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Evaluation of the performance of different mulching materials on growth and yield of chilli

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Abstract
An invesigation entitled "Studies on effect of different mulches on growth and yield of chilli (*Capsicum annum* L.)" was carried out during 2018 to 2020. The field experiment was conducted at the ICR Farm, Department of Horticulture, B N College of Agriculture, AAU, Biswanath Chariali, Assam to evaluate the performance of different mulching materials on growth and yield of chilli. The experiment was laid out in randomized block design with four replications incorporating six treatments *viz*., mulching with black polyethene (T_1), mulching with white polyethene (T_2), mulching with transparent polyethene (T_3), mulching with dry banana leaves (T_4), mulching with paddy straw (T_5) and control, without mulching (T_6). The morphological, phenological and yield attributing parameters were significantly influenced by mulching treatments. Among the treatments, T_1 produced significantly highest plant height (18.91 cm, 37.13 cm, 68.04 cm and 76.64 cm at 30, 60, 90 and 120 DAP respectively), total number of branches per plant (8.59, 17.92, 49.26 and 64.36 at 30, 60, 90 and 120 DAP respectively), primary branches per plant (8.08, 12.00, 15.73 and 19.53 at 30, 60, 90 and 120 DAP respectively) and plant spread of 67.91 cm at the time of first harvest. The same were lowest in T_3. Moreover, T_1 took shortest 44.32 days to first flower appearance, 118.17 days to first harvest and longest 182.06 days to last harvest. The T_1 treatment also maintained the highest fruit yield (20.18 t/ha), number of fruits per plant (93.85), length of fruit (4.76 cm), fruit girth (2.75 cm), fruit fresh weight (1.30 g), fruit dry weight (0.50 g) and fruit volume (2.21 cc) which was followed by T_2 and T_4.

Keywords: Chilli, black polyethene, white polyethene, dry banana leaves, paddy straw, growth and yield

Introduction
Chilli (*Capsicum annum* L.) is one of the most valuable spice crop. Chilli belongs to the genus Capsicum under Solanaceae family. Chilli is widely cultivated throughout warm temperature, tropical and sub tropical countries. The centre of origin of chilli is Mexico. Chilli is a diploid with chromosome number 2n=24. The crop is not an annual but is frost tender. In the absence of winter frost, it can grow into a large, shrubby perennial herb. It is the most widely used universal spice, named as wonder spice (Maida *et al*. 2019) [4]. It is an indispensable spice essentially used in every Indian cuisine for its pungency, taste, colour and aroma. Over 10,000 varieties of chillies around the world, only 6000 varieties are cultivated and they belong to five species *viz. Capsicum annum*, *Capsicum baccatum*, *Capsicum chinense*, *Capsicum frutescens* and *Capsicum pubescens.* India is the largest producer, consumer and exporter of chilli and contributes 25% of total world's production.

In India, total area under chilli cultivation is 792 million hectares with a production of 1376 metric tonnes with an average productivity of 1643 kg/ha (National Horticultural Board, 2015-16). In Assam, area and production under chilli cultivation are 21.31 ha and 19.12 tonnes respectively (National Horticultural Board, 2015-16).

The crop is mainly cultivated for its fruits all over the India. The fruits are an excellent source of health-related phytochemical compounds, such as ascorbic acid, carotenoids, tocopherols, flavonoids and capsaicinoids that are very important in preventing chronic diseases such as cancer, asthma, coughs, sore throats, toothache, diabetes and cardiovascular diseases (El-Ghoraba *et al*., 2013) [3]. The heat produced by the chillies, acts as an effective pain reliever, as an digestive and anti-ulcer aid. Pungency and red colour of chilli is due to the presence of "Capsaicin" and "Capsanthin" respectively. Chilli fruit contains moisture (85.7%), protein (2.9 g), fat (0.6 g), minerals (1.0 g), fiber (6.8 g), carbohydrates (3.0 g), calcium (30 mg), magnesium (24 mg), riboflavin (0.39 mg), nicotinic acid (0.9 mg), phosphorus (80 mg), iron (1.2 mg), sodium (6.5mg), potassium (217 mg), Vitamin A (292 I.U.) and Vitamin C (111 mg)

per 100 g of edible portion (Prajapati *et.al*., 2017) [6]. Chilli fruits are used as fresh or often prepared and eaten like a vegetable. Whole pod can be dried and ground into chilli powder which is used as a spice or seasoning. The leaves of every species of Capsicum are edible because unlike other solanaceous crop it does not have toxin in their leaves. Due to its pungency, taste, medicinal properties, attractive colour etc. chilli fetches a great importance among people. In fact, the demand of chilli is increasing day by day across the globe, thus there is urgent need to increase the production and productivity of chilli. Among the various factors affecting the production and quality of chilli, mulching may be considered as prime one. Therefore, in the present experiment the effect of different mulches on growth and yield of chilli was evaluated in Assam condition.

Mulching is one of the simplest and most beneficial method. Mulching is a process of covering the soil and make more favourable conditions for plant growth and development. It is an important cultural method of reducing the amount of work involved in gardening and helps to produce healthy plants with good productivity (Sathiyamurthy *et al*., 2017) [7]. Mulches can either be organic - such as grass clippings, paddy straw, dry leaves, bark chips and similar materials or inorganic mulches such as stones, brick chips and plastic. Organic mulches improve the condition of soil by providing organic matter through decomposition which causes loosening of soil and improves root growth. Mulching also prevents the germination of annual weeds from receiving light. Benefit of mulching during dry season is that steam in the soil has released but still moisture is available in the soil, which helps the organic mulch to decompose into the soil. The moisture will be retained by the mulching material, and it will be used for the plants for many weeks or even months. Due to its pungency, taste, medicinal properties, attractive colour etc. chilli fetches a great importance among people. In fact, the demand of chilli is increasing day by day across the globe, thus there is urgent need to increase the production and productivity of chilli. Among the various factors affecting the production and quality of chilli, mulching may be considered as prime one.

Materials and Method

The investigation was conducted at the Instructional cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali, during December 2018 - June 2019. The experimental site was situated at 26.7° 26/ 42// N latitude and 93.5° 93/ 30// E longitude at an elevation of 105 m above msl (mean sea level). The selected plot has good slope and well drainage system. The prevailing climatic condition of Biswanath Chariali which is located in the middle of the North Bank Plain Zone of Assam is subtropical with hot summer, cold winter and high relative humidity. The experiment consisted of 6 treatments of same variety (Krishna Jolokia) of chilli which was laid out in randomized block design (RBD) with four replications. Details of the treatments are mulching with black polyethene (T_1), mulching with white polyethene (T_2), mulching with transparent polyethene (T_3), mulching with dry banana leaves (T_4), mulching with paddy straw (T_5) and control, without mulching (T_6). Krishna jolokia variety was undertaken for this investigation. The fruits are small 4-6 cm long and are pointed at the ends. It is black in colour. The height of the plant, total branches per plant, number of primary branches per plant, was recorded at 30 days interval from the five tagged plants starting from 30 days after transplanting. The height was measured from the base of the plant to the tip of the plant in centimeter with the help of meter tape and average height was calculated. The spreads of plants were recorded at first harvesting with the help of measuring scale. The maximum distance in between two outer leaves were measured in centimeter crosswise and averages was calculated which was considered as diameter. The first flower appearance was counted from the date of planting to the date at which the first flower appeared and was expressed in days. Days to first harvest was recorded as number of days from planting to first fruit harvest and the days to last harvest was calculated by recording the number of days from transplanting to the last harvest in five tagged plants and the average was computed and was expressed in days. The total number of edible green fruits was harvested and counted separately in all picking from tagged plants. Then the average number of fruits was calculated per plant and recorded. Weight of ten randomly selected fresh fruits from each treatments and were measured in an electronic balance and the mean was worked out to estimate average fruit fresh weight and was expressed in grams (g). Then the fruits were sun dried and the dry weight was taken periodically until the constant value of dry weight was obtained and the mean was worked out to estimate average fruit dry weight and was expressed in grams (g). To measure the fruit volume, fruit length and fruit girth, fruits were picked randomly from the tagged plants in each replication and the mean was computed. The fruit volume was measured by water displacement method and expressed in cubic centimeter (cc). The length of edible green fruits were taken from pedicel end to the tip of the fruits picked and the girth of individual fruit at center and was expressed in centimeter (cm). The fruit yield per hectare was estimated by weighing the number of fruits obtained from per plot and expressed in Tones per hectare (t/ha).

Results and Discussion

Among the treatments, T_1 (mulching with black polyethene) produced the maximum plant height (18.91 cm, 37.13 cm, 68.04 cm and 76.64 cm at 30, 60, 90 and 120 DAP respectively), number of total branches per plant (8.59, 17.92, 49.26 and 64.36 at 30, 60, 90 and 120 DAP respectively), number of primary branches per plant (8.08, 12.00, 15.73 and 19.53 at 30, 60, 90 and 120 DAP respectively) and plant spread (67.91 cm at first harvest). T_1 was followed by T_2 (mulching with white polyethene) while, T_3 (mulching with transparent polyethene) performed the poorest in terms of these parameters with plant height (13.05 cm, 23.06 cm, 48.68 cm and 58.20 cm at 30, 60, 90 and 120 DAP respectively), number of total branches per plant (5.62, 10.95, 39.06 and 54.76 at 30, 60, 90 and 120 DAP respectively), number of primary branches per plant (4.47, 7.71, 10.34 and 14.10 at 30, 60, 90 and 120 DAP respectively) and plant spread (51.85 cm at first harvest).

Compared to black as well as white polyethene mulch organic mulches were probably less effective in checking evaporation loss thus maintained less soil moisture content hence, in the present study comparatively poor vegetative growth of the plants were found in plants grown with organic mulch. On the other hand, transparent polyethene allows maximum light to pass through it hence the weed below the mulch receive sufficient light to continue their normal growth and

development. Marichamy *et al.* (2016) [5] reported that the plant height and number of primary branches per plant were increased due to sufficient soil moisture near root zone and minimum evaporation loss due to mulching. High moisture content may lead to more nutrient and water uptake require for proper growth and development of plants.

Among the different mulching treatments T_1 (mulching with black polyethene) took shortest duration to first flower appearance (44.32 days) as well as first harvest (118.17 days) and longest duration to last harvest (182.06 days). In contrast, T_3 (mulching with transparent polyethene) required longest duration for first flower appearance (56.19 days) as well as first harvest (126.05 days) and shortest duration to last harvest (170.60 days). T_3 was followed by control plants. The result observed might be due to positive effect of mulching like better uptake of nutrients and less weed infestation in the plot with mulch treatment. These plants might complete their required Basic Vegetative Phase earlier than the unmulched plants and thus were prepared to enter into the reproductive phase. Among the treatments T_1 recorded the highest number of fruits per plant (93.85), fresh weight of individual fruit (1.30 g), dry weight of individual fruit (0.50 g), fruit volume (2.21 cc), fruit length (4.76 cm), fruit girth (2.75 cm) and fruit yield (20.18 ton/ha) while, the minimum number of fruits per plant (82.41), fruit fresh weight (1.16 g), fruit dry weight (0.37 g), fruit volume (2.11 cc), fruit length (4.56 cm), fruit girth (2.55 cm) and fruit yield (11.12 ton/ha) were found in T_3. These improvement in yield attributes with mulch treatments could have resulted from less weed population, increased photosynthesis and metabolic activities, higher uptake of water and nutrients which facilitated growth and yield of plants (Debbarma *et al.*, 2015 and Marichamy *et al.*, 2016) [2, 5].

Table 1: Plant height (cm) under different treatment

Treatments	Plant height (cm)				Mean
	30 DAP	60 DAP	90 DAP	120 DAP	
T_1	18.91	37.13	68.04	76.64	50.18
T_2	16.70	30.08	62.63	71.27	45.17
T_3	13.05	23.06	48.68	58.20	35.74
T_4	15.78	26.64	57.13	67.58	41.78
T_5	15.50	25.03	55.35	65.68	40.39
T_6	14.10	23.90	50.16	59.86	37.00
S.Ed	0.22	0.25	0.14	0.16	
CD(P=0.05)	0.46	0.53	0.30	0.34	

DAP: Days after planting

Table 2: Number of total branches per plant (No./plant) under different treatment

Treatments	Total branches (No./plant)				Mean
	30 DAP	60 DAP	90 DAP	120 DAP	
T_1	8.59	17.92	49.26	64.36	35.03
T_2	7.91	16.05	47.26	63.78	33.75
T_3	5.62	10.95	39.06	54.76	27.59
T_4	6.92	14.96	46.29	61.68	32.46
T_5	6.53	14.11	45.31	60.64	31.64
T_6	6.11	11.98	42.75	57.94	29.69
S.Ed	0.08	0.09	0.22	0.13	
CD(P=0.05)	0.16	0.19	0.47	0.28	

Table 3: Number of primary branches (No./plant) per plant under different treatment

Treatments	Primary branches (No./plant)				Mean
	30 DAP	60 DAP	90 DAP	120 DAP	
T_1	8.08	12.00	15.73	19.53	13.83
T_2	7.67	10.89	14.43	18.05	12.76
T_3	4.47	7.71	10.34	14.10	12.20
T_4	6.71	10.40	13.28	17.19	11.89
T_5	5.97	9.26	12.41	16.52	11.04
T_6	5.15	9.13	11.50	14.89	10.16
S.Ed	0.20	0.24	0.12	0.11	
CD(P=0.05)	0.42	0.50	0.25	0.24	

Table 4: Plant spread (cm) under different treatment

Treatments	Plant spread (cm)
T_1	67.91
T_2	67.54
T_3	51.85
T_4	66.43
T_5	64.89
T_6	57.33
S.Ed	0.08
CD(P=0.05)	0.17

Table 5: Phenological parameters under different treatment

Treatments	Days to first flowering(days)	Days to first harvest(days)	Days to last harvest(days)
T_1	44.32	118.17	182.06
T_2	46.59	119.81	180.23
T_3	56.19	126.05	170.60
T_4	48.20	121.08	179.78
T_5	49.40	121.97	178.22
T_6	53.04	123.13	174.84
S.Ed	0.10	0.11	0.21
CD(P=0.05)	0.21	0.23	0.44

Table 6: Fruit characters and yield under different treatment

Treatments	Fruits (No. / plant)	Fruit fresh weight (g)	Fruit dry weight (g)	Fruit volume (cc)	Fruit length (cm)	Fruit girth (cm)	Fruit yield (ton/ha)
T_1	93.85	1.30	0.50	2.21	4.76	2.75	20.18
T_2	91.05	1.27	0.48	2.20	4.74	2.72	18.54
T_3	82.41	1.16	0.37	2.11	4.56	2.55	11.12
T_4	91.00	1.25	0.46	2.17	4.68	2.69	16.27
T_5	89.31	1.24	0.43	2.16	4.66	2.67	14.46
T_6	86.77	1.19	0.40	2.13	4.62	2.59	12.76
S.Ed	0.15	0.05	0.04	0.03	0.06	0.04	0.05
CD(P=0.05)	0.24	0.10	0.08	0.06	0.12	0.08	0.11

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