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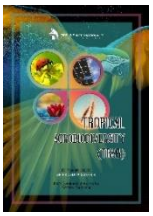

RESEARCH ARTICLE

EFFECT OF DIFFERENT MULCHING MATERIALS ON GROWTH AND YIELD OF CUCUMBER (Cucumis sativus cv. Bhaktapur local), IN GOKULESHWOR, BAITADI

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ABSTRACT

The experiment titled "Effect of Different Mulching Materials on Growth and Yield of Cucumber" was conducted during March to June 2021 at Gokuleshwor , Baitadi district of Nepal. Cultivar Bhaktapur local was used as principal cultivar for this research. The experiment was done by using Randomized Complete Block Design (RCBD). Accordingly, four different mulching material,viz.silver on black polythene mulch, black polythene mulch, rice straw and wheat husk mulch were used as treatment. Each treatment was replicated five times. Un-mulched plot served as control. Results reveals that the application of mulching significiantly influence both growth and yield parameters of cucumber. The broad objectives of this study was to determine the effect of mulching on the growth and yield of cucumber plant. The primary data was obtained through experimental analysis of sample plants of each plot without replacement. Plant height and number of leaves were significantly higher when black polythene mulch was used. Similarly, maximum leaf area was shown in paddy straw mulching at 75 days of transplanting (2318 cm square) . Mulching enhances flower production by 3-4 folds and increases the amount of blooms and fruit per plant. Likewise maximum number of flowers (80.00) and fruit (65.00) were observed in paddy straw mulching. Also highest weight (33.52) and yield (16.76) is seen in paddy straw mulching. And shortest height (977cm) , least number of leaves(402) and leaf area (1911cm square) was observed in control at 75 days after transplanting. Due to these mentioned reasons no mulch gave lowest yield per plot. Finding of this experiment thus clearly suggest the benefit of using paddy straw mulch as well as silver and black polythene mulch in cucumber compared to the other common mulching materials.

KEYWORDS

Cucumber, Cucumis sativus, Mulching, Growth, Yield

1. INTRODUCTION

Cucumber (*Cucumis sativus*) is a Cucurbitaceae family member. Cucumber was first brought to the United States by Christopher Columbus (Weng, 2020). Watermelon, muskmelon, pumpkin, and squash are also prominent members of this family. Cucumber is one of the oldest vegetables known to man, and it is native to Nepal and India. In Nepal, the area under cucumber production is 10,216 hectares with a production of 158,688 mt. and productivity of 15.53 mt/ha (MOALD, 2020). Widely regarded as the greatest fruit vegetable, it thrives in moist, well-drained soil with a high organic matter content and mild alkalinity, as well as full sun (Gough, 2020) Though cucumber is a significant Asian fruit vegetable, it is also grown in many other countries, including Iran, Russia, Turkey, and the United States. (Saleh and Abou-Shleel, 2012).The genus Cucumis has Thirty species in Africa and Asia (Sebastian et al., 2010). The most significant species include: (*Cucumis sativus, C. humifructus, C. melo, C. anguria, C. myriocarpus, C. picrocarpus, C. variabili, C. argenteus, C. ficifolius, C. metuliferus*).

Nomenclature and Taxonomy

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Cucurbitales

Family: Cucurbitaceae

Genus: *Cucumis*

Species: *sativus*

Cucumber is a nutrient-dense vegetable that is low in calories and high in vitamins and potassium (Khanal et al., 2020; Pal, 2020). *Cucumis sativus*, or cucumber, is one of the most extensively consumed fruits and vegetables on the planet. When fully developed, these fruits have a cylindrical shape with a length of 60 centimeters and a width of 10 centimeters. The color of the fruit matures from green to yellow as it age (Gao et al., 2021; Usha et al., 2015). Cucumber fruits comprise 95 percent water, 4% carbohydrate, and 1% protein. Phytonutrients and vitamin K are abundant in cucumbers. Vitamin B1, vitamin C, phosphorus, potassium, manganese, and copper are also present. Cucumber consumption has various health benefits, including weight loss, balanced hydration, digestive regularity, detoxification, improved brain function, cancer prevention, renal health, constipation relief, natural cure for intestinal worms, and control of diabetes (Panhwar et al., 2018).

Weed control, soil moisture conservation, and temperature modification are the major goals of mulching (Karki et al., 2020b). Mulching lowers soil evaporation, preserves soil moisture, inhibits weed development, regulates soil structure and temperature, influences soil microbes, and is aesthetically pleasant (Kader et al., 2017). Mulching improves the microclimate, which has a significant impact on plant growth parameters such as plant height, the number of leaves, and branches per plant

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(Ashrafuzzaman et al., 2011).

Mulching prevents the growth of weed species, allowing for improved uptake of nutrients from the soil while also reducing plant competition (Parmar et al., 2013). Mulching enhances floral production by 3-4 times and increases the number of blooms and fruits per plant (Karki et al., 2020b). Plants produced in various mulching conditions create larger yields than those planted in the absence of mulch; across all ground cover, black polythene mulch produces early yield and yield per plant is also higher

Cucurbit downy mildew, produced by an obligate biotroph *(Pseudoperonospora cubensis*), is one of the most serious problems in cucumber production (Berg et al., 2020; Soleymani et al., 2015). Farmers in the village's hilly terrain have been experiencing disease and pest management problems, and their motivation in cucumber production is diminishing. Powdery mildew, gummy stem rot, anthracnose, Alternaria leaf blotch, and fusarium wilt are some of the diseases that might affect your plants. White powdery development on the upper surface of the leaves and on the stem of diseased cucumber plants is caused by powdery mildew. The cucumber plant's fruit is affected by gummy stem blight, which develops black rot.

The research's findings will be extremely useful in enhancing cucumber yields not just in the study area but also in other cucumber-growing locations. Plants grown in different mulch conditions create better ultimate yields than plants cultivated without mulch (Soleymani et al., 2015). Among the mulches, black polythene mulch delivers earlier yield, and yield per plant was also greater. Mulch soil has a stronger nutritional hold than soil that hasn't been mulched, hence it supports bigger yields (Oliveira et al., 2021). We conducted this research to see how different mulching materials affect cucumber var. Bhaktapur local growth and yield in the Gokuleshwor area.

2. Materials and Methods

This research entitled "Effect of different mulching material on growth and yield of cucumber (*Cucumis sativus* L.) was conducted at the Horticulture field of Gokuleshwor Agriculture and Animal Science College, during the period of March 2021.

2.1 Geographical Situation

The research was carried out at the Horticulture research farm of GASSC, Gokuleshwor Baitadi in the year 2021. The morphometry of this area is latitude 29°68' 80'' N and longitude 80° 54' 94" E, and the elevation is 800 masl.

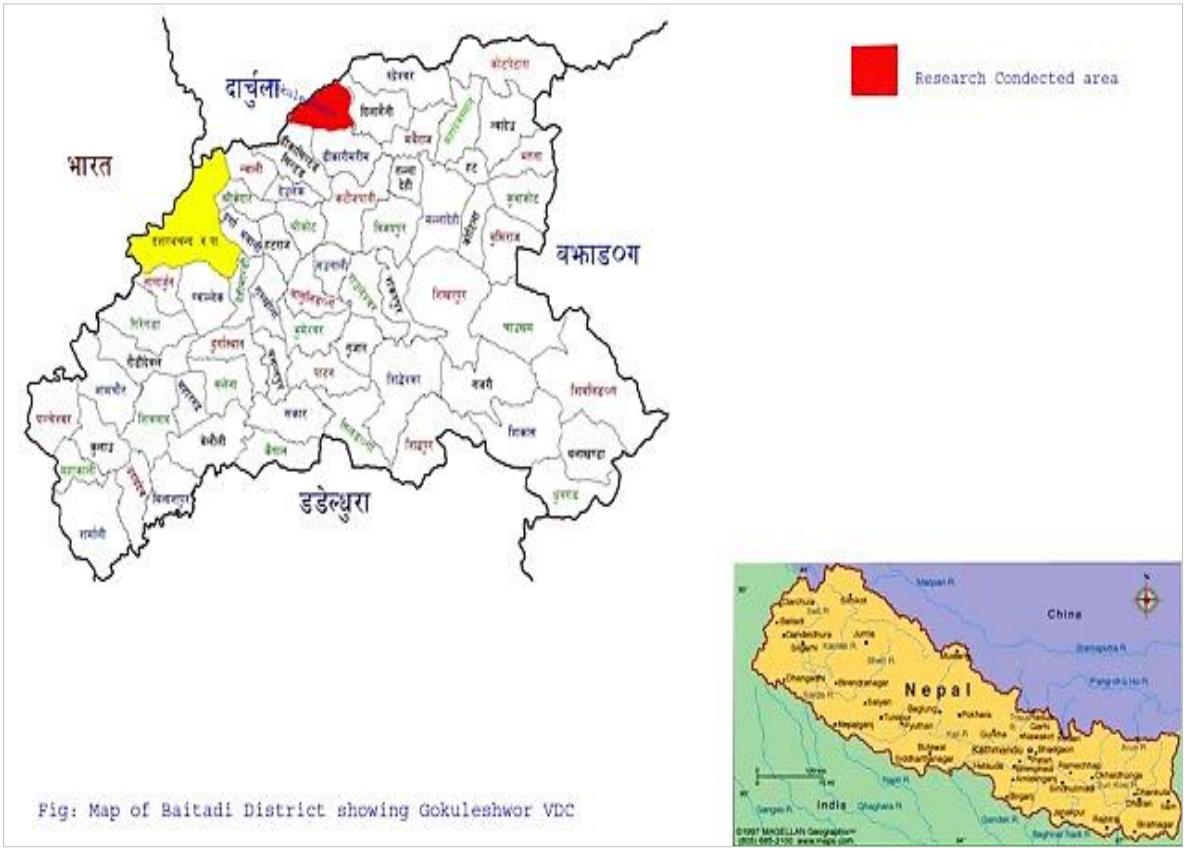

Figure 1: Map of Study Area, Gokuleshwor, Baitadi

2.1.1 Agro Climatic Condition

Experiment was conducted in warm subtropical climate condition. The average temperature of summer was 31 Degree Celsius. Here the Annual average receiving precipitation was about 96.39 mm

2.1.2 Physio-Chemical Characteristics of Experimental Soil

The soil texture of experimental field was sandy loam with the PH 5.5. Sampling technique

The probability sampling technique was used in data collection. Simple random sampling without replacement (SRSWOR) was used. Five (5) plants were selected randomly as sample plants from each plot leaving the border plant.

2.2 Agronomic Practices

2.2.1 Nursery Raising

The seeding Cucumber was raised in a polythene bag. The mixture of coco peat, sand, field soil dry FYM, and organic manure was used as growing substrates. The seeding was sown in Chaitra 7 2077. All the polythene

bags were filled with a mixture of growth medium and in each polythene bag, two seeds were seeded. Enough moisture was provided for the germination of the seed. Regular monitoring was done. Proper care was given to protect the seedling from hard weather and climatic condition. During the 3rd day, seeds were germinated. External fertilizer was not applied and timely irrigation was done to maintain optimum moisture in the soil. After 9 days almost all seeds were germinated. After 20 days four-leaf stages were seen. And the seedling was robust.

2.2.2 Hardening of Seedlings

Hardening is very effective in increasing seedling strength, and tolerance. Seedlings were placed in full sunlight before transplanting. Irrigation was reduced to 4 days before transplanting.

2.2.3 Field Preparation

The field was lightly irrigated before tillage due to the harness of soil. A tractor was used for primary tillage. Secondary tillage was done manually

by using a spade, hoe, and rake. Leveling was done by breaking all clods. Ten (10) kg FYM was mixed at each plot during field preparation. All weeds, pebbles, and stones were removed during the field preparation. Every plot was raised to prevent water flooding conditions.

2.2.4 Layout

After leveling, the layout was done. The research field was divided into 4 replications each replication had 5 plots. The gap between plots was maintained at 0.5 m and the gap between replication was 1m for easy access to management practices. Each plot has a size of 5×4 m^2 size. The total area of field research was 400.5 m^2 the plots were divided into equal parts by measuring tape. The total number of the plots was 20. The layout was done by plastic rope.

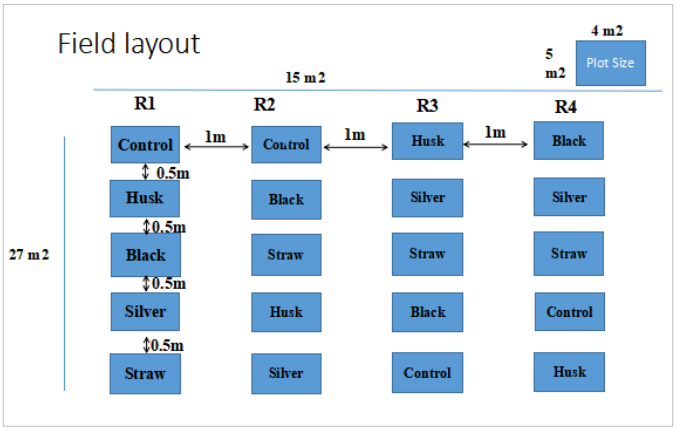

Figure 2: Research Design

2.2.5 Research Details

Table 1: Details of Research

Particulars	Details
Name of Crop	Cucumber (Cucumis sativus)
Name of Variety	Bhaktapur Local
Experimental Design	Randomized Complete Block Design (RCBD)
Number of Treatments	5
Number of Replications	4
Number of Plots	20
Plot Size	5*4 m2
Net Area of Experiment	405m2
Plant Population	400
Planting Distance (Spacing)	1*0.5m
Distance Between Replication	0.5m
Distance Between Treatment	1m
No of Plants Per Plot	20
No Of Plants Selected for Study Per Plot	5
Date of Sowing (Nursery)	3/22/2021
Date of Transplanting	4/17/2021

Table 2: Treatment Details

Treatments	Details
T1	No Mulch (Control)
T2	Wheat Husk
T3	Black Polythene Mulch
T4	Silver Polythene Mulch
T5	Paddy Straw

Table 3: Fertilizer Application

Particulars	Details
Nitrogen	0.279 kg/plot
phosphorous	0.079 kg/plot
Potassium	0.199 kg/plot
FYM	59.79 KG/plot

2.2.6 Fertilizer Application

Recommended dose of fertilizer= 7:2:5 NPK per Ropani. So, fertilizer dose with the size of plots was used. The recommended dose of FYM= 1500 kg/Ropani.

2.2.7 Transplanting

The seedling was ready for transplanting after emergence of two true leaves. Before transplanting the plots were applied with fertilizer and ridge and bunds were made. After hardening the seedlings, they were transplanted to the ridge. Transplanting was done on the 17th of April 2021 at a spacing of 1m × 0.5 m. Transplanting was done by making a hole in the ridge and placing the root in the hole then pressing with the thumb. Altogether 400 healthy seedlings were transplanted in 20 plots.

2.2.8 Gap Filling

After transplanting of seedlings regular supervision was done. Some of the plants were damaged in the plots. Replacement of damaged seedlings with healthier ones was done by previously germinated seedlings. For maintaining uniform crops in the plot replacement was done with new seedlings.

2.2.9 Weeding

Weddings were done to check the competition of weeds with the cucumber plant. The wedding was done four times manually with the help of a hoe. The first wedding was practiced after 15 days of transplanting. Second weeding was done after 30 days of transplanting. Third weeding was done after 45 days of transplanting. Fourth weeding was done after 60 days of transplanting.

2.2.10 Irrigation

After transplanting initially light irrigation was done because of less moisture in soil during summer season. For few days light irrigation was done every day until the seedling were established in the field. Cucumbers being water sensitive require frequent irrigation during summer. After the full establishment of seedlings in the field, irrigation was applied at the 7 days interval.

2.2.11 Harvesting

Four successive harvestings were done at 30, 45,60, and 75 DAT, and yield performance was recorded.

2.2.12 Data Collection

Data collection was started after 15 days of transplanting and continued up to final harvesting 75 days of transplanting. The total crop period from germination to final harvesting was of 100 days. Data collection was done on the basis of different parameters taken in the study. Data were collected for determining the growth and yield of cucumber. Data was collected after randomly tagging 5 plants from each plot and 100 plants were taken as sample plants to collect data.Different parameters taken in research are:

2.2.13 Plant Height (cm)

The height of 5 sample plants was measured in cm-scale from the soil surface up to the terminal portion of the plant with the help of measuring tape. The height was measured with the respective time of 15,30,45,60, and 75 DAT and the average was calculated for each plant.

2.2.14 Number of Leaves

Numbers of leaves were counted from the five sample plants on 15,30,45,60 and 75 DAT and the average was calculated for each plant.

2.2.15 Leaf Area (cm^2)

Leaf areas from five sample plants on 15,30,45,60 and 75 DAT were taken and the average was calculated from each plant.

2.2.16 Number of Flowers

The number of flowers was counted from the five-sample plants on 15,30,45,60 and 75 DAT and the number of the average flower were calculated for each plant.

2.2.17 Yield Per Plot (kg)

The yield was taken from selected five plants and calculated average yield per plant. Similarly, yield per plot was also calculated by weighting fruits from all plants of each plot.

2.2.18 Statistical Analysis

Experiment data were analyzed using GEN STAT Software of the 15th edition and treatment means separated Duncan's Multiple Range Test (DMRT) at a 5% level of significance. Analysis of variance (ANOVA) was used to test the differences among the factors (Gomez and Gomez,1984).

3. Result and Discussion

The experiment entitled " Effect of different Mulching on vegetative growth and yield of Cucumber var. Bhaktapur local was conducted on March 22, 2021, the experimental findings computed on the basis of the observation recorded and the statistical analysis are presented and discussed below:

3.1 Plant Height

Mulching has a significant impact on the increase of crop/fruit production and improving quality (Dubey et al., 2020). Plastic mulching improves soil quality by improving the physicochemical qualities of the soil, as well as influencing microbial activity. Mulching aids in the control of weed development and also the uptake of moisture and solar radiation by the plant. The maximum cucumber height was obtained at 60 DAT in silver on black mulching, while the lowest height was observed in the no mulch. (Karki et al., 2020b).

At 60 days after transplanting, a group researchers found that black mulching yielded the highest height while control or no mulch yielded the lowest height in cucumber (Bhandari and Bhandari, 2021). Cucumber planted in black mulching grows the tallest, while cucumber cultivated in control grows the shortest among the mulches tested (Soleymani et al., 2015). Summer squash cultivated with silver plastic mulching had the highest height, following the black plastic, and no mulch has the lowest height Cucumber mulched in black plastic grows the tallest, while cucumbers with no mulch grow the shortest (Hallidri, 2001; Radhika Regmi et al., 2021).

Plant height at 15, 30,45,60,75 DAT was positively influenced by the effect of mulching. Black mulching shows the greatest height (1052cm) at 60 days after transplanting which is also seen in the result of Bhandari, S., Bhandari, A., (2021). On 75 days after transplanting T_3 (Black Polythene Mulching) shows maximum plant height (1102 cm) whereas the lowest plant height seen in T_1 (Control) is 977 cm. Mulching provides sufficient soil moisture near the root zone and minimizes evaporation loss as a result higher nutrients will be available in the soil which favors the maximum plant growth which is in accordance with our findings (Parmar et al., 2013).

Mean with same letter within column do not differ significantly at p= 0.05, SEM=Standard error of mean, LSD= Least significance difference, CV= Coefficient of variation, *=Significant at 5% & **= Significant at 1% level of significance, NS= Non-Significant

Table 4: Effect of different Mulching Materials in Plant Height (cm)

Treatment	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT
Control	86.75	498.2	849.5	940	977
Wheat Husk	97.88	491.5	907.5	944.5	991
Black Polythene	107.25	484	1021	1052	1102
Silver Polythene	99.62	502.5	971	997.8	1041
Paddy Straw	107.12	512	896.5	989.2	1045
SEm (±)	9.9	29.6	38.9	54.8	44.5
LSD (0.05%)	30.5	91.3	119.8	119.4	137
CV (%)	19.9	11.9	8.2	7.9	8.6
F-Value	NS	NS	NS	NS	NS
GRAND MEAN	99.7	498	949	985	1031

Level of Significance ***0.001, **0.01, *0.5

3.2 Leaf Numbers

In cucumber, black plastic mulching produced the most leaves, while no mulching produced the least leaves (Akter et al., 2020). Black plastic mulching produced the most leaves, followed by transparent film, silver film, and wheat straw, while no mulching produced the least leaves (Hallidri, 2001). The number of leaves at 15,30,45,60,75 DAT were positively influenced by the effect of mulching. Black mulching shows the maximum number of leaves (613.5) at 60 DAT which is also seen in the result of (Bharati et al., 2020). On 75 days after transplanting T_3 (Black Polythene Mulching) shows maximum leaves numbers (512.5) whereas lowest was seen in T_1 (Control) 402 leaves. Mulching holds the moisture as well as enhances the nutrient availability by the plant which leads to overall growth and development of plant including number of leaves (Sweety et al., 2018).

Mean with same letter within column do not differ significantly at p= 0.05, SEM=Standard error of mean, LSD= Least significance difference, CV= Coefficient of variation, *=Significant at 5% & **= Significant at 1% level of significance, NS= Non-Significance

Table 5: Effect of different Mulching Materials in No of leaves.

Treatment	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT
Control	25.5	135.2^{b}	406.7^{b}	453.5^{b}	402
Wheat Husk	25.25	176a	596.0^{a}	611.8^{a}	457.2
Black Polythene	26.25	168.2^{ab}	555.8^{a}	613.5^{a}	512.5
Silver Polythene	27.25	163.8^{ab}	525^{ab}	554.5^{ab}	432.5
Paddy Straw	27	176.5^{a}	544.2^{a}	576.5^{ab}	441.8
SEm (±)	2.105	10.42	38.4	40.3	4
LSD (0.05%)	6.486	32.11	118.3	124.1	132.3
CV (%)	16	12.7	14.6	14.3	19.1
F-Value	NS	NS	*	NS	NS
GRAND MEAN	26.25	163.9	526	562	449

Level of Significance ***0.001, **0.01, *0.5

3.3 Leaf Area

Mulching shows the maximum leaf area than no mulch (control) which is also seen in the result of (Bharati et al., 2020). On 75 days after transplanting T_5 (Paddy straw Mulching) shows maximum leaves area (2318 cm^2) whereas lowest was seen in T_1 (Control) 1911 cm^2. Mulching improves the microclimatic condition of soil which provides the suitable environment for uptake of nutrients and water, which ultimately increases the cell division and cell elongation as a result leaf canopy increase.

Mean with same letter within column do not differ significantly at p= 0.05, SEM=Standard error of mean, LSD= Least significance difference, CV= Coefficient of variation, *=Significant at 5% & **= Significant at 1% level of significance, NS= Non-Significant

Table 6: Effect of different Mulching Materials in leaf area (cm^2).

Treatment	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT
Control	469.6	1457	2058	2155	1911
Wheat Husk	465.6	1414	2068	2300	2016
Black Polythene	545	1580	2236	2343	2011
Silver Polythene	517.1	1458	2283	2398	2166
Paddy Straw	549.4	1515	2318	2432	2318
SEm (±)	55.2	97.2	140.4	122.8	179.6
LSD (0.05%)	170	299.4	432.5	378.3	533.4
CV (%)	21.6	13.1	12.8	10.6	17.2
F-value	NS	NS	NS	NS	NS
GRAND MEAN	509.34	1485	2193	2325	2084

Level of Significance ***0.001, **0.01, *0.5

3.4 Number of Flowers, Fruits, Weight (kg) and Yield (ton)

Mulching enhances flower production by 3-4 times and increases the amount of blooms and fruits per plant (Karki et al., 2020b). Black and silver mulch generates more male flowers in the early days of transplanting than control, which produces more female flowers, but in

later stages of growth, black and silver mulch produces more female flowers while control produces the most male flowers (Karki et al., 2020a).

Plants grown under various mulching conditions provide better ultimate yields than plants grown without mulch; across all mulches, black polythene mulch produces the highest early yield and yield per plant (Soleymani et al., 2015). Mulch soil has a stronger nutritional hold than soil that hasn't been mulched, hence it supports bigger yields (Oliveira et al., 2021). When a plant is planted on black mulch, it produces a better yield per m2 than if it is grown without it (Bharati et al., 2020). Mulching treatment resulted in a considerable increase in average fruit weight (kg) when compared to no mulch (Parmar et al., 2013). Mulching inhibits the growth of weeds, allowing for improved nutrient uptake from the soil. It also reduces plant competition, resulting in a higher yield (Parmar et al., 2013). Plants cultivated with mulch have the maximum yield / plant when compared to plants planted without mulch (Hudu et al., 2002). In comparison to plants cultivated without mulch, plants planted on silver polythene mulch provide the maximum yield (Arancibia and Motsenbocker, 2008).

Table 7: Effect of Mulching Materials in No. of flowers, fruits, weight & yield.

Treatment	Flower	Fruit	Weight	Yield
Control	60.50^{d}	43.50^{c}	17.93^{c}	8.97^{c}
Wheat Husk	66.50^{c}	49.00^{bc}	25.86^{b}	12.93^{b}
Black Polythene	70.75^{bc}	53.25^{b}	26.97^{b}	13.49^{b}
Silver Polythene	74.00^{b}	54.75^{b}	28.11^{b}	14.05^{b}
Paddy Straw	80.00^{a}	65.00^{a}	33.52^{a}	16.76^{a}
SEm (±)	1.726	2.133	1.522	0.761
LSD (0.05%)	5.318	6.571	4.69	2.345
CV (%)	4.9	8	11.5	11.5
F-value	***	***	***	***
GRAND MEAN	70.35	53.1	26.48	13.24

Level of Significance ***0.001, **0.01, *0.5

Long-term use of biodegradable mulch (paddy straw mulch) does not lower soil nutrient content or microbial activity, but it can reduce soil bulk density. It can, on the other hand, improve the condition of the soil and hence, help in better productivity (Zhang et al., 2022). Paddy straw mulching T_5 shows the greatest fruit, flower, weight and yield (65.00^{a}), (80.00^{a}), (33.52^{a}) and (16.76^{a}) respectively than no mulch (control) (43.50^{c}, 60.50^{d} ,17.93^{c}, 8.97^{c} respectively in fruits, flowers, weight & yield) which is also seen in the result (Kishore and Daniel, 2018). Mulching improves the microclimatic condition of soil, provides the suitable environment for uptake of nutrients and water which increases superior branches characteristics, number of flowers, fruits, fruit size and total yield in plant.

Mean with same letter within column do not differ significantly at p= 0.05, SEM=Standard error of mean, LSD= Least significance difference, CV= Coefficient of variation, *=Significant at 5% & **= Significant at 1% level of significance, NS= Non-Significant

4. Summary and Conclusion

The research was laid out in a Randomized complete block design with 4 replications and 5 treatments. The observation of growth and yield were recorded and results were found optimum at 60 and 75 DAT. From this research, it can be concluded that mulching plays a significant role in vegetative growth, reproductive growth, and in the yield of cucumber. The application of Black Polythene Mulching has significant results for attributes like, plant height, number of leaves, leaf area, number of flowers, fruits, and yield per plot at 60 and 75 DAT whereas, no mulching was less effective for gaining a good height in the same period of 60 and 75 days respectively. When evaluating all treatments it was seen that the leaf area was observed highest in Paddy straw mulching and the lowest leaf area was seen in wheat husk, number of flowers, fruits, and yield per plot were seen highest under Paddy straw mulching at 75 DAT. This may suggest that paddy straw mulch added some nutrients to the soil and these were available for plant growth.So, it can be concluded that Mulching might be best economic option for obtaining high growth and yield of Cucumber. Similarly, growth and yield of cucumber was found to be significantly different between different mulching and no mulching (control) treatments. Among the different mulching's, Paddy straw Mulching (T_5) could be best for cucumber production in Gokuleshwor area.

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