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Effect of mulch materials on vegetative characters, yield and economics of summer squash (*Cucurbita pepo*) under rainfed mid -hill condition of Uttarakhand

Lalit Bhatt, Renu Rana, SP Uniyal and VP Singh

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Abstract In order to find out the effect of different mulch materials viz., black plastic, clear plastic, dry leaves, pine needles, green twigs of non fodder plants, forest litter and F.Y.M. on vegetative characters, yield and production economics of summer squash, the field experiment were undertaken during spring - summer season of 2009 and 2010 under rainfed mid-hill condition of Uttarakhand. The maximum plant height (38.11 cm), plant spread (142.39 cm), number of leaves per plant (41.85), root length (36.83 cm) and yield (62.72 t/ha) were recorded in black plastic mulch when compared with other treatments. The black plastic mulch not only advanced the harvesting time but also produced 74.17 per cent higher fruits yield than the control. Amongst the organic mulches, pine needles and forest litter were found equally effective in improving vegetative characters, which ultimately resulted in higher yields. Mulching with black plastic in summer squash was also found most economical with a net return of . 232628.70 ha-1 and Benefit: Cost ratio of 2.61.

Keywords: Mulch, Summer squash, *cucurbita pepo,* rainfed

Lalit Bhatt, Renu Rana, SP Uniyal and VP Singh
Department of Vegetable Science,
College of Forestry & Hill Agriculture
G.B. Pant University of Agril. & Tech.,
Hill Campus,
Ranichauri -249199 (Uttarakhand)

Introduction

Summer Squash (*Cucurbita pepo* L.), which is also known as Vegetable marrow, Vilayatikaddu, Kumra, Chappan kaddu, Bush squash etc., is grown throughout the world from U.S.A. to China. In India, it is confined to a limited scale in states like Punjab, Delhi, Uttar Pradesh, Himachal Pradesh etc. Vegetable marrow is sporadically grown in Uttarakhand due to unawareness among the vegetable growers, but experiences revealed that the state has a great potential for this vegetable due to easier cultivation, short duration and off season nature of the crop with higher economic return per unit area. The results of some of the demonstrations in Uttarakhand indicate that the average yield of this bushy cucurbit is reasonably low in hilly areas. In rainfed mid hill situation, spring - summer season (February to July) has been observed the best time for summer squash cultivation, but during this cropping season the crop generally faces the problem of low temperature in initial growth phase followed by moisture stress and temperature fluctuation problems in later parts of crop growth. Higher wind velocity coupled with the scorching solar radiation further aggravates these problems. Under these circumstances it becomes necessary to have the efficient use of irrigation water, which is a scarce natural resource during summers in mid hills of Uttarakhand. The use of organic and inorganic mulches has been observed to have important role in vegetable production, particularly under rainfed situations. These not only conserve the soil moisture, but along with regulation of soil temperature also suppress the weed population which ultimately helps in increasing the total and early yield. The yield increase in squash has been found to the tune of 30 per cent (Annda *et al.,* 2008; Sari *et al.*, 1994). Reduction in labour requirement and drudgery is the additional advantage of mulch in stress prone hilly conditions of Uttarakhand as crop raising is labour intensive due to lack of mechanization in hill agriculture (Singh *et al.,*

2008). Considering distinct advantages of mulching in vegetable production and keeping in view the rainfed situation of Uttarakhand, an investigation was undertaken to study the influences of plastics and locally available organic mulch materials on vegetative characters, yield and economics of summer squash.

Materials and Methods

The field experiments were conducted during spring - summer season of 2009 and 2010 on summer squash hybrid Ducato with seven mulch materials (five locally available organic mulches viz., dry leaves, pine needles, green twigs of non fodder plants, FYM & forest litter and two plastic mulches i.e. clear and black plastic) at Vegetable Research Block of College of Forestry and Hill Agriculture, G.B.P.U.A.&T., Hill Campus, Ranichauri, Tehri Garhwal, Uttarakhand in randomized block design replicated thrice. The mulching treatments were compared with unmulched control. The experimental site was situated in mid hill zone of Garhwal Himalayas at 30015' N latitude and 78075' E longitude and an altitude of 2000 amsl. The soil was clay loam in texture, slightly acidic in nature with a pH of 6.14 with available carbon of 6.14 %. The available N P and K content were 366 Kg/ha, 37.45 Kg/ha and 587 Kg/ha, respectively. The fertilizers were applied @100 Kg N, 80 Kg P2O5 and 60 kg K2O ha-1 along with FYM of 20 t/ha. The seed of summer squash were sown in poly bags on 26 February during both the year of experimentation under polyhouse and one month old seedlings were transplanted on raised beds at row spacing of 1.00 m and plant to plant spacing of 0.75 m in the plot size of 3.00 m x 2.00 m. The thickness of organic mulches on next days of transplanting was maintained as 6-7 cm for pine needles, dry fallen leaves, green twigs of non - fodder plants and 3-4 cm for FYM and forest litter. The plastic used for mulching was of 25 micron. The control treatment was without mulch, a traditional practice followed by the farmers. Observations for vegetative parameters were recorded by using standard techniques in summer squash and fruits were harvested when attained a weight of 750 to 1000 g. The economics of summer squash was calculated taking consideration of all inputs and operational cost as well as wages of labours incurred since seed sowing for nursery raising to final picking with expenditure on marketing and transportation. The gross and net returns were worked out accordingly by taking cost of cultivation and average sale price of fruits (. 10.00/kg for initial twenty days of pickings and . 7.00/kg. for rest of picking). The data recorded for both the years were analyzed using design of experiment as suggested by Panse and Sukhatme (1989) and pooled data were presented in Tables.

Results and Discussion

Different mulch materials had significantly influenced the plant growth characters viz., plant height, collar diameter, plant spread, number of leaves per plant, root length and days to 50 per cent male and female flowering. Out of seven mulch materials, plastic mulches (black and clear) significantly increased the growth characters when compared with locally available organic mulches and unmulched control. Plants mulched with black plastic (T2) recorded a maximum plant height (38.11cm), plant spread (142.39 cm), number of leaves per plant (41.85), which were significantly superior over all other treatment under investigation for these characters. The significantly higher root length was also observed in T2 (36.83 cm) than other treatments except T1 which showed significantly at par results in this regard. The effect of organic mulches (pine needles, dry leaves, FYM and forest litter) in respect to plant height, plant spread, number of leaves and root length were also found superior over unmulched plots (T0). The maximum collar diameter (20.79 cm) was noted in FYM mulch treatment (T5) followed by forest litter mulch (20.79) and black plastic (20.15) with no significant differences among these values while minimum (17.47 cm) was observed in control (Table 1).

Table 1: Effect of different mulching materials on vegetative characters of summer squash (pooled)

Treatments	Plant height (cm)	Collar diameter (mm)	Plant spread (cm)	Number of leaves per plant	Days to 50% flowering (female)	Days to 50% flowering (male)	Root length (cm)
T_1: Clear plastic	35.20	17.94	125.27	36.35	26.33	32.67	35.34
T_2 : Black plastic	38.11	20.15	142.39	41.85	27.17	32.00	36.83
T_3 : Pine needles	29.14	17.71	116.93	33.85	33.33	35.00	33.73
T_4 : Dry leaves	28.47	17.40	117.02	32.19	33.83	36.83	33.38
T_5 : FYM	28.31	21.04	117.31	33.04	32.67	36.67	33.64
T_6 : Green twigs	25.83	19.23	115.60	31.03	35.00	38.83	33.03
T_7 : Forest litter	33.02	20.79	121.30	32.09	28.00	36.67	34.59
T_0 : Control	24.87	17.47	102.35	29.62	31.50	36.67	30.02
CD at 5%	1.87	1.57	9.10	1.74	1.71	1.33	1.98

Table 2: Effect of different mulching materials on yield & yield attributes of summer squash (pooled)

Treatments	Number of harvestings	fruits/ plant	Yield (t ha $^{-1)}$					Total yield (t ha^{-1})	Per cent increase in yield over control
			1st 46-55 (DAT*)	2nd 55-65 (DAT)	3rd 66-75 (DAT)	4th 76-85 (DAT)	5th 86-95 (DAT)		
T_1: Clear plastic	12.33	6.01	20.66	10.25	17.465	5.872	1.52	55.85	55.09
T_2 : Black plastic	13.00	6.75	20.79	10.46	19.76	9.49	2.21	62.72	74.17
T_3 : Pine needles	12.00	5.41	9.48	13.90	16.75	4.945	4.07	49.15	36.49
T_4 : Dry leaves	11.00	5.67	8.55	12.97	16.99	4.627	2.78	45.93	27.54
T_5 : FYM	11.33	5.18	7.95	11.81	15.76	6.123	2.40	44.03	22.27
T_6 : Green twigs	09.66	5.51	6.98	12.08	16.67	6.385	2.44	44.75	24.27
T_7 : Forest litter	12.33	5.82	10.93	10.93	17.79	6.347	3.33	49.33	36.99
T_0 : Control	09.66	4.96	5.745	10.48	13.04	4.095	2.67	36.01	-
CD at 5%	1.59	0.77	2.81	NS	3.12	2.14	0.88	3.39	-

*DAT : Days after transplanting

Table 3: Economics of summer squash under different mulching materials (pooled)

Treatments	Cost of Cultivation (₹ ha^{-1})	Gross income (₹ ha^{-1})	Net return (₹ ha^{-1})	**B:C ratio**
T_1: Clear plastic	140944.70	345143.30	204198.20	2.43
T_2 : Black plastic	143519.30	376148.30	232628.70	2.61
T_3 : Pine needles	118432.50	292533.30	174100.80	2.47
T_4 : Dry leaves	117224.30	272708.30	155483.80	2.32
T_5 : FYM	121513.00	259678.30	138165.20	2.11
T_6 : Green twigs	116779.80	261863.30	145083.30	2.23
T_7 : Forest litter	118499.80	290396.70	171896.80	2.44
T_0 : Control	118505.50	212525.00	94019.50	1.79

Compared to the organic mulch materials and unmulched control, the plastic mulches significantly advanced the flowering in summer squash plants. On the other hand all the organic mulches except forest litter delayed the flowering when compared with control. Improvement in growth characters as a result of mulches might be due to the enhancement in photosynthesis and other metabolic activities. Higher soil temperature under plastic mulch improves the plant microclimate led to early growth and development which advanced the flowering. Similar kind of observations with respect to plant growth parameters were also reported by Singh et al. (2005) in tomato. They were of the view that plastic mulches improve the CO2 availability in the plant which ultimately led to higher rate of photosynthesis due to chimney effect. Black plastic mulch has an additional advantage that the absence of light within it did not allow photosynthesis under the film and therefore weed growth was depressed. On the contrary with transparent films, the presence of light with the improved condition of growth (heat, moisture, good soil structure) encouraged weed growth.

Mulching had also shown significant influence on number of harvestings and number of fruits per plant (Table 2). It was black plastic mulch (T2) which gave the maximum number of harvestings (13.00) and fruits per plant (6.75). The harvest numbers in organic mulched plots were also higher than the unmulched plots. Similar to harvest number, the plastic mulching had also given significantly higher early and total yield compared to other mulch treatments. Black plastic mulched plots had given as much as 74.17 per cent higher yield than unmulched plots, out of which 49.8 per cent of total yield was contributed by black plastic mulch in initial twenty days' of harvestings. The different organic mulch materials were also significantly superior in recording higher yield over control. It was noted highest (49.33 t/ ha) in plots mulched with forest litter (T7) followed by pine needles (49.15 t/ha). The increase in number of harvestings, number of fruits per plant and higher early and total yield under black plastic mulch might be attributed due to increased growth of plants under warmer and favorable soil microclimate. Similar kind of observation were also reported by Singh et al. (2005) in tomato and Nimah (2007) in cucumber. The yield increase under organic mulches could be due to their ability to reduce soil temperature fluctuation, increased water holding capacity, smothering weed population which led to favorable condition for plant growth and development. The positive influence of organic mulch

materials on yield was also reported by Uniyal and Mishra (2003) and Singh and Ahmed (2008) in potato. The economic analysis of different mulch materials revealed that mulching with black plastic (T2) in summer squash is most profitable, giving highest gross return (₹ 376148.00), net return (₹ 232628.70) and Benefit : Cost ratio (2.61). Amongst the locally available mulch materials studied, all proved better than control treatment. Out of four organic mulches, pine needles were found most profitable with respect to net return (₹ 174100.00) and Benefit :Cost ratio (2.47) followed by forest litter with Benefit :Cost ratio of 2.44. The control treatment had given only a Benefit :Cost ratio of 1.79 (Table 3). The increase in gross and net return and Benefit :Cost ratio under different mulch treatments was mainly due to higher early and total yield. These findings are in agreement with those reported by Hedau and Kumar (2002) and Nagalakshmi et al. (2002).

Based on present study, it could be concluded that use of black plastic mulch in summer squash is the most profitable mulch material under rainfed mid - hill condition of Uttarakhand. Amongst locally available organic mulch materials, pine needles and forest litter were found equally good in yield and economic return, beside eco- friendly too.

सारांश

छप्पन कद्दू की वृद्धि, उत्पादन एवं आर्थिकी पर पारदर्शी पॉलीथीन, काली पॉलीथीन, चीड़ की सूखी पत्तियाँ (पिल्टू), अन्य सूखी पत्तियाँ, गोबर की खाद, बिना चारे वाले पेड़ों की हरी शाखाओं एवं जंगली वृक्षों की खाद जैसे पलवार पदार्थों का प्रभाव आकलन हेतु वर्ष 2009 एवं 2010 में उत्तराखण्ड के असिंचित मध्य पर्वतीय क्षेत्र की जलवायु में एक अध्ययन किया गया। ज्ञात हुआ कि पलवार पदार्थों ने पौधे की लम्बाई व फैलाव, प्रति पौधा पत्तियों की संख्या, शीघ्र पुष्पन, प्रति पौधा फलों की संख्या एवं फल उत्पादन को सार्थक रूप से प्रभावित किया गया। विभिन्न उपचारों (पलवार पदार्थों) में सबसे अधिक पौधे की लम्बाई (38.11 सें. मी.), फैलाव (142.39 सें. मी.), प्रति पौधा पत्तियों की संख्या (41.85), जड़ की लम्बाई (36.83 सें. मी.) तथा अधिकतम फलों का उत्पादन (62.72 टन/है.) काली पॉलीथीन उपचार के अन्तर्गत मिला। काली पॉलीथीन से न केवल अगेती फसल प्राप्त हुई अपितु प्रचलित उत्पादन विधि की तुलना में इस उपचार द्वारा 74.17 प्रतिशत अधिक उत्पादन भी मिला। शुद्ध लाभ एवं लाभ–लागत अनुपात की दृष्टि से भी यह पलवार सर्वोत्तम रहा जो कि क्रमशः . 232628.70 प्रति है. तथा 2.61 था।

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