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Black Plastic Mulch on Flower Production and Petal Coloration of Aster (C*allistephus chinensis*)

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Abstract: An experiment was conducted at the Horticultural Farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh to assess the effect of traditional mulches on the flower production and petal coloration of China Aster (C*allistephus chinensis*). Treatments were control (no mulch), water hyacinth mulch (WHM), straw mulch (SM) and black plastic mulch (BPM). Healthier vegetative growth and highest number of flowers were produced with the plants under black plastic mulch while minimum yield was obtained in control. Vivid colored flowers were also produced with the black plastic mulch treated plants.

Key word: Aster (C*allistephus chinensis*) % Mulch % Petal coloration and flower production

INTRODUCTION

Aster (*Callistephus chinensis* L.) is an important commercial flower, used for cut flower as well as landscape gardening [1]. The genus belongs to the family Compositae, having radiated flower heads with white, pink, or violet rays and a usually yellow disk. Aster distributed over most of the earth and in almost all habitats and climates. Aster being a shallow rooted bedding flower needs plenty of water for its normal growth and development. Irrigation is therefore essential for flower production and its petal coloration. But additional irrigation causes increased production cost. Under such condition, mulching may be practical in flower production, which is highly effective in checking evaporation and is hence recommended for most crops in home garden [2]. Generally straw, rice husk, water hyacinth, crop residues or plastic mulch are used as artificial mulch in vegetable and ornamental crops [3].

Physically, mulches prevent rapid evaporation from the soil surface and reduce rapid drying. Mulching also suppress weed infestation effectively. Furthermore it stimulates microbial activity in soil through increasing soil temperature, which improves agro physical properties of soil. Mulching used as a means of successful crop production mainly in place, where irrigation facilities are scanty. The effect of these is to cut off the upward flow of underground moisture at a point below the actual surface and to prevent its rapid escape into the air during dry weather [4-5]. It has a unique character of reducing the maximum soil temperature and increasing the minimum temperature [6].

Photodegradable and biodegradable mulches made of plastic, paper, or other materials have been tested for their utility for annual food production with varying degrees of success [7]. As early as the 1920s, researchers developed acceptable production practices with paper mulches in annual vegetables and fruit production [8]. Currently, plastic mulch is uses on thousand of acres of vegetables in the United states and mulching practices have increased on a wide range of vegetables crops [9]. At present, it is needed to produce flower in different ways through which maximum benefits can be obtained from the limited available water resources. In this regards there is a need to standardize production technology under local climatic and edaphic conditions so that the farmers can get maximum benefits from flower production with limited irrigation resources. The information on utilization of different tradition mulches in floriculture is scanty. Hence, the present investigation was designed to determine the effect of black plastic mulch along with other traditional mulches in flower production of Aster.

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MATERIALS AND METHODS

This experiment was conducted at Horticultural Farm, Sher-e-Bangla Agricultural University, Dhaka during the period from October 2005 to February 2006. Seedbed was seeded on 30 October 2005 and 25 days old seedlings were transplanted in the 1.2 m × 1.2 m sized plots, maintaining 30×20 cm spacing. Traditional mulches used in the experiments were control (no mulch), straw mulch (SM) with 4 inch thick, water hyacinth mulch (WHM) with 4 inch thick and black plastic mulch (BPM) with 150 µm gauge thickness. Experiment followed randomized complete block design with three replications. pH of the experimental soil was 5.8 to 6.8. Average day temperature was 18^0C and night was 10^0C. Land was opened on 15 days before transplanting. Recommended doses of manures and fertilizers (Cowdung 10 kg m^{-2}, TSP 20g m^{-2}, MP 20 g m^{-2}) were applied in the experimental plots and mixed with plot soil. Cowdung was applied during land preparation. All of the TSP and MP were applied during transplanting. Seedlings were transplanted in the afternoon and were protected from sun providing leaf sheath of banana. Mulches of water hyacinth and rice straw were applied immediately after transplanting while polythene sheet was spreaded over the plot immediately before transplanting of seedling. Gap filling, weeding and pesticide application were done when necessary. Data on plant height, number of leaf per plant, days to bud initiation, bud growth at every alternate day, number of flowers color measurement of full bloom petals etc. Data were collected from 10 plants per treatment, randomly.

Petal color at three different locations of the top center of outer epidermis was measured using a handy-type t ristimulus colorimeter, NR-3000 (NIPPON Denshoku), followed by L^* (lightness), a^* and b^* (two cartesian co-ordinates), based on the CIELab scale with the standard CIE observer (10° visual field) and the CIE standard illuminant D_{65} [10, 11]. Metric chroma, C^* and hue angle, h_{ab}, were calculated according to the following equations: $C^* = (a^{*2}+b^{*2})^{0.5}$ and $h_{ab} = \text{tang}^{-1}(b^*/a^*)$ [12]. The CIE color system, chromatic tonalities are spread across a continuous circle 0-360°, with 0° being on the +a* axis, red to purple; then continuing to 90° for the +b* axis, yellow, 180° for -a* bluish-green, 270° for -b*, blue and back to 360° [13].

An analysis of variance was done according to the procedures of Gomez and Gomez [14] followed by Duncan's multiple range test, when significance was identified for comparing treatments. No interactions between the cultivars and mulch treatments were calculated for any of the data collected. Statistical analyses were recorded at 5% level by LSD.

RESULTS AND DISCUSSION

Height of the plant differed significantly with different mulches. Highest plant height (18 cm) was produced at 60 DAT with black plastic mulch and lowest (7 cm) was obtained at the same DAT in control (Fig. 1). Plant height was showed a good result with straw mulch (14 cm) and water hyacinth mulch (13 cm) and both were statistically identical.

Mulches showed a significant result in total number of flower production. Highest cumulative number of flowers (70) was recorded with black plastic mulch at 62 DAT (Fig. 2). Flower initiation with the plants under black plastic mulch was earlier than straw mulch or control and was identical with water hyacinth mulch. It was might be due to the increased soil temperature of black polythene mulch treatment, which was directly related to early initiation of flower and the increased cumulative number of flowers.

Petal coloration of different group of aster differed significantly with traditional mulch. Pink asters showed highest lightness (88.0) in control and lowest was recorded in black plastic mulch (Table 1). According to Uddin *et al.* [13], +a* (79.0), -b* (-22.0), C* (82) and hue angle (344.4^0) defined the petal color as vivid pink with plants those are treated with black plastic mulch with in the pink group. Similarly purple group asters also showed significant variations in petal coloration with the treatments. Plants under the black plastic mulch treatment produced vivid purple color petal in purple group. White petal group flowers do not showed any variation with the treatments.

Vivid petal color means that the plant produced more anthocyanin in petals. Plastic mulches effectively shut off vapor transport; no energy was consumed by evaporation. Soil would be warmed up and increased the availability of irrigated water. Lippert *et al*. [15] and Waggoner *et al.* [16] reported that moisture distribution in the upper soil layers in mulched is more uniform compared to unmulched soil, root development is better in the upper soil layer, which usually is rich in nutrients and useful microorganisms. Lal [17] also reported that mulching enhances the biological activity of soil fauna and thus increases soil fertility. Mulching has been reported to increase yield by creating favorable

Table 1: Influence of different traditional mulches on petal coloration of Aster[z]

Group	Treatments[x]	Coloration [y] L*	a*	b*	C*	h°
Pink	C	88.0a	48.0b	-15.0b	50.3c	342.6b
	SM	58.0c	53.0c	-9.0a	53.8bc	350.3a
	WHM	72.0b	52.0c	-21.0c	56.1b	338.0d
	BPM	56.0c	79.0a	-22.0c	82.0a	344.4c
Purple	C	79.0a	29.0c	-30.0b	41.7b	314.0a
	SM	78.0a	33.0b	-27.0c	42.6b	320.7b
	WHM	65.0b	35.0a	-45.0a	57.8a	307.2c
	BPM	61.6c	24.0d	-29.ob	37.6c	309.6c
White[NA]	C	100.0	-	-	-	360
	SM	100.0	-	-	-	360
	WHM	100.0	-	-	-	360
	BPM	100.0	-	-	-	360

[x]C, control; SM, Straw mulch; WHM, Water hyacinth mulch; and BPM, Black plastic mulch; NA, Not analyzed

[y]L*, lightness; C* (Chroma); $(a^{*2}+b^{*2})^{1/2}$ and h°(hue angle), b*/a*; (a*, a hue of green to red; b*, blue to yellow)

[z]Means having common letters within the same row under color groups are not statistically different at 5% level by LSD

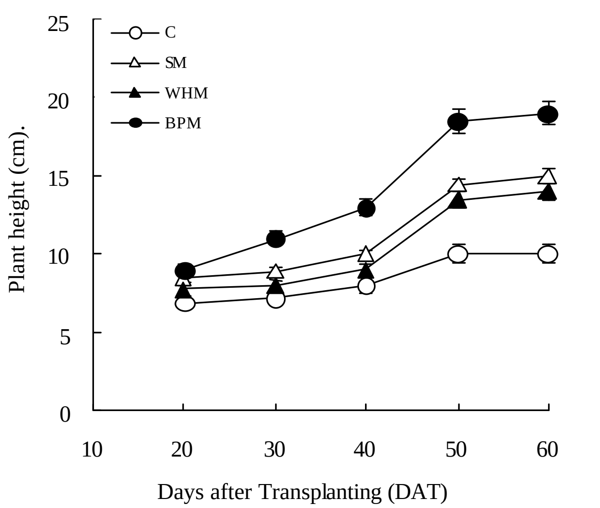

Fig. 1: Variation of plant height of Aster due to different mulches. C, control; SM, Straw mulch; WHM, Water hyacinth mulch; and BPM, Black plastic mulch

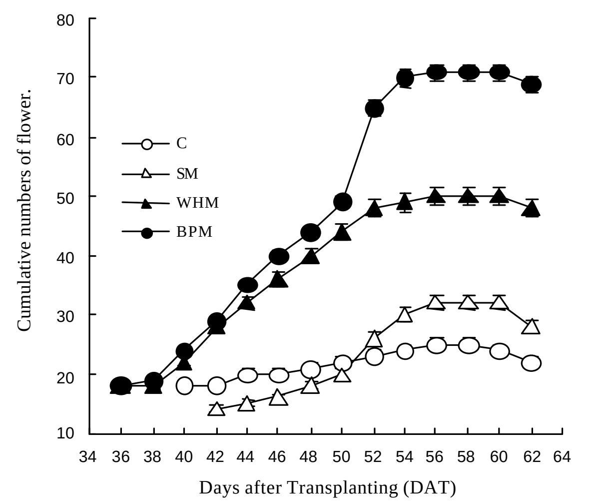

Fig 2: Influence of different traditional mulches on flower initiation and total number of flower. C, control; SM, Straw mulch; WHM, Water hyacinth mulch; and BPM, Black plastic mulch

temperature and moisture regimes. Actually, the plant grows very well, increase of nitrogen utilization, result the accumulation of some form of carbohydrates and that carbohydrate used for the synthesis of anthocyanin. This finding was consistent with the report of Griesbach [18]. Al-Masoum *et al*. [19] reported that plastic mulch is better because, in addition to warming the soil and eliminating weeds, it reflects beneficial spectra of light back on to the plants. Similarly, in this experiment, more anthocyanin was synthesized in presence plastic mulch. It is clear that polythene mulch showed significantly better performance in flower production and coloration. Actually black plastic mulches increased the aster production, through faster germination and better root proliferation while checking weed growth, preserving the soil structure, retaining soil moisture and increasing CO_2 contents around the plants. Ratio of different pigment constituents and their concentration define the flower color and intensity. To understand the particular pigment constituent responsible for the vivid flower coloration in both pink and purple group, further chemical analysis is recommended.

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