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Efficacy of Mulching Materials on Growth Performance and Yield Characters of Summer Squash (*Cucurbita pepo cv* Shlesha 1214) in Mahottari, Nepal

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ABSTRACT

An experiment was conducted to study the effect of mulching materials on growth performance, and yield characters of summer squash under water constraint condition during February to May 2020 in Mahottari district, Nepal. Shlesha 1214 variety of summer squash was used and the experiment was laid in single factor Randomized Complete Block Design (RCBD) with 4 replications in an area of about 600 m^2. Four different mulching materials black plastic mulch, silver on black plastic mulch, rice straw mulch and sawdust mulch were used as treatments, un-mulched plot serving as control. The effect of mulching materials on growth parameters was found to be statistically significant. Plant height, number of leaves per plant and leaf petiole length were the highest in silver plastic mulch. Effect of mulches on days to opening of first male flower had non-significant effect but had the significant effect on days to opening of first female flower, total number of male and female flowers per plant, Sex ratio, Fruit length, Number of fruits per plant, total number of pickings and the yield. Highest yield (72.16 Mt/ha) was recorded with silver plastic mulch and lowest (46.73 Mt/ha) was recorded with saw dust mulch. Highest B:C (3.46) ratio was obtained from silver plastic mulch and the lowest (1.98) being at saw dust mulch. The use of plastic mulch (plasticulture) mainly silver on black plastic mulch is a better tool for promoting vegetable production in the research area.

Keywords- Growth, Mulching, Summer squash, Yield.

I. INTRODUCTION

Summer squash (*Cucurbita pepo* L.) is an important summer season New World cucurbit generally grown under open field conditions (Lower and Edwards, 1998). It is one of the most prized vegetables because of its excellent flavor, varied usefulness, texture and medicinal value (Sebastian, 2010). It is originated in Tropical America however, large number of cultivated species have developed and grown worldwide (Robinson et al., 1997). Summer squash is a warm-season crop and grown mostly in the tropics, subtropics and warmer parts of the temperate zones in the world (Sharma & Arora, 1993). Its high demand has also made it an important crop to be widely grown in glasshouses or plastic houses (Sarkar & Sirohi, 2011). In Nepal, it is grown mostly as the summer crop as it requires hot and humid weather for better growth and performance in the rainy season during the period of February and June (Acharya, 2004). The monthly average temperature range of 21^{0}C to 30^{0}C is considered to be favorable for the proper growth and development of the squash (Tindal, 1983; Nonnecke, 1989). The germination is poor at the temperature below 20^{0}C and the flower drops at temperature higher than 40^{0}C (Chaudhary, 1979; Chauhan, 1972). It is a good source of magnesium and phosphorus, the nutrients essential for building and maintaining healthy bones (Gholami et al., 2012). It also helps to cure asthma, as it contains vitamin C, which is a powerful antioxidant and has anti-inflammatory properties (Gillivray et al., 1942).

Growth, Yield and quality of summer squash are hampered by lack of knowledge about the best management practices. Any degree of water stress may produce deleterious effects on growth and yield of cucurbits (Saif et al., 2003). The water-stress during the critical periods like flowering and fruiting may decrease the yield by 70% (Mbagwu & Adesipe, 1987). The yield of squash may reduce by more than 79.39% due to the weed infestation and improper weed management (Tiwari et al., 1985). The production and productivity of Vegetable in Mahottari district (14.43 Mt/ha) which is significantly lower than national average (15.59 Mt/ha) (MOAD, 2016). The main reasons for lower productivity are the labor shortage and the unavailability of irrigation facilities. The weeding charges due to the labor shortage also increases their production cost. As a result, there is a decrease in interest in cultivating cucurbits by farmers. Moreover, the use of the insecticides and the herbicides to control the weed growth not only increases the cost of the production but also hampers the health status of the people consuming it. Mulching is straw, leaves and plastic spread over the ground of the cultivated area without affecting the plants, to protect from solar radiation or evaporation (Jacks & Smith, 1955). Mulch facilitates retention of soil moisture, control in temperature fluctuations, improves physical, chemical and biological properties of soil and ultimately enhances

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the growth and yield of crops (Kumar et.al., 1990). Along with that, it also controls water vapor loss, soil erosion, weeds problems and nutrient loss (Derwerken and Wilcox, 1988). Thus the objective of this experiment is to study the effect of mulching materials on growth performance and yield characteristics of summer squash for that locality.

II. MATERIALS AND METHODS

Experimental detail

The experiment was conducted at Bardibas, Mahottari (about $26^{0}33''$ north latitude and $84^{0}47''$east longitude) during spring-summer season started from February to June 2020. The site is working area of Prime Minster Agriculture Modernization Project (PMAMP) Vegetable Zone, Mahottari. It lies in terai region in the southwestern part of Province No. 2 of Nepal (Soil Management Directorate, 2004). The area is characterized with tropical climate and the soil type is sandy loam and slightly acidic with grayish red color.

Experimental Material and Design

Summer squash was selected for experiment purpose because it doesn't need staking and because of its' quick growing nature early yielding. Experiment was conducted using Shlesha1214 (F1) variety of summer squash because of its' quick growing and early yielding nature. The experiment was laid out in one factorial RCBD design with 5 treatments namely Control (no mulching), Black Plastic Mulch, Silver on black Plastic Mulch, Rice straw mulch and Sawdust mulch.

Each treatment was replicated four times keeping plot size of 20 m^2 with 1/1 m row to row and plant to plant spacing, respectively. The individual plot was with 4 rows and 5 plants per row giving a total of 20 plants in each plot. The distance between the blocks of replication was 1 m and distance between the plots within a single replication block i.e. between the treatments, was 50 cm. Out of total 4 rows, 2 rows was taken as border plants and the data was recorded from the sample plants selected within the remaining 2 rows. The outer border was at a distance of 1 m from the main plot.

Climatic condition of the experimental site

The climatic data were taken from meteorological station of Regional Agriculture Research Station, Nepal Agriculture Research Centre (NARC), Parwanipur, Bara, Nepal to describe the climatic pattern of research area. This is the most nearby station that resembles the weather pattern of the experimental site (Figure 1). There was an increasing scenario of both maximum and minimum temperature from Feb to May. Similarly, a continuous increment in the average temperature was observed with highest average temperature in May. The research area received the highest max temperature in April, in Feb, both max, and min temperatures were the lowest. The total rainfall was the highest in May but there was no rainfall in February. Increasing rainfall pattern was observed with zero rainfall in February and 133.2 mm in May (Figure 1).

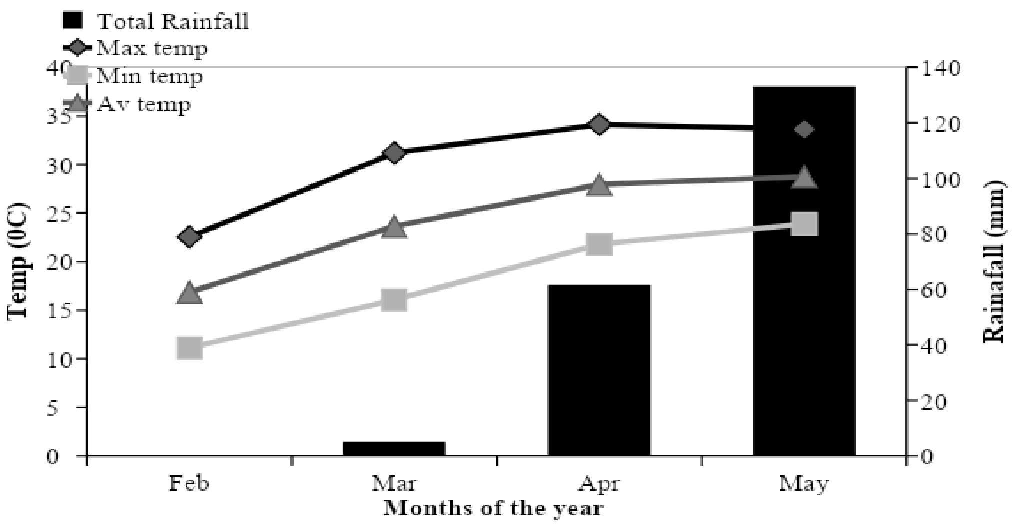

Figure1. Cardinal temperature and rainfall distribution in the research area in 2020

Seeds were sown in polybags containing compost manure, topsoil, sand and coco-peat media. All polybags ware placed under gummose. One deep plowing and three light plowing was done followed by planking was done for field preparation. Mulching materials were evenly sprayed over the respective plots after the field preparation and then transplanting was done at the distances calculated.

Observations recorded

The observations were recorded for the following traits:

Plant height (cm)

Plant height was measured from the base of the plant to the tip of the plant from each replication and expressed in centimeters.

Number of leaves per plant

Fully developed fresh leaves attached to the plants while recording the data were counted and taken under measurements.

Leaf petiole length (cm)

Petiole of fully developed fresh leaves attached to the plants while recording the data was measured in cm.

Days to first male and female flower

The date of anthesis of first male and female flower were recorded as number of days taken from the date of transplanting to date of anthesis of first male and female flower.

Number of staminate and pistillate flowers per plant

Number of staminate flowers and number of pistillate flowers assessed at 2 to 3 days interval to determine number of staminate flowers present in each replication from the start of flowering till end of the harvesting season. Only flowers that were open or that had opened since last sample day were counted. Flower petals were removed during each sample interval to facilitate future enumeration. Plants with abnormalities were eliminated from data analysis.

Flowering habit ratio/sex ratio

Number of staminate (male) and pistillate (female) flowers per plant were counted all over the flowering and fruiting period and the flowering habit ratio was recorded by dividing number of staminate flowers by pistillate flowers.

Days to first picking

The number of days taken from transplanting to the first harvest was counted for each plant and averaged.

Number of pickings per plant

This comprises the total no. of pickings from the first to the last picking from the 6 randomly selected sample plants within the net plot area.

Number of fruits per plant

This comprises the average of fruits harvested from the 6 randomly selected sample plots during the crop period. The total no. of fruits obtained from the sample plants was divided by 6 in order to obtain the data.

Fruit length (cm)

Length of fruits of each replication at every picking was measured individually from the base of calyx to the tip of fruit and average of fruits was worked out and expressed in centimeters.

Fruit diameter (mm)

The fruits selected for measuring fruit length were used to measure the diameter of fruit in millimeter using vernier callipers at widest point of the fruit. Average of fruit diameter was worked out and expressed in millimeter.

Productivity (Mtha-1)

The net plot yield (yield obtained from six plants leaving single border plant from all sides) was converted to yield in Mg ha^{-1} to determine the productivity of the production.

Benefit cost ratio (B:C)

This was obtained by dividing the gross return by cost of cultivation.

Statistical analysis

The data collected during the experiment was analyzed using the statistical package Microsoft Excel and R-stat. Duncun's Multiple Range Test (DMRT) and Least Significant Difference (LSD) tests were used for the mean separation. Graph was prepared using MS Excel.

III. RESULTS

The experiment was conducted to study the effect of mulching materials on growth performance and yield characteristics of summer squash. The result of each parameter have been discussed and interpreted in this section.

Table 1: Effect of different mulching materials on plant height (cm) of summer squash in Mahottari, 2020

Treatments	Plant height (cm)			
	15 DAT	30 DAT	45 DAT	At final harvest
Silver plastic mulch	12.11^{a}	23.77^{a}	43.07^{a}	48.63^{a}
Black plastic mulch	9.88^{b}	22.20^{a}	39.68^{b}	43.58^{b}
Rice straw mulch	7.92^{c}	17.23^{b}	30.38^{c}	34.78^{c}
Saw dust mulch	7.64^{c}	16.56^{b}	29.69^{c}	33.11^{c}
Control	7.34^{c}	16.76^{b}	29.93^{c}	33.28^{c}
LSD (0.05)	0.85	2.68	2.71	3.94
SEM (±)	0.123	0.39	0.39	0.57
F- test	***	***	***	***
CV (%)	6.18	9.03	5.09	6.65

****=Significant at 0.1% probability level.*

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The average plant heights at 15 DAT, 30 DAT, 45 DAT and final harvest were found to be statistically highly significant. Silver plastic mulch had highest plant height followed by black plastic mulch (Table 1). Effect of different mulching materials on number of leaves per plant was significant on all observation (Table 2). At 30 DAT, silver plastic mulch had highest leaf number (17.28) and sawdust mulch had lowest (12.94) which was statistically similar with control (13.30cm). Effect of different mulches on leaf petiole length was significant at 30DAT, 45 DAT and at final harvest but it was found to be non-significant at 15 DAT (Table 3). At 45 DAT and at final harvest, silver plastic mulch had highest leaf petiole length (29.70cm and 31.77 cm respectively) and sawdust had lowest (22.81 cm and 23.65 cm respectively) leaf petiole length which was statistically similar with control (22.89cm) at 45 DAT and with control (23.65 cm) at final harvest.

Table 2: Effect of mulching materials on number of leaves per plant of summer squash in Mahottari, 2020

Treatments	No. of leaves per plant			
	15 DAT	30 DAT	45 DAT	At final harvest
Silver plastic mulch	5.32[a]	17.28 [a]	25.00[a]	31.27[a]
Black plastic mulch	5.06[ab]	16.76[ab]	24.96[a]	28.34[b]
Rice straw mulch	4.63[bc]	14.14[bc]	23.89[ab]	26.83[c]
Saw dust mulch	4.46[c]	12.94[c]	22.66[b]	25.68[d]
Control	4.45[c]	13.30[c]	22.85[b]	25.54[d]
LSD (0.05)	0.52	2.9	1.64	0.63
SEM (±)	0.075	0.42	0.24	0.41
F- probability	*	*	*	**
CV (%)	7.68	12.66	4.92	12.67

=Significant at 5% probability level.=Significant at 1% level of significance*

Table 3: Effect of mulching materials on leaf petiole length (cm) of summer squash in Mahottari, 2020

Treatments	Leaf petiole length (cm)			
	15 DAT	30 DAT	45 DAT	At final harvest
Silver plastic mulch	15.86	24.91 [a]	29.70[a]	31.77[a]
Black plastic mulch	15.17	22.52[ab]	26.26[b]	27.34[b]
Rice straw mulch	14.42	20.95[b]	24.24[c]	25.23[c]
Saw dust mulch	14.28	20.80[b]	22.81[d]	23.65[d]
Control	14.21	20.83[b]	22.89[d]	23.68[d]
LSD (0.05)	NS	2.87	1.06	1.13
SEM (±)	0.22	0.42	0.25	0.17
F- probability	NS	*	***	***
CV (%)	6.58	8.46	9.92	5.03

*NS=non - significant, *=Significant at 5% probability level. ***=Significant at 0.1% probability level*

Effect of mulching materials on all the floral characteristics was found to be significant except on days to first male flower (Table 4). The total number of male flowers per plant was obtained highest in sawdust mulch (20.25). While, the lowest number of male flowers was observed in silver plastic mulch (13.75). Silver plastic mulch produced highest number of female flowers per plant (9.98) and saw dust mulch produced the lowest (7.73). Sex ratio (male: female) was highest in saw dust mulch (2.62:1) being statistically similar with control (2.58), likewise, sex ratio being lowest (1.38:1) at silver plastic mulch as shown in table 4.

Table 4: Effect of mulching materials on floral characteristics of summer squash in Mahottari, 2020

Treatments	Days to first female flower (DAT)	Days to first male flower (DAT)	Total no. of pistillate flower per plant	Total no. of staminate flower per plant	Sex ratio / flowering habit ratio
Silver plastic mulch	27.21[c]	25.67	9.98[a]	13.75[d]	1.37[c]

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Black plastic mulch	26.97^{c}	25.09	9.16^{ab}	16.31^{c}	1.78^{bc}
Rice straw mulch	27.88^{bc}	25.76	8.49^{bc}	18.17^{b}	2.14^{b}
Saw dust mulch	28.91^{ab}	26.48	7.73^{c}	20.25^{a}	2.61^{a}
Control	29.36^{a}	26.49	7.84^{c}	20.22^{a}	2.57^{a}
LSD (0.05)	1.44	NS	1.09	1.31	0.41
SEM (±)	0.21	0.22	0.159	0.289	0.016
F-test	*	NS	**	***	***
CV (%)	4.33	7.37	8.87	7.71	6.72

*NS=non-significant, *=Significant at 5% probability level. **=Significant at 1% probability level ***=Significant at 0.1% probability level*

Table 5: Effect of mulching material on yield parameters and productivity of summer squash at Mahottari, 2020

Treatments	Days to first picking (DAT)	Total Number of pickings	Number of fruits per plant	Average fruit diameter (mm)	Average fruit length (cm)	Productivity (Mt ha^{-1})
Silver plastic mulch	33.96^{bc}	5.39^{a}	5.48^{a}	83.83^{a}	24.15^{a}	71.16^{a}
Black plastic mulch	33.47^{c}	5.11^{a}	5.22^{a}	81.24^{b}	23.45^{a}	66.19^{ab}
Rice straw mulch	34.88^{b}	4.52^{b}	4.71^{b}	78.35^{c}	22.54^{b}	56.80^{bc}
Saw dust mulch	36.41^{a}	3.94^{c}	4.19^{c}	75.45^{d}	21.50^{c}	46.73^{c}
Control	37.16^{a}	4.08^{bc}	4.30^{bc}	76.09^{d}	21.25^{c}	47.88^{c}
LSD (0.05)	1.24	0.55	0.48	1.23	0.75	11.48
SEM (±)	0.24	0.079	0.069	0.178	0.242	1.67
F-probability	*	***	***	***	**	**
CV (%)	4.97	7.69	6.54	7.25	8.79	12.90

=Significant at 5% probability level,=Significant at 1% probability level,***=Significant at 0.1% probability level*

Effect of mulching material on yield parameters and productivity of summer squash was found to be statistically significant at 5% level of significance. The highest number of picking (5.39) was recorded from silver plastic mulch being statistically similar with black plastic mulch (5.11). The lowest (3.94) being at saw dust mulch (Table 5). Highest yield was obtained from silver plastic mulch (72.16Mtha^{-1}) followed by black plastic mulch (66.19 Mtha^{-1}) and rice straw mulch (56.80 Mtha^{-1}).While lowest yield being at saw dust mulch (46.73 Mtha^{-1}), statistically similar with control(47.88Mtha^{-1}) (Table 5).

Economic analysis revealed that the highest benefit to cost ratio was found in plastic mulch being statistically significant to organic mulch and control (Table 6). Highest benefit to cost ratio was found in Silver plastic mulch (3.46: 1) being similar with black plastic mulch (3.29: 1). Saw dust mulch had the lowest benefit to cost ratio (1.98:1) being statistically similar with control (2.17:1).

Table 6: Effect of mulching materials on total cost of cultivation, gross return (NRs. ha-1), net return (NRs. ha-1) and B: C ratio of summer squash in Mahottari, 2020

Treatments	Total cost of cultivation (NRs. ha-1)	Gross return (NRs. ha-1)	Net return (NRs. ha-1)	B:C ratio
Silver plastic mulch	205800^{ab}	721600^{a}	505800^{a}	3.46^{a}
Black plastic mulch	200800^{ab}	661900^{b}	461100^{b}	3.29^{a}
Rice straw mulch	189600^{b}	511200^{c}	321600^{c}	2.69^{b}
Saw dust mulch	212200^{a}	420570^{d}	208970^{d}	1.98^{c}
Control	198000^{ab}	430920d	232920^{d}	2.17^{c}

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LSD	18175.20	29166.20	23986.20	0.21
SEm (±)	121.76	456.10	345.89	0.186
F-probability	*	***	***	***
CV%	9.20	13.20	7.06	13.27

=Significant at 5% probability level. *=Significant at 0.1% probability level*

IV. DISCUSSION

The increase in growth parameter was attributed to sufficient soil moisture near root zone and minimized evaporation loss due to mulching. The extended retention of moisture and availability of moisture also leading to higher uptake of nutrient for proper growth and development of plants, resulted higher growth of plant, as compared to control . The changes in soil temperature below plastic mulch could be attributed to different manners of heating and heat transfer to soil and also to heat accumulation during day and loss during night which might be a possible reason behind increased plant height in silver on black plastic compared to control (Parmaret al., 2013). Plastic mulches absorb incoming solar radiation and transmit a considerable part of it to the soil increasing soil temperature suitable for more leaf formation. The study of Rajablariani et al. (2012) showed the maximum number of leaves per plant in the plants mulched with silver/black plastic. He concluded that microclimatic condition improved by mulching might have provided a suitable condition for producing higher number of leaves in the plants. The alteration of the light microenvironment as upwardly reflected light from silver mulches decreases the ratio of red to far-red light compared to black mulches is thought to lead to greater leaf areas in plants grown on reflective silver mulches compared to black plastic (Decotcau, 2007; Decotcau et al., 1988). Bhujbal et al., (2015) also observed maximum number of flowers per plant (39.86) in treatment black on silver plastic mulch which was followed by treatment silver on black plastic mulch (37.66) in tomato. Favorable soil temperature, moisture conditions and pest-disease control consistently increased fruit set than other mulch and no mulch in silver on black polyethylene mulch in watermelon (Parmar et al., 2013). These finding are in accordance with (Hanna, 2000) in cucumber, (Andino & Motsenbocker, 2004; Johnson et al., 2000; Ansary et al., 2005) in watermelon. The favorable root-zone temperature created by plastic mulches promotes the uptake of water and mineral nutrients which in turn promote fruit set (Tindall et al., 1990). Increased weight of fruit and yield under polythene mulch resulted due to better water utilization, higher uptake of nutrients and excellent soil-water-air relationship with higher oxygen concentration in root zone (Bhujbal et al., 2015). These findings are in agreement with those of (Singh & Kamal, 2012; Gornat, Goldberg, Rimon, & Ben, 1973). As mulch films are nearly impervious to carbon dioxide which is necessary for photosynthesis, 'Chimney effect' might have been created, resulting in abundant CO_2 for the plants which might have added higher plant growth and fruit yield grown under different plastic mulches. Total cost of cultivation was highest for saw dust mulch (NRs.212200 ha^{-1}) due to high cost of saw dust and high weeding and irrigation cost. According to Dattatraya (2014), highest net returns (NRs 249,029 ha^{-1}) and highest B:C ratio (3.25:1) was observed in chilli in silver-black polythene mulch. These findings are also in line with the findings (Parmar et al., 2013) in watermelon where silver on black mulch resulted in the highest net return and found to be more economical with highest benefit: cost ratio (1.65:1).

V. CONCLUSION

The experiment brought some important information about effect of mulching materials on vegetative, phonological and yield characters of summer squash. Yield and yield parameters of summer squash were significantly affected by different mulching materials. Among the different mulches, silver plastic mulch was found to be superior in growth performance and yield characteristics of summer squash. Economically, all mulches seemed beneficial except saw dust mulch. Highest Summer squash productivity with highest net return and highest benefit cost ratio was obtained from silver plastic mulching though the cost of production was also the highest in silver plastic mulching. The use of plastic mulch (plasticulture) mainly silver plastic mulch is better tool for promoting the summer squash production by modifying the soil environment for the better crop stand and higher production.

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

REFERENCES

[1] Acharaya, U.K. (2004). Effect of plant growth regulators on growth and yield of spring summer season okra under inner Terai condition of Chitwan, Nepal.

Thesis, M. Sc. Tribhuwan University, Institute of Agriculture and Animal Science, Rampur, 74p.
[2] Andino, J., & Motsenbocker, C. (2004). Coloured plastic mulches influence cucumber beetle populations, vine growth and yield of watermelon. *Hort. Science*, 39(6): 1246-1249.
[3] Ansary, S., & Roy, D. (2005). Effect of irrigation and mulching on growth, yield and quality of watermelon (*Citrullus lanatus* Thunb). *Environment and Ecology* , 23 (Spl-1): 141-143.
[4] Bhujbal, P., Tambe, T., & Ulemale, P. (2015). Effects of mulches on flowering, fruiting, yield and pest-disease incidence of tomato (*Lycopersicon esculentum mill.*).*The Bioscan*, *10*(1): 465-468.
[5] Chauhan, D.V.S. (1972). Vegetable production in India. *Ram Prasad and Sons, Agra*, 3, 122p.
[6] Choudhary, B. (1979). Vegetables. *National Book Trust India. New Delhi*. 125p.
[7] Dattatraya, M. Y. (2014). *Studies on effect of different mulches on growth and yield of chilli (Capsicum annuum L.) Cv. Phule Jyoti.* Rahuri: College of Agriculture, Kolhapur Mahatma Phule Krishi Vidyapeeth.
[8] Decotcau, D. (2007). Leaf area distribution of tomato plants as influenced by polyethylene mulch surface color. *Hort Technology* , 17: 341-345.
[9] Decoteau, D., Kasperbauer, M., Daniels, D., & Hunt, P. (1988). Plastic mulch color effects on reflected light and tomato plant growth. *Scientia Hort* , 34: 169-175.
[10] Hanna, H. (2000). Black polyethylene mulch does not reduce yield of cucumbers double-cropped with tomatoes under heat stress. *Hort. Sci*, 35(2): 190-191.
[11] Mbagwu, J.S.C., & Adesipe, F.A. (1987). Response of three okra (*Abelmoschus esculentus* L. Moench) cultivars to irrigation at specific growth stages. *Scientia Horticultur* ,31, 35-43.
[12] MoAD. (2016). *STATISTICAL INFORMATION ON NEPALESE AGRICULTURE 2015/2016.* Singha Durbar, Kathmandu: Triveni chhapakhana.
[13] Parmar, H., Polara, N., & Viradiya, R. (2013). Effect of mulching materia on growth, yield and quality of watermelon (*Citrullus lanatus* thunb) Cv. Kiran . *Universal Journal of Agricultural Research* , 1(2): 30-37.
[14] Rajablariani, H., Hassankhan, F., & Rafezi, R. (2012). Effect of colored plastic mulches on yield of tomato and weed biomass . *International Journal of Environmental Science and Development* , 3(6).
[15] Robinson, Walters, D., & Warren, R. (1997). *Cucurbits.* Cab. International.
[16] Saif, U., Maqsood, M., Hussain, S., & Habib, A. (2003). Effect of planting patterns and different irrigation levels on yield and yield component of maize (*Zea mays*, L.). *International Journal of Agriculture and Biology* , 64-66.
[17] Sarkar, M., & Sirohi, P. (2011). *Diallel analysis of quantitative character in cucumber (Cucumis sativus).*
[18] Sebastian, P. S. ((2010)). Proceedings of National Academy of Sciences.
[19] Sharma, H., & Agrawal, N. (2004). Effect of different color mulches on the growth and yield of tomato under drip irrigation. *Plant Archives*, 4(1): 93-99.
[20] Tindall, James, A., Beverly, R., & Radcliffe, D. (1991).Mulch effect on soil properties and tomato growth using micro-irrigation. *Agronomy Journal*, 83: 1028-1034.
[21] Tiwari, K., Singh, A., & Mal, P. (2003). Effect of drip irrigation on yield of cabbage (*Brassica oleracea* L. var. capitata) under mulch and non-mulch conditions. *Agricultural Water Management* , 58, 19-28.

