *ananassa* Duch.) cv. Chandler. The trial followed a Randomized Block Design (RBD) with seven treatments and three replications: T1 – Control, T2 – Sawdust, T3 – Paddy Straw, T4 – Paddy Husk, T5 – Dry Leaves and Grasses, T6 – Banana Leaves, and T7 – Spent Mushroom Substrate.

Among the treatments, T4 (Paddy Husk) resulted in superior plant growth metrics, including height, canopy spread, leaf number, leaf area, fresh and dry biomass, flower count (37.90), fruit set percentage (87.08%), and runner production (19.85), along with the shortest time to first flowering (81.07 days). It also produced the highest fruit yield (138.43 q/ha), closely followed by T3 (Paddy Straw) with 125.07 q/ha. Control plots (T1) consistently recorded the lowest values across all measured parameters, underscoring the effectiveness of organic mulch application in improving crop performance.

The highest benefit-cost (B:C) ratio of 1:3.17 was recorded with T4 (Paddy Husk). Post-harvest soil analysis revealed the highest available nitrogen (244.44 kg/ha) in T5 (Dry Leaves and Grasses), while the greatest potassium availability (253.31 kg/ha) was observed in T6 (Banana Leaves). Differences in available phosphorus (P_2O_5) were not statistically significant.

Keywords **:** Strawberry, Organic Mulch, Growth, Yield, Soil Nutrients.

Introduction

The cultivated strawberry (*Fragaria* × *ananassa* Duch.) is a hybrid species resulting from the cross between two wild octoploid species: *Fragaria chiloensis* Duch. and *Fragaria virginiana* Duch. (Bakshi *et al*., 2014). Introduced to India by the British during the early 1960s, strawberry is a perennial, herbaceous plant that belongs to the family Rosaceae. It is characterized as a short-day plant and is valued for its distinctive aroma and delicate flavor, primarily attributed to the presence of volatile esters. Among berry crops, strawberry stands out for its appealing taste, high nutritional value, and soft texture, making it one of the most desirable fruits (Hancock *et al*., 2008). Additionally, strawberry offers high economic returns in a relatively short time frame, as it typically begins yielding fruit within six months of planting (Bakshi *et al*., 2014). The North Eastern region of India presents favorable conditions for strawberry cultivation due to its temperate and conducive climate (Hossain *et al*., 2017).

Among the various agronomic practices influencing strawberry production, mulching plays a key role in enhancing plant growth, yield, and fruit quality. Although plastic mulch has traditionally been used, growing concerns about its long-term

environmental impact and adverse effects on soil health have shifted attention towards more sustainable alternatives. Organic mulches serve as an eco-friendly option that not only suppresses weed growth and conserves soil moisture but also moderates soil temperature and enriches the soil with nutrients through decomposition. Moreover, organic mulches are widely available and more cost-effective compared to synthetic ones.

The primary aim of this research is to assess the influence of different organic mulch materials on the growth and yield performance of strawberry plants. In addition, the study seeks to evaluate the economic viability of these mulching options and analyze changes in soil nutrient status following harvest

Materials and Methods

Study was conducted during the 2023–24 cropping season at the Horticultural Experimental Field, Department of Horticulture, College of Agriculture, Iroisemba, under the Central Agricultural University, Imphal, Manipur. The experimental soil was clayey in texture, moderately acidic with a pH of 5.6, and contained 0.98% organic carbon. Nutrient analysis revealed low levels of available nitrogen (225.79 kg/ha) and phosphorus (P_2O_5: 19.68 kg/ha), while potassium (K_2O: 239.23 kg/ha) was in the medium range.

The experiment followed a Randomized Block Design (RBD) comprising seven treatments with three replications. The treatments were as follows:

- T1: Control (no mulch)
- T2: Sawdust
- T3: Paddy Straw
- T4: Paddy Husk
- T5: Dry Leaves and Grasses
- T6: Banana Leaves
- T7: Spent Mushroom Substrate

A uniform basal dose of NPK fertilizers was applied at the rate of 75:80:60 kg/ha using urea, single superphosphate (SSP), and muriate of potash (MOP), respectively, through the ring application method. Strawberry runners of the 'Chandler' cultivar, sourced from the Central Farm of CAU, were transplanted on October 26, 2023. Mulching treatments were applied three days later, on October 29, 2023, maintaining a consistent thickness of approximately 5 cm across all plots.

Standard agronomic practices, including intercultural operations and pest/disease management, were carried out as needed throughout the growing season. Observations on growth and yield parameters were recorded from five randomly selected plants per plot. After harvest, soil samples were collected and analyzed for nutrient content using standard laboratory procedures.

The collected data were subjected to statistical analysis using Analysis of Variance (ANOVA), and economic returns were calculated based on yield data and prevailing market prices.

Results and Discussion

Growth Attributes

Significant differences were observed among treatments in plant height, canopy spread (N–S and E–W directions), and number of leaves during the vegetative growth stages, with the exception of data recorded at 30 days after planting (DAP). At 60, 90, and 120 DAP, the tallest plants were noted in T4: Paddy Husk, with average heights of 6.99 cm, 7.20 cm, and 7.53 cm, respectively. This treatment also produced the widest plant spread 13.91 cm, 19.84 cm, and 22.73 cm (N–S) and 13.95 cm, 18.90 cm, and 23.33 cm (E–W) at the same intervals. Similarly, T4 recorded the highest number of leaves per plant at each stage (6.13, 9.77, and 17.89), followed by T3: Paddy Straw (Table 1). Comparable trends were previously reported by Singh *et al*. (2023), Pandey *et al*. (2015), Kumar *et al*. (2022), Sujatha *et al*. (2018), Kumar *et al*. (2012), and Pandey *et al*. (2016).

T4: Paddy Husk also produced the largest leaf area (46.43 cm²), again followed by T3: Paddy Straw. These findings are consistent with those of Sujatha *et al*. (2018) and Ali and Gaur (2013). The highest flower count per plant (37.90), fruit set percentage (87.08%), and runner production (19.85) were also observed under the Paddy Husk treatment, aligning with the results of Singh *et al*. (2023), Kumar *et al*. (2022), and Ali and Gaur (2013). The shortest time to first flowering (81.07 days) was recorded in the same treatment, which was statistically at par with T3: Paddy Straw, T7: Spent Mushroom Substrate, T2: Sawdust, and T5: Dry Leaves and Grasses, echoing earlier observations by Kumar *et al*. (2018) and Misra *et al*. (2023).

In contrast, the control treatment (T1) consistently recorded the lowest values: minimum leaf area (35.18 cm²), flower count (23.87), fruit set (73.60%), runner production (3.60), and the longest time to first flowering (84.67 days).

The superior growth observed under mulched conditions can be attributed to the favorable

microenvironment created by organic mulches. These materials help maintain loose, aerated soil, enhancing root growth and moisture retention. Additionally, the mulches reduced weed competition by limiting light penetration, which likely improved nutrient availability and uptake, contributing to overall better vegetative performance.

Table 1: Effect of organic mulches on the plant height, spread and number of leaves of strawberry cv. Chandler

Treatments	Plant height (cm)				Plant Spread (N-S) (cm)				Plant Spread (E-W) (cm)				Number of leaves			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
T_1	4.22	4.52	5.50	5.77	7.55	10.13	13.67	15.57	7.35	9.67	13.07	15.87	2.47	4.51	6.87	9.40
T_2	5.08	5.81	6.29	6.66	8.51	11.35	15.88	19.03	8.26	11.75	15.20	19.14	3.27	5.20	8.73	14.00
T_3	5.33	6.48	6.77	7.06	8.90	12.38	16.90	21.23	8.62	12.62	15.86	20.91	3.33	5.67	9.29	15.38
T_4	5.75	6.99	7.20	7.53	9.69	13.91	19.84	22.73	8.87	13.95	18.90	23.33	3.60	6.13	9.77	17.89
T_5	4.70	5.41	6.01	6.37	8.39	10.77	15.16	18.00	8.03	11.03	14.83	18.43	2.87	4.80	8.13	12.30
T_6	4.61	5.08	5.81	6.18	7.99	10.69	15.06	16.55	7.84	10.79	14.55	16.44	2.73	4.73	8.00	11.80
T_7	5.25	6.31	6.57	6.96	8.57	12.04	16.60	20.48	8.31	12.46	15.72	20.45	3.30	5.53	9.08	15.00
SEd (±)	0.64	0.16	0.12	0.06	0.62	0.17	0.19	0.35	0.96	0.19	0.15	0.21	0.37	0.10	0.13	0.22
CD 5%	NS	0.34	0.26	0.12	NS	0.37	0.41	0.76	NS	0.42	0.32	0.47	NS	0.21	0.27	0.48

Table 2: Effect of organic mulches on the days to first flowering, fruit set percentage, number of flowers and runners of strawberry cv. Chandler

Treatments	Leaf area (cm^2)	Days to first flowering	No. of flowers	Fruit set (%)	No. of runners
T_1	35.18	84.67	23.87	73.60	3.60
T_2	41.29	82.20	30.61	79.39	12.11
T_3	45.41	81.80	34.03	85.01	16.07
T_4	46.43	81.07	37.90	87.08	19.85
T_5	37.66	82.27	28.00	76.78	9.24
T_6	36.74	82.87	27.78	74.39	9.15
T_7	44.41	81.87	32.99	84.67	14.88
SEd (±)	0.42	0.70	0.67	1.10	0.75
CD 5%	0.91	1.53	1.47	2.39	1.64

Yield and Yield Attributes

The application of various organic mulches had a significant impact on the yield and associated traits of strawberry, as shown in Table 3 and Figure 1. Among the treatments, T4: Paddy Husk produced the highest number of fruits per plant (33.00), followed by T3: Paddy Straw (28.93). These observations are consistent with findings reported by Pandey *et al*. (2015) and Vanlalhmuaka *et al*. (2021).

T4 also resulted in the largest fruit dimensions, with a fruit length of 3.55 cm, diameter of 1.99 cm, average fruit weight of 7.26 g, and fruit volume of 7.85 cc. additionally, this treatment extended the harvesting duration to 67.67 days. Similar patterns have been observed in previous studies, including those by Pandey *et al*. (2015), Sujatha *et al*. (2018), and Misra *et al*. (2023) in strawberry, as well as Sahu *et al*. (2024) in guava.

The highest fruit yield per plant (296.63 g) was also obtained under T4: Paddy Husk, closely followed by T3: Paddy Straw. In terms of total yield, T4 recorded 138.43 quintals per hectare, which was statistically similar to T7: Spent Mushroom Substrate. These results are in agreement with earlier work by Sujatha *et al*. (2018), Singh *et al*. (2023), and Abonmai *et al*. (2023) in various crops.

The improved yield performance under mulched conditions may be attributed to reduced weed pressure, improved moisture retention, and enhanced soil nutrient availability. These favorable conditions likely promoted better photosynthetic efficiency and reproductive development, leading to superior fruit yield, quality, and an extended harvesting period.

Table 3: Effect of different sources of organic mulch on the yield parameters of strawberry cv. Chandler

Treatments	No. of fruits	Fruit length (cm)	Fruit diameter (cm)	Fruit wt. (g)	Fruit vol. (cc)	Duration of harvest
T_1	17.57	3.05	1.77	5.09	5.25	44.33
T_2	24.30	3.38	1.88	6.91	6.75	58.33
T_3	28.93	3.46	1.91	7.02	7.40	60.67
T_4	33.00	3.55	1.99	7.26	7.85	67.67
T_5	21.50	3.35	1.87	6.45	6.43	55.67
T_6	20.67	3.33	1.85	6.21	6.25	52.00
T_7	27.93	3.44	1.90	6.96	7.35	58.67
SEd (±)	1.23	0.08	0.03	0.09	0.09	2.06
C.D 5%	2.68	0.17	0.07	0.21	0.21	4.49

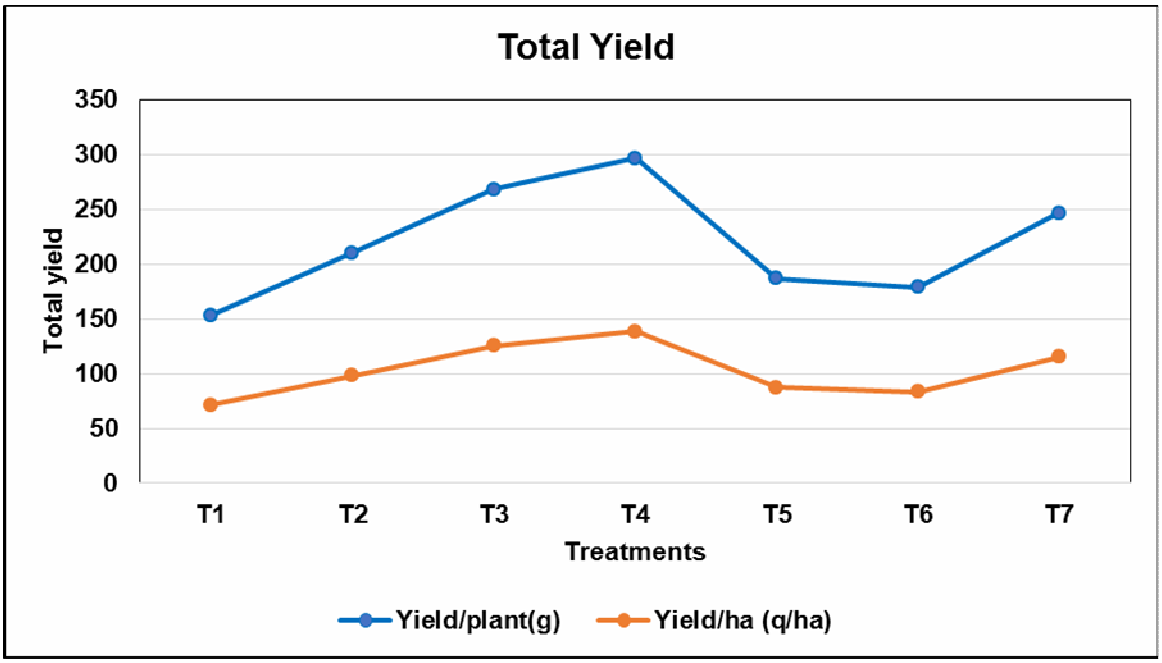

Fig. 1: Effect of organic mulches on the yield per plant (g) and yield (q/ha) on strawberry cv. Chandler

Soil Nutrient Availability

Post-harvest analysis revealed that soil nutrient levels were significantly affected by the different mulching treatments. The availability of nitrogen in the soil tended to increase under treatments involving organic materials, likely due to enhanced nitrification stimulated by the integration of organic matter. The highest level of available nitrogen (244.44 kg/ha) was observed in T5: Dry Leaves and Grasses, which was statistically comparable to T7: Spent Mushroom Substrate (239.27 kg/ha). These findings are consistent with those reported by Verma *et al.* (2005) in apple and Lalruatsangi & Hazarika (2018).

Differences in available phosphorus among the treatments were found to be statistically non-significant. However, potassium availability showed notable variation, with the highest post-harvest potassium content (253.31 kg/ha) recorded under T6: Banana Leaves. On the other hand, the control treatment (T1) recorded the lowest values for all three macronutrients available nitrogen (224.11 kg/ha), phosphorus (20.56 kg/ha), and potassium (238.25 kg/ha).

Organic mulches contribute to improved soil fertility as they decompose, gradually releasing nutrients into the soil. They may also reduce ammonia loss by acting as a physical barrier to volatilization. Materials such as banana leaves, paddy straw, and paddy husk are particularly rich in potassium, which likely explains the increased levels observed under those treatments following harvest.

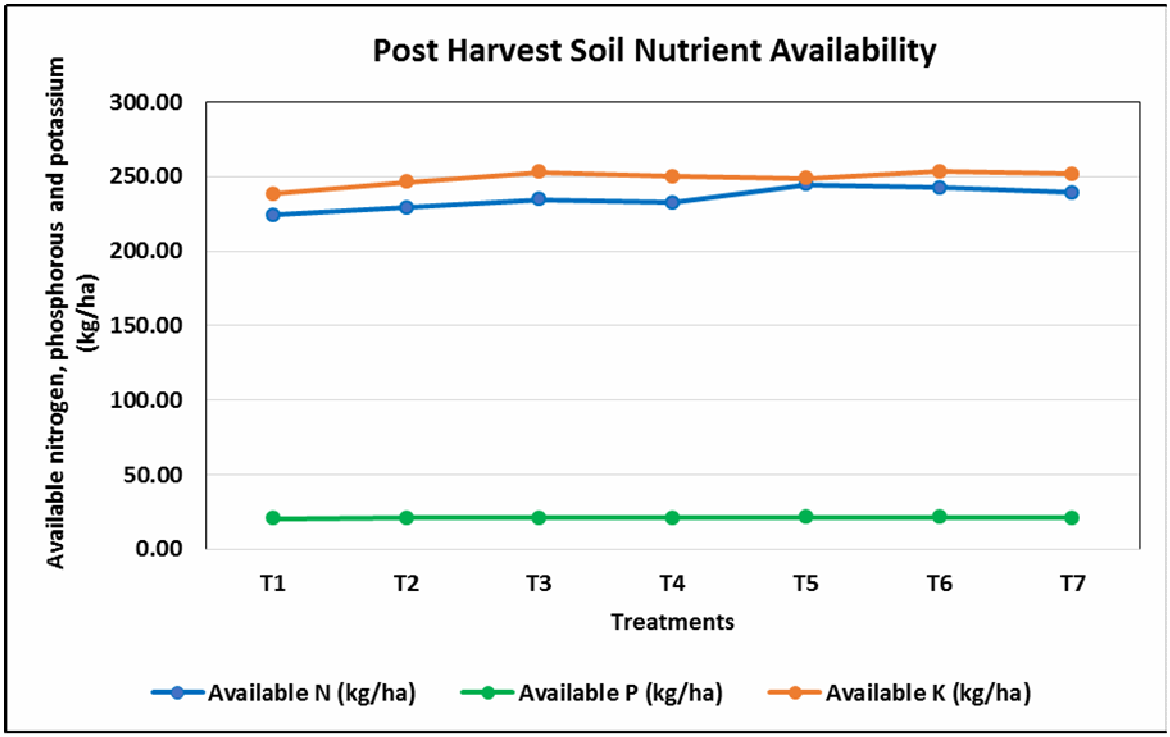

Fig 2: Effect of different organic mulches on the post-harvest soil nutrient availability of strawberry cv. Chandler.

Economics

Mulched treatments consistently yielded higher economic returns in terms of gross income, net profit, and benefit-cost (B:C) ratio. The highest values were recorded under T4: Paddy Husk, with gross returns of Rs. 58,13,948/ha, net returns of Rs. 44,20,197/ha, and a B:C ratio of 1:3.17, as shown in Figure 3. These findings align with earlier research by Sharma *et al.* (2023) in tomato and similar observations by Abonmai *et al.* (2023) and Bons *et al.* (2018) in studies involving organic mulching.

The improvement in economic performance under mulched conditions can be attributed to enhanced plant growth and yield traits, ultimately leading to increased marketable yield and profitability.

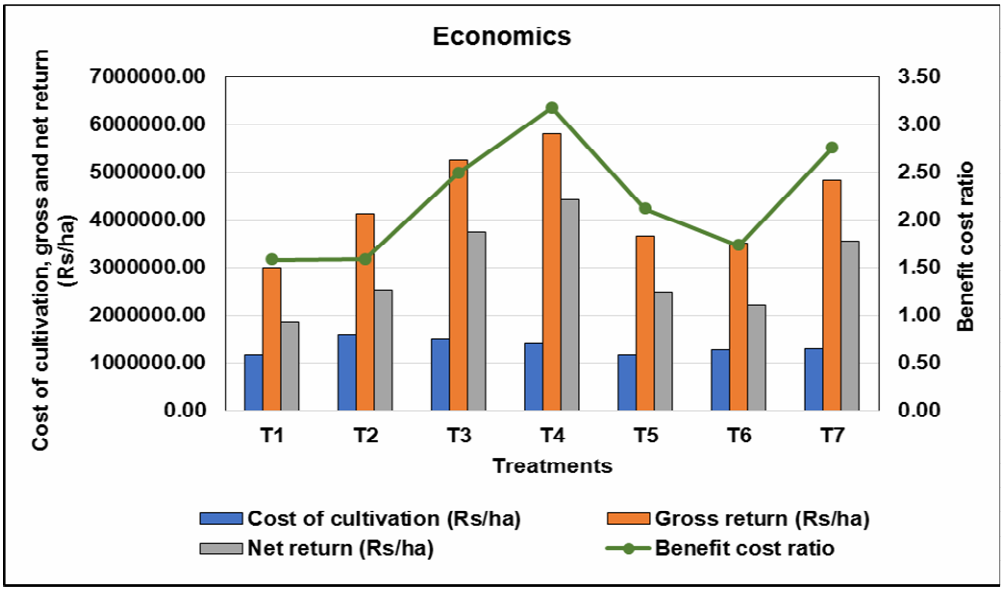

Fig 3: Effect of different sources of organic mulches on the economics of strawberry cv. Chandler

Conclusion

The study demonstrated that the use of organic mulches positively influenced both vegetative growth and fruit yield in strawberry cultivation. Among the treatments, paddy husk proved to be the most effective, resulting in superior growth performance, highest yield, and the greatest economic returns, closely followed by paddy straw. This indicates that paddy husk mulch offers a promising, sustainable alternative to conventional plastic mulching, with added benefits to soil health and environmental sustainability.

Moreover, organic mulches improved post-harvest soil nutrient availability, particularly nitrogen, phosphorus, and potassium. Based on these findings, the use of biodegradable, organic mulch materials like paddy husk can be recommended for enhancing both productivity and sustainability in strawberry farming. Further investigations could focus on integrating organic mulching with other eco-friendly agricultural practices to develop more holistic approaches to sustainable strawberry production.

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