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EFFECT OF MULCHING AND NITROGEN ON GROWTH AND YIELD OF STRAWBERRY

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Abstract: Field experiment was conducted on clay loam soils of Research Farm of Himachal Pradesh Krishi Vishvavidyalaya, Palampur to determine the suitable mulching material and nitrogen for higher productivity of strawberry in mid hills of north- west Himalayas. Four mulches viz; black polyethylene (50 micron), paddy straw(10cm thickness), Eupatorium (10cm thickness) and no mulch and four levels of nitrogen (0, 40, 80 and 120 kg N/ ha) were tried in a randomized block design with three replications. The findings revealed that the plants mulched with black Polyethylene have significantly better growth and yield attributes than either with Eupatorium or paddy straw or no mulch. Further, fruit yield of strawberry was significantly higher in plants mulched with black polyethylene (26.2 q/ha) which was 39.4, 29.7 and 83.2 percent higher as compared to Eupatorium, paddy straw and no mulch, respectively. Runners fertilized with 120 kg N/ha produced significantly higher fruit yield of strawberry than other levels of nitrogen.
Keywords: Mulching, nitrogen, fruit yield, polyethylene, strawberry.

Introduction

Strawberry is a delicious fruit and is widely acclaimed for its characteristics aroma and flavour. The berries are highly perishable and used for making jams and juices, besides table consumption. The agro-climatic conditions prevailing in the state are conducive for its successful cultivation. However, no systematic work has been done on strawberry cultivation in the state and only adhoc recommendations are put forth to the growers with the result that the productivity and the quality of the crop is highly variable and erratic. Strawberry is a surface feeder and therefore moisture and temperature conditions of the upper layer of the soil have great bearing on the growth and development of the crop. Mulch play an important role in moisture conservation, weed control, regulation of soil hydrothermal regime, besides keeping the delicate fruit neat and clean (Abbotty and Gough, 1; Hancock 4; Tarara, 6). Locally available materials like hay, pine needles, Lantana and Eupatorium constituted the traditional materials employed for mulching to derive maximum benefit. However, in the recent years different types of polyethylene materials are being increasingly used for mulching. But no comparison of these materials has been done so far in hill region. Straw

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berry being shallow rooted is surface feeder and thus the nutrient status of the top layer of the soil is very vital to sustain optimum growth and production of the crop. Among different nutrients, the nitrogen management is of special significance as most of the Indian soils are deficient in this element. Hence it is very necessary to evaluate the efficacy of different mulches and to find out optimum dose of nitrogen under mid hills of north- west Himalayas to obtain maximum returns from this crop.

Materials and Methods

Field experiment was conducted during 2001-2003 on a silty clay-loam soil of Research Farm of Himachal Pradesh Krishi Vishvavidyalaya, Palampur (320 5' N, 760 32' E, 1 290 m above mean sea level) The experiment was laid out in randomized block design with three replications, consisting of sixteen treatments having combinations of four mulches (polyethylene, Eupatorium, paddy straw and no mulch) and four levels of nitrogen (0, 40, 80 and 120 kg N/ha). The soil having 0.80 % organic carbon was low in available nitrogen (196.0 kg N/ha), and phosphorus (8.6 kg P/ha) and medium in potassium (250.8 kg K/ha), with acidic reaction (pH 5.6). Healthy and disease free runners of uniform age, size and vigour were planted on September 5, 2000. Black polyethylene sheet with 1x3m size of 100 gauge thickness was used. The polyethylene was spread over the beds by unrolling the bundles and cut according to the size of bed. Corresponding to the position of plant, incisions were given on polyethylene and the plant stems were taken out through the slits to keep the foliage uncovered. Rice straw and tender plants of Eupatorium were spread over the plots evenly in different treatments to maintain a mulch of 10 cm thickness. Soil temperature was recorded daily at 10.30 A

Nitrogen was applied in the form of urea (46 % N). Half of the nitrogen was given in the first week of January and remaining half in two equal splits in March during flowering and fruit set. Basal dose of phosphorus and potash was also given during September. The harvesting of berry fruits was done when the berries developed normal ripening colour. However, three pickings were taken for every crop during all the three years. All necessary cultural practices and plant protection measures were followed uniformly for all the plots and treatments during the experimentation period.

Results and Discussion

Effect of mulches

Plant growth parameters, like crown height, number of leaves per plant and plant spread of Tiogo strawberry were significantly influenced by mulching. Crown height

(11.15cm), plant spread (21.9cm) and leaf area (cm^2) were significantly higher in plants mulched with black polyethylene than those either mulched with paddy straw or Eupatorium and no mulch (Table 2). It may be attributed to better soil hydrothermal regimes (Table 1) better moisture conservation and suppression of weeds in plants mulched with black Polyethylene than other mulches and no mulch (Badiyala and Aggarwal 1981; Gupta and Acharya 1993; Hassan et al. 2000 and Tarara 2000.

Duration of Flowering in straw berry appeared to be greately influenced by various mulching treatments. Flowering under black polyethylene mulching was found to be extended by10.1 to 17.8. Black polyethylene mulch was found to have significantly better effect on the extent of fruit set than other mulching materials tried. Black polyethylene mulch consistently increased higher fruit set than other mulches and no mulch. This might have been influenced by favourable soil temperature and moisture conditions as influenced by black polyethylene mulch. This is also in keeping with the finding of Abbotty and Gough (1992) who reported better moisture conservation and higher soil temperature with the use of black polyethylene mulch than other mulches. Row spacing however, failed to influence flowering and fruiting.

Yield attributes, like berry weight, berry length, berry diameter were significantly influenced by mulching and row spacing. Berry weight (10.1gm), berry length (3.7 cm) and berry diameter (2.4 cm) were significantly higher in plants mulched with black polyethylene than paddy straw, Eupatorium and no mulch. It appears that black polyethylene mulch might have induced favourable conditions conducive to attainment of berries with higher weight, length and diameter. Similar observations have also been reported by Badiyala and Aggarwal (1981).

Mulching influenced strawberry yield significantly (Table 3). Fruit yield of strawberry was significantly higher in plants mulched with black polyethylene (26.2 q/ha), which was 29.70, 39.36 and 51.44 percent higher as compared to plants mulched with paddy straw, Eupatorium and no mulch, respectively. Plants under polyethylene mulch produced larger fruit and have higher yield per plant because of better plant growth due to favourable hydrothermal regime of soil and complete weed free environment. Similar observations on increased yield with black polyethylene mulch have also been reported by Badiyala and Aggarwal (1981) and Hassan et al. (2000).

Effect of nitrogen

Plant growth parameters, like crown height, number of leaves per plant and plant spread of Tiogo strawberry were significantly influenced by nitrogen. Crown height (12.58 cm), plant spread (23.6cm) and leaf area (85.4cm^2) were significantly higher in plants fertilized with 120 kg N/ ha than 40, 80 and control (Table 2). Such a response to nitrogen is obvious when it is deficient in the growing medium. The soil samples analysed before the start of the experiment also showed that available nitrogen in the experiment field was in lower range (196.0 kg/ ha). Application of nitrogen in a soil deficient in nitrogen provided better nutrition to the crop. Moreover, acceleration of meristematic activity and encouragement of vegetative growth are some of the recognized effects of nitrogen. Nitrogen however, failed to influence flowering and fruiting.

Yield attributes, like berry weight, berry length and berry diameter were significantly influenced by nitrogen. Berry weight (11.4gm), berry length (4.0 cm) and berry diameter (2.6cm) were significantly higher in plants fertilized with 120 kg N/ ha than 0, 40 and 80 kg N/ ha. The effect of nitrogen application in relation to increased yield attributes viz. berry weight, berry length, berry diameter etc. due to 120 kg N/ ha may be indirect. Fertilizer application may first improve the internal nutritive condition of plant leading to increased growth and vigour associated with higher photosynthesis and translocation of assimilates in the fruits. Hochmuth and Hanlon (1995) also reported similar results and reported increased rate of translocation of photosynthetic products from leaves to developing fruits.

Application of nitrogen fertilizers increased the berry yield and these observations are in consonance with the findings of Hochmuth and Hanlon (1995). Application of 120 kg N/ ha recorded significantly higher berry yield (25.1 q/ ha) over 0, 40 and 80 kg N/ ha. On an average, 120 kg N/ ha recorded 50.3, 30.05 and 17.28 per cent higher yield over 0, 40 and 80 kg N/ ha, respectively. This is in conformity with the observations made by Albregts *et al*. (1990) who reported that total berry yield under Florida conditions increase with the increasing nitrogen rates up to 120kg N/ha. They opined that attainment of higher yield following the application of 120Kg N/ha was due to increase in fruit number and fruit size.

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Table 1: Soil temperature under different mulches (Mean of 3 years)

Month	**Black Poly ethylene**		**Paddy straw**		**Eupatorium**		**Control**	
	Maximum	**Minimum**	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**	Minimum
January	11.1	5.5	10.7	4.9	10.5	4.8	10.2	4.5
February	14.2	7.8	13.8	7.3	13.6	7.0	13.2	6.7
March	16.1	9.0	16.0	8.5	15.8	8.2	15.4	7.8
April	26.8	16.5	26.3	16.0	26.0	15.9	25.5	15.5
May	27.3	20.4	27.0	19.1	26.8	19.0	26.5	18.5
June	27.8	20.9	27.2	19.5	27.1	19.2	26.2	18.4
July	19.5	12.4	18.7	12.2	18.5	12.0	18.0	11.1
August	25.8	15.5	25.3	15.1	25.1	14.1	24.2	14.0
September	25.8	15.4	25.2	15.3	24.9	15.1	20.5	10.3
October	21.8	11.8	21.4	11.4	21.5	11.2	19.6	10.5
November	15.5	9.0	14.5	8.6	14.7	8.2	12.1	6.8
December	11.8	6.2	11.0	5.7	10.8	5.3	9.5	4.8

Table 2: Effect of mulching and nitrogen on growth parameters of strawberry.

Treatment	Crown height (cm)	Plant spread (cm)	Leaf area (cm^2)	Duration of flowering	Duration of fruiting
Mulches					
Polythene sheet	11.15	21.9	85.8	68.2	65.3
Paddy straw	10.47	19.3	73.5	58.1	58.2
Eupatorium	10.12	18.7	70.3	57.0	56.4
Control	8.12	16.8	64.3	50.4	50.3
C.D. (P=0.05)	0.42	0.98	4.8	5.6	4.2
Nitrogen (kg/ha)					
0	7.15	14.6	61.6	57.1	56.2
40	9.18	18.5	70.5	58.4	56.6
80	10.95	20.0	76.4	58.7	58.4
120	12.58	23.6	85.4	59.5	59.0
C.D. (P=0.05)	0.42	0.98	4.8	NS	NS

Table 3. Effect of mulches and nitrogen on yield and yield attributes of strawberry

Treatments	Berry weight (gm)	Berry length (cm)	Berry diameter (cm)	Berry yield (q/ha)
Mulches				
Polythene sheet	10.1	3.7	2.4	26.2
Paddy straw	8.1	2.9	2.1	20.2
Eupatorium	7.4	2.8	2.1	18.8
Control	5.2	1.9	1.7	17.3
C.D.(P=0.05)	1.80	0.42	0.14	2.4
Nitrogen (kg/ ha)				
0	4.2	1.6	1.3	16.7
40	6.5	2.5	2.0	19.3
80	8.7	3.2	2.4	21.4
120	11.4	4.0	2.6	25.1
C.D. (P=0.05)	1.80	0.42	0.14	2.4