

EFFECTS OF PLASTIC MULCHING ON GROWTH, YIELD AND COST AND RETURN ANALYSIS OF *CAPSICUM ANNUUM* L. VAR. *ANNUUM* CV. *ACCUMINATUM* FINGERH

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Abstract

The field experiment was conducted at Aungmyinttar Quarter, Magway Township from June to November 2017. In the experiment, two different plastic mulches were transparent, black and control (without mulch). Soil temperature and moisture had no significant were observed. Significant differences on plant height, number of leaves, fresh weight of fruit and harvest index of chili pepper were observed. According to the results of different plastic mulches, T₂ black was tallest plant height (22.33cm), maximum number of leaves (30.91), fresh weight of fruit (16.94g) and harvest index (12.46) compared to other T₁ transparent and T₃ control. Production of chili pepper by using plastic mulch was more cost than the fruit production without using the plastic mulching, however, higher yields in the plastic mulched chili pepper fruits than fruits without using it in 2017. The results of 2017, using black plastic mulch gave the highest profit in all treatments and the use of transparent plastic mulch profited five times than without plastic mulch (control). There was a very high difference between black plastic mulch and control. The results clearly suggested that using the black plastic mulch can be performed the best yield components and yields of chili pepper production.

Introduction

Mulching is an agricultural and horticultural technique in which the use of organic is involved. The technique is very useful in protecting the roots of the plants from heat, cold (Bhardwaj, 2013). Mulch can be defined as use of a material that covers soil for a variety of uses. The term was at one time used for the application of organically based plant residue, although the understanding of the term mulch has grown to incorporate use of paper and plastics applied from a roll or polymers applied to the soil (Horst, 2001). Plastic mulch has been used commercially on vegetables since the early 1960s. Currently, it was used on the thousands of acres of vegetables in the United States (Hochmuth, 2001).

Plastic mulches offer many advantages to growers including earlier and higher overall yields, reduced evaporation, fewer weed problems, reduced fertilizer leaching, and elimination of root pruning. The major disadvantages of plastic mulch are initial cost, removal, and disposal (Lamont, 1993). There are various colored plastic such as, clear, black, red, blue, silver, white, yellow polyethylene, etc. Black mulch was used most widely because it suppress weed growth, resulting in less chemical usage (Hochmuth, 2007).

Black plastic mulch applied to planting will warm the soil and promote faster growth in early season, which generally leads to earlier harvest (Bhardwaj, 2013). Even though the use of black plastic mulch was expensive, it has become an accepted practice for commercial growers of many vegetable and fruit crops including chilli, tomato, eggplant, muskmelon, watermelon and strawberry (Lamont, 1999). Transparent plastic mulch was used in some areas due to its increased soil warming characteristics (Bhardwaj, 2013). Transparent plastic transmitted radiation to the soil surface, which was absorbed and converted to sensible heat (Hopen, 1964). Transparent plastic mulch has a repellent effect on pest and vector insects, such as aphids, whiteflies and thrips (Bhardwaj, 2013).

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Cost and Return Analysis will show weak points of a business that cause of low returned and unnecessary large expenditure (Bautista, 1994). The plan includes the activities to be done, manpower requirement and organization, resource to be used, budget to be utilized, records to be kept, schedule of farm operations, and labor requirement (Bautista, 1994). Based on the plan, and budget is prepared. Budgeting is determining the production requirements, allocating money and non financial resources to different production activities and estimating the financial gain (Bautista, 1994). In both the U.S.A and parts of Europe, cost of production studies became increasingly prevalent from before the First World War up until the 1930s (Mc Cathy, 1975). The major direct cost items were seed, cultivation, herbicides and fertilizer (Mc Cathy, 1975). A goal in sustainable agriculture is more productivity per production costs in crop production systems (Mc Cathy, 1975). The economic analysis is the only tools, which compel the farmers to decide what to grow and what not to grow. Important economical indicators as well, total costs production, gross return, net return, benefit to cost ratio and productivity were calculated to purpose successful management. Finally, minimizing costs production is necessary because in addition to increasing economic benefit as well as increased sustainability of these agroecosystems (Yousefi, 2011).

In facts, the study was carried out to evaluate the plastic mulching on growth and yield of *Capsicum annum*L. var. *annuum* cv. *acuminatum* Fingerh (ripen fruits of chilli). To estimate by using plastic mulching techniques the cost and returns associated with these chilli production. To know the gross income and net profit of ripen fruits of chilli production by the application of plastic mulching techniques.

Materials and Methods

Time and Place of the Study

The field experiment was conducted at Aungmyinttar Quarter, Magway Township from June to November 2017 to study the effects of plastic mulching on the growth and yield of *Capsicum annum*L. var. *annuum* cv. *acuminatum* Fingerh.

Preparation of Materials

The seeds of *Capsicum annum*L. var. *annuum* cv. *acuminatum* Fingerh were obtained from Selywar village, Pakokku Township, Magway Region.

Preparation of soil and plots for chilli cultivation

In the study area, the wild grasses were cut and the land was ploughed to transparent the root stocks and to clean up the land one week before conducting the experimentation. The soil was prepared by thoroughly mixed with cowdung, loamy and compost in the ratio of 2 : 1 : 1 were applied to the soil at final land preparation. Each plot was laied out in 60 cm wide, 450 cm long, 15 cm height and 30 cm apart.

Preparation of plastic mulches and transplanting of seedlings

Plastic mulches were carefully spread over the plots and holes were punched with 4 inches P.V.C pipe and razor blade. After making the holes, seedlings were transplanted to the centre of the bed at a distance of 75 cm between plants. Furrow irrigation once in two weeks about 7 hours after transplanting.

Determination of Meteorological Parameter

The report of meteorological data such as monthly minimum and maximum temperature, rainfall, and relative humidity (RH) of the study area were obtained from Department of Meteorology and Hydrology, Magway Station, Magway Township from May to September in 2017.

Harvest Index

Harvest index was determined by using the following formula (Gomez and Gomez, 1984).

$$\text{Harvest Index (HI)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

Economic yield = seed/fruit yield

Biological yield = total dry matter

Benefit- Cost Ratio (BCR)

Benefit- Cost Ratio (BCR) is the ratio based on the invest (cost) the profit (benefit) was produced. The calculation was followed by the method of Bautista, (1994).

$$\text{Benefit - Cost Ratio (BCR)} = \frac{\text{Gross income}}{\text{Cost of production}}$$

Gross income = sale of produce+ non- cash returns

Cost of production = total investment

Return on Investment (ROI)

Profitability is the rate of Return on Investment (ROI). It was obtained by the following method of Bautista, 1994.

$$(\text{ROI}) = (A) \div C \times 100$$

A = net income

C = gross income – cost of production

Measurements of Soil Temperature and Moisture

Soil temperature and moisture under each plastic mulches were done weekly starting from transplanting to final harvesting. Soil temperature was measured at 2 inches soil depth by using a laboratory thermometer. Soil moisture was measured at 2 inches soil depth by using a McGregor's 3 in 1 Soil Tester. Measurements of soil temperature and moisture were done weekly at 9:00 AM.

Data Collection

Three plant samples were randomly taken from each plot at their vegetative stage (35 DAS) (DAS = day after sowing), at reproductive stage (56 DAS) and at harvesting time (98 DAS and 112 DAS). The following data were collected in the study: soil temperature, soil moisture, plant height, number of leaves, , number of flowers, fresh weight of fruits and harvest index (HI).

Statistic Analysis

Two factor factorial design in RCBD with 3 replications was carried out in this study. Factor A was assigned in 2 kinds of plastic mulching (T_1 = transparent, T_2 = black, T_3 = control). Factor B was assigned in 3 kinds of planting times (S_1 = 5th June, S_2 = 10th July, S_3 = 15th August).

The data were analyzed using the IRRISTAT software (Version 7.0). Treatments means were compared by Least Significant Difference (LSD) at 5% level of significance.

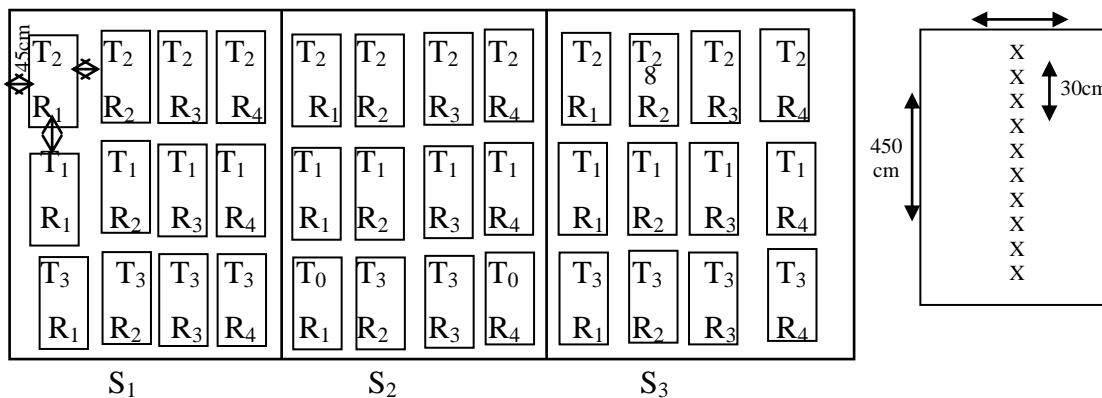


Figure 1 Plot layout of cultivation of chili pepper using plastic mulching techniques

Results

Meteorological Parameters during Growing of *Capsicum annum* L. var. *annuum* cv. *accuminatum* (2017)

The monthly temperature, rainfall and relative humidity (RH) of the cultivation area were noted from May to September, 2017.

According to the report from Department of Meteorology and Hydrology, Magway Station, maximum temperature (41.7°C) was obtained on May and the minimum temperature (18.5 °C) in September. The maximum rainfall (42.22 inches) was obtained in September and the minimum rainfall (6.06 inches) in July. The maximum RH (83%) was obtained in September and the minimum RH (63%) in May.

Soil Temperature

The result observed that soil temperature had not significantly difference at 35 DAS(day after sowing), 77 DAS and 112 DAS in different plastic mulching.

Soil Moisture

The result observed that soil temperature had no significant difference at 35DAS, 77DAS and 112 DAS in different plastic mulching.

Plant Height

The result observed that plant height was significantly different at 35 DAS to 105 DAS. When compared to the plastic mulching, T₂ black was tallest plant height (22.33 cm) followed by T₁transparent(22.23 cm) and T₃ control (19.89 cm).

Number of leaves

The result observed that number of leaves was significantly different at 35 DAS to 105 DAS. When compared to the plastic mulching, the maximum number of leaves was found in T₂ black (30.91) followed by T₁transparent (25.99) and T₃ control (23.74).

Fresh weight of fruits

The result observed that fresh weight of fruits was highly significant difference at 98 DAS and 112 DAS in different plastic mulching. When compared to the plastic mulch, T₁transparent was higher (13.25 g) than T₃ control (10.88 g). The maximum fresh weight of fruits was found in T₂ black (16.94 g).

Harvest Index (HI)

The result observed that harvest index were significantly differences after harvesting at 105 DAS and 119 DAS in different plastic mulching. When compared to the plastic mulching, the harvest index of T₂ (black) was higher than T₁ transparent and T₃ control. The T₂ black was (12.46), T₁transparent(8.49) and T₀ control (9.68).

Estimated Cost and Return Analysis

The total cost estimated included the purchasing fertilizer and chemical pesticide, soil mixes and laborer cost for soil preparation, spraying, watering, weeding and harvesting. The income was based on the yield per acre and current sold price per basket (400 viss). As shown in Table 1, total cost, gross income and net profits were significantly greater in chilli cultivation with black plastic mulches and transparent plastic mulches than control. The total cost estimated was higher using black plastic mulch and without plastic mulch (13,66,000 kyats and 12,00,000 kyats acre⁻¹) than transparent plastic mulch (10,34,000 kyats acre⁻¹). According to result, in year 2017, gross income was obtained (285,0000 kyats) acre⁻¹ with black plastic mulches followed by transparent plastic mulches (205,0000 kyats) and control (175,0000 kyats). In year 2017 showed that the net profits was higher in transparent plastic mulches (1,016,000 kyats) than control (550,000 kyats). In year 2017, the highest net profits was found in black plastic mulches (14,84,000 kyats) acre⁻¹ among treatments.

Table 1 Estimated total cost, gross income and net profits per acre of ripen chilli fruits production using the plastic mulching techniques in year 2017

Plastic Mulching	2017		
	Total Cost (Kyat)	Gross income (Kyat)	Net profit (Kyat)
Black plastic	13,66,000	28,50,000	14,84,000
Transparent plastic	10,34,000	20,50,000	10,16,000
Control	12,00,000	17,50,000	550,000

Source of sold price per basket: Magway and Pakkoku market in September 2016, 2017.

Return On Investment (ROI) and Benefit – Cost Ratio (BCR) results were also presented Table 2. BCR were obtained (2.09) in black plastic mulches and there was slightly difference between transparent plastic mulch (1.45) and control (1.98) in 2017. In 2017, ROI was obtained 108.64% with black plastic and 98.26% with transparent plastic compared to control 45.83%.

Table 2 Benefit Cost Ratio (BCR) and Return on Investment (ROI) percentages of chilli which was black, transparent plastic and control treatments in year 2017

Plastic mulching	BCR	ROI(%)
	2017	2017
Black plastic	2.09	108.64
Transparent plastic	1.98	98.26
Control	1.45	45.83

Table 3 Estimated cost and return analysis of ripen chilli fruits production by using the black plastic mulching in 2017

Items	Unit	Unit amount	Price per unit (Kyat)	Total Price (Kyat hectare ⁻¹)
Black plastic	Roll	24	35500	852000
Seed	Gram	100	3000	3000
Fertilizer	Bag (13.5kg)	2	45000	90000
Cowdung	Bag (13.5kg)	60	500	30000
Loamy	Bag (13.5kg)	30	2500	75000
Laborer				
Soil preparation	Time	2	50000	100000
Plastic mulch Preparation	Laborer x Time	20 x 1	3000	60000
Spraying insecticide	Time	2	15000	30000
Irrigation	Time	3	21000	63000
Harvesting	Laborer x Time	7 x 3	3000	63000
Total cost				1366000
Total income	Basket	675 (50)	4000	2850000
Net profit			(3000)	1484000

Table 4 Estimated cost and return analysis of ripen chilli fruits production by using the transparent plastic mulching in 2017

Items	Unit	Unit amount	Price per unit(Kyat)	Total Price (Kyat hectare ⁻¹)
Transparent plastic	Roll	10	52000	520000
Seed	Gram	100	3000	3000
Fertilizer	Bag (13.5kg)	2	45000	90000
Cow dung	Bag (13.5kg)	60	500	30000
loamy	Bag (13.5kg)	30	2500	75000
Laborer				
Soil preparation	Time	2	50000	100000
Plastic mulch Preparation	Laborer x Time	20 x 1	3000	60000
Spraying insecticide	Time	2	15000	30000
Irrigation	Time	3	21000	63000
Harvesting	Laborer x Time	7 x 3	3000	63000
Total cost				1034000
Total income	Basket	475 (50)	4000 (3000)	2050000
Net profit				1016000

Table 5 Estimated cost and return analysis of ripen chilli fruits production by using the without plastic mulching (control) in 2017

Items	Unit	Unit amount	Price per unit(Kyat)	Total Price (Kyat hectare ⁻¹)
Seed	Gram	100	3000	3000
Fertilizer	Bag (13.5kg)	4	45000	180000
Cowdung	Bag (13.5kg)	60	500	30000
Loamy	Bag (13.5kg)	30	2500	75000
Laborer				
Soil preparation	Time	3	50000	150000
Spraying insecticide	Time	11	15000	165000
Weeding	Laborer x Time	40 x 3	1500	180000
Irrigation	Time	4	21000	84000
Harvesting	Laborer x Time	7 x 3	3000	63000
Total cost				1200000
Total income	Basket	350 (60)	4000 (3000)	1750000
Net profit				550000

Discussion and Conclusion

Two types of plastic mulch materials and control were tested on chilli in order to determine their effects on chilli plant growth and yield in this study. According to plastic mulching, the tallest plant height were found in black plastic mulch followed by transparent plastic mulch. The shortest plant height were found in control. The result was agree with Shinde, (1999) who reported that the increased plant height in mulched plants was possibly due to better availability of soil moisture and optimum soil temperature. According to the plastic

mulching, the maximum number of leaves per plant was found on the plants mulched with black plastic at all growth stages, followed by the transparent plastic mulch. The minimum number of leaves per plant was found in control. Among the plastic mulching treatments, black plastic mulch gave the maximum fruit yields, (3.96) while transparent plastic mulch gave the second highest fruit yields, (3.09) and control (2.29) respectively. Lamont 1993 reported that Plastic mulches offer many advantages to growers including earlier and higher overall yields, reduced evaporation, fewer weed problems, reduced fertilizer leaching, and elimination of root pruning.

This result was agree with Izakovic, (1989) who reported that the microclimate condition improved by the mulches might have provided a suitable condition for producing higher number of leaves in the plants. The estimated cost and return analysis showed that the application of plastic mulching with black and transparent plastic would be more total costs in the cultivation of chilli pepper, however, it can be obtained more profitable high yields than without plastic mulch (control) after studied in 2017. In 2017, using black plastic mulch profited four times than using transparent plastic mulch which was also more profitable five times than control because heavy rainfall onto bare soil leads to the destruction of the soil structure and the texture of the soil. However, mulching prevents the leaching of fertilizer, because it acts as a physical barrier to rainfall.

In year 2017, BCR (Benefit Cost Ratio) showed that more increased in black plastic followed by transparent plastic and then control. According to the results of ROI (return on investment), both the black and transparent plastic mulching indicated more profitability of ROI percentages (about 39–45%) than control in 2017. Those findings were agreement with Singh *et.al.* (2014), maximum benefit per unit cost of cultivation was observed in summer squash, tomato and capsicum cultivation under black plastic mulch was found to be the best with respect to net returns and benefit cost ratio (BCR). Before computing cost and return analysis there is a indeed to set up the plan to get benchmark information on available resources land use, labour charges, capital including cash and utilized equipment.

According the computation, the gross value can provide relative comparisons between treatments (plastic mulch and control) and can be given an economic indication of the relative potential to increase the producer of chilli net income. According the results of gross income and net profits were very obviously increased in the black and transparent plastic mulches than control in 2017 because plastic mulches conserved soil moisture, maintained a more even soil temperature, suppressed weed growth and increased soil organic matter. However, there will be needed the further studies of relating researches using this plastic mulching techniques on other vegetable and fruit crops to be achievement of more production, greater net profits and maximum gross incomes on the final products.

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