Anthocyanin content of spray Chrysanthemum cultivars under polyhouse and open field conditions

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Fifteen spray Chrysanthemum cultivars were grown under polyhouse and open field condition during winter seasons of 2004-2005 to estimate anthocyanin in flower tepals of the cultivars. The anthocyanin was estimated (mg/100g of tepals) from freshly harvested flower tepals that were collected at 5 days interval from flower opening to flower colour fading stage. The results indicated that the anthocyanin content of flower tissues of spray chrysanthemum cultivars was non-significantly more in polyhouse condition as compared to open field, whereas those cultivars which produced mostly whitish coloured flower, viz. ‘Sarad Mala’, ‘White Anemone’, ‘Kelvin Brisk’ and ‘Lokenath’ showed more anthocyanin in open field. The cultivars ‘Tata Red’, ‘Red Gold’, ‘Arati’, ‘Apsara Violet’ and ‘Jaya’ has been screened out as high anthocyanin content cultivars and these may be used to exploit for extraction of anthocyanin as organic colour of plant origin.

Keywords: Anthocyanin, Spray Chrysanthemum, Chrysanthemum morifolium, Polyhouse, Open field conditions

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Introduction

Chrysanthemum (Chrysanthemum morifolium Ramat.) belonging to the family Asteraceae is a popular commercial flower as well as pot mum and it ranks second to rose among the top ten cut flowers in the world trade of flower crops¹. Among the two types of chrysanthemum, viz. standard and spray types, the spray chrysanthemums have genetic potentiality to produce numerous numbers of flowers in a plant. The wide variation exhibited by its large number of cultivars in respect to colour and shape of blooms ranks chrysanthemum suitable to exploit for extraction of anthocyanin as a source of colour of plant origin. Red through purple to blue flower colours are all caused by anthocyanins. Anthocyanins are water soluble strong colours and have been used to colour food since historical times. In practice the pure colours are very hard to obtain and most often crude extracts are used as colour for different purpose². The tepals of spray type chrysanthemum cultivars are good source of anthocyanin since those produce large number of flowers in a single plant with wide variations of flower colour. Many experiments on different aspects of chrysanthemum have been undertaken till date but there is lack of information on total anthocyanin content of flower tepals of chrysanthemums in polyhouse and open field.

In view of the above an experiment was undertaken by estimating total anthocyanin in tepals of fifteen spray chrysanthemum cultivars individually growing under polyhouse and open field condition to meet up the following objectives: (i) to estimate the total anthocyanin content and their variation according to cultivars in polyhouse and open field; (ii) to compare polyhouse and open field in respect of anthocyanin content of cultivars; and (iii) to assess the trend of periodical changes in anthocyanin content in tepals of spray chrysanthemum cultivars

Materials and Methods

Plate 1 — Various spray Chrysanthemum cultivars
Soil texture was clay loam having pH 6.8, organic carbon 0.58, total N 156.8 kg/ha, available P_2O_5 50.4 kg/ha and available K_2O 208.5 kg/ha. The experiment was conducted in Factorial Randomized Block Design with three replications. The fifteen cultivars were planted each of them on 30th July in polyhouse and open field separately. Individual plot size was 1 × 1 m and plants were transplanted at spacing 25 × 25 cm. Each plot was received with the recommended dose of fertilizer of N:P:K @ 20:10:10 g/m² and FYM 5 kg/m². All the agronomic practices were followed to raise a good crop. The anthocyanin was estimated according to Thimm-aiah from freshly harvested flower tepals that were collected at 5 days interval from flower opening to flower colour fading stage stated as H₁, H₂, H₃, H₄, H₅ and H₆ indicating first harvesting followed by second, third, fourth, fifth and sixth harvesting of flowers, respectively.

The replicated data on estimated anthocyanin each for polyhouse and open field for the cultivars were subjected to statistical analysis following Panse and Sukhatme.

**Results and Discussion**

The analysis of variance (Table 1) revealed that there were highly significant differences among the anthocyanin content in flower tepals of the cultivars. The perusal of result presented in Table 2 and Figs 1-15 revealed that the anthocyanin content in flower tepals of spray chrysanthemum cultivars were found to be non-significantly higher in polyhouse condition as compare to open field, whereas the cultivars produced mostly whitish coloured flower, viz. ‘Sarad Mala’, ‘Kelvin Brisk’, ‘White Anemone’, ‘Apsara Violet’ and ‘Aditi’ showed more anthocyanin in open field. As indicated in Table 2 the anthocyanin content in flowers of cultivars both in polyhouse and open field condition and their mean varied significantly. The anthocyanin content in tepals of flower was noticed to be significantly maximum in cv. ‘Tata Red’ with records of 19.95, 19.24 and 19.60 mg in polyhouse, open field and their mean, respectively, which was at par with the records of cv. ‘Red Gold’. Whereas significantly lowest amount of anthocyanin in flower tepals was found in cv. ‘Kelvin Brisk’ showing 0.50, 0.56 and 0.53 mg anthocyanin in polyhouse, open field and their mean, respectively.

From the perusal of data regarding maximum anthocyanin content in tepals of the cultivars regardless of the growing conditions in the experiment has been classified into four groups presented accordingly in Table 3.
Fig. 1: Anthocyanin content (mg/100g) of cv. 'Ama1'

Fig. 2: Anthocyanin content (mg/100g) of cv. 'Sarad Maia''

Fig. 3: Anthocyanin content (mg/100g) of cv. 'Kundan'

Fig. 4: Anthocyanin content (mg/100g) of cv. 'Kelvin Victory'

Fig. 5: Anthocyanin content (mg/100g) of cv. 'Nanako'

Fig. 6: Anthocyanin content (mg/100g) of cv. 'Red Gold'

Fig. 7: Anthocyanin content (mg/100g) of cv. 'Kelvin Brisk'

Fig. 8: Anthocyanin content (mg/100g) of cv. 'Tata Red'
Figs 1-15—Changes in anthocyanin content (mg/100g of tepals) of different spray chrysanthemum cultivars grown under polyshade and open field condition.
noticed maximum anthocyanin in tepals after 15 days of flower opening in polyhouse condition, whereas the cultivars ‘Sarad Mala’, ‘White Anemone’ and ‘Aditi’ recorded more anthocyanin during 10 days after opening of flower in open field condition. The three cultivars ‘Kelvin Brisk’, ‘Nanako’ and ‘Lokenath’ among the fifteen showed maximum anthocyanin in their flower tepals at different period, viz. 10, 20 and 25 days after opening of flower, respectively both in polyhouse and open field condition. In cv. ‘Apsara Violet’ the anthocyanin concentration was apparently higher in open field as compare to polyhouse. The anthocyanin content in that cultivar was found to increase gradually from the flower opening to onwards 15 days and thereafter that was declined. The same was observed in cv. ‘Lokenath’ in which anthocyanin was noticed to start increase apparently more in open field compare to polyhouse from flower opening and that rise gradually up to next 25 days and then declined sharply. There were a number of cultivars ‘Sarad Mala’, ‘Red Gold’, ‘Kelvin Brisk’, ‘Jaya’, ‘Yellow Anemone’, ‘White Anemone’ and ‘Aditi’ showed to produce initially more anthocyanin just from flower opening to next 10 days onwards apparently in open field than polyhouse but that declined thereafter more rapidly in open field as compared to polyhouse. A similar observation was noticed in cv. ‘Nanako’ in which anthocyanin concentration in tepals was found to increase for longer time up to 15 days after flower opening. In general regardless of growing conditions the anthocyanin content in flower tepals in most of the cultivars were found to increase up to the first 15 days after flower opening and then decreased gradually up to flower colour fading stage. This may be due to the reason of genetic make up of the cultivars and also to some extent due to the effect of the weather variables like thermal regime and diurnal variations during the crop growing cycle.

Regardless of the cultivars and growing environment it was observed that the resolution of colour of flower looked maximum when anthocyanin concentration in tepal was maximum. Thereafter, during declination of anthocyanin in tepals the overall colour of flower faded gradually from original colour to purplish then bluish and lastly senescent white. The total discoloration of flower was found to coincide with the lowest anthocyanin concentration in flower tepals. This may also be due to changes in pH of sap of flower tepals as anthocyanin is strongly water soluble colour and are strongly pH dependent, when the acidity changes, the colour changes\(^5\). Delgado-Vargas and Paredes-Lopez\(^6\) reported that many anthocyanins are red at acidic conditions and turn purple to blue at less acidic to alkaline conditions.

**Conclusion**

The anthocyanin content in flower tepals of spray chrysanthemum cultivars were found non-significantly higher in polyhouse condition as compared to open field, whereas the cultivars produced mostly whitish coloured flower, viz. ‘Sarad Mala’, ‘Kelvin Brisk’, ‘White Anemone’, ‘Apsara Violet’ and ‘Aditi’ showed more anthocyanin content in open field than polyhouse. The variation in anthocyanin content of flowers tepals of cultivars was found statistically significant both in polyhouse and open field conditions. The cultivars ‘Tata Red’, ‘Red Gold’, ‘Arati’, ‘Apsara Violet’ and ‘Jaya’ has been screened out as high anthocyanin content cultivars and may be used to exploit for extraction of anthocyanin as organic colour of plant origin. Regardless of growing conditions the anthocyanin contents of flower tepals of different cultivars were in increasing trend during the first 15 days of flower opening and thereafter decreased gradually up to fading of flower colour mostly 25-30 days after flowering according to the varieties, except cultivars ‘Nanako’, ‘Kelvin Brisk’ and ‘Lokenath’.

**References**


4 Panse VG and Sukhatme PV, Statistical Methods for Agricultural Workers, Indian Council of Agricultural Research, New Delhi, India, 1967.
