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Application of Benzyladenine on quality production and post-harvest life of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda

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Abstract
Flower is the integrated part of human life but among of the others flowers, it is very common and highly valuable in our society. Marigold belong to asteraceae or composite family and it has several species but, six species are most popular such as; *Tagetes etecta, Tagetes patula, Tagetes lucida, Tagetes tenuifolia, Tagetes lemmonii, Tagetes minuta.* Marigold has several purpose uses that are; garden decoration, pot decoration, ritual and workshop, poultry feed preparation, organic colour preparation, Ayurvedic medicinal and carotenoid extraction. Growth regulator (Benzyl adenine) has tremendous potential power for quality flower production with increase post-harvest life. The highest canopy temperature was taken from T_8 (22.76 °C) and minimum canopy temperature was taken from T_{13} (16.12 °C). T_5 (52.42 mg) treatment was content maximum chlorophyll and T_2 (44.21 mg) treatment was content minimum chlorophyll in marigold leaf. Highest Numbers of flowers was taken from T_2 (44.13 days) and lowest T_6 (32.80 days) treatment. Diameter of the flowers and ten flowers weight was maximum from T_7 (7.25 cm), T_7 (87.42 cm) treatment. Maximum Post-harvest life with distilled water condition and Post-harvest life with ambient condition was taken from T_1 (6 days) and another also T_1 (3.67 days). Maximum Post-harvest life with refrigerator was taken from T_8 (13 days). Highest B: C was taken from T_1 (3.19) treatment and lowest from T_{10} (1.7).

Keywords: Marigold, benzyl adenine, post-harvest life, B: C ratio

Introduction
Marigold is the important and most valuable loose flower crop in India (Kumar *et al*., 2015) [6] but, *terai* region of West Bengal it basically grown as winter annual flowers. It is easy to cultivate and has wide adaptability with increasing demand in National and International market (Ahmad *et al.,* 2011) [1]. Marigolds belong to the genus-"*Tagetes*", which was derived from the Greek word "Tages", the name of Estrucsch God, a demigod, known for beauty. Portuguese first discovered Marigold during 16th century in Central America (Gawle *et al.*, 2012) [4]. They first introduced marigold flowers from America to Europe and India (Komalpreet and Ramninder, 2013) [5]. Marigold belongs to asteraceae or composite family (Panero and Funk, 2002). It is one of the most important commercial flower crops grown all over the world and in India as well, accounting for more than half of the Nation's loose flower production (Raghava, 2000) [8]. Marigolds include 28 genera and approximately 216 species comprising the genus "*Tagetes*" (Barkley *et al.*, 2006) [3]. The genus *Tagetes* has 56 species but among them 27 are annual and 29 are perennial, distributed throughout the world (Soule, 1993a, and Soule 1993b). Some important species of marigold commercially cultivated in India are African marigold (*Tagetes erecta*), French marigold (*Tagetes patula*), sweet scented marigold (*Tagetes lucida*), signet marigold (*Tagetes tenuifolia*), shrubby marigold (*Tagetes lemmonii*) and wild marigold (*Tagetes minuta*).
Nowadays, marigold has huge demand throughout the world. Marigold has multifarious uses in our daily life and currently it is commercially used in ayurvedic medicine preparation. If applied various technology so, increase of flowers yield and easily fulfill of the demand in market. Plant growth regulator is important substance to increase of flowers quality and quantity. Plant growth regulator has several types such as Auxin, Gibberelline, Cytokinin, ethylene and abscisic acid. Duhamal du Monceau in 1788 first opined the development of hormone concept in plants but in 1893 Julius Von Sachs proposed the mechanism of organ formation in plants through first theory of substances which we now called as hormones which derived from Greek word and meaning set in motion (Anon 2013) [2].
Basically Nature plant hormone secretion very low amount so, need artificially application of

this hormone for increase of yield and fulfill our demand. Zeatin and benzyl adenine both are derived from the phyto hormone cytokinin. Without cytokinin hormone, any other hormone had various research works, so it has vast scope for observing new findings under marigold field.

Materials and Methods

The present research work entitled "Application of Benzyladenine on quality production and Post-harvest life of African Marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda" was conducted under the Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar, West Bengal, during the year 2016-17. Geographically the farm is situated at an elevation of 43 meter above the mean sea level at 26° 19'86" N latitude and 89°23'53" E longitude. According to my research work, i have taken twelve different concentration dose which was T_1 = BA @ 25 ppm, T_2 = BA @5 0 ppm, T_3 = BA@75 ppm, T_4=BA @ 100 ppm, T_5=BA @ 125 pm, T_6 = BA @ 150 ppm, T_7 = BA @ 175 ppm, T_8 = BA @ 200 ppm, T_9 = BA@ 225 ppm, T_{10} = BA @ 250 ppm, T_{11} = BA @ 275 ppm, T_{12}=BA @ 300 ppm, T_{13} = Control (Distilled water).

Twelve different concentrations of benzyl adenine were the deciding factors of this experiment. The required amount of ingredient (BA) was calculated, weighed and measured in laboratory using the formula-ppm = mg/lit &1% = 10000 ppm PGR was weighed as per requirement using a Metler Toledo digital balance. Basically BA was dissolved in 0.1(N) sodium hydroxide (NaOH) or hydrochloric acid (HCl). Initially BA was dissolved by adding the base or acid drop wise and after completion the volume was made up to 1 liter by adding distilled water. Fresh PGR solutions were thoroughly sprayed at 21 and 42 days after transplanting. Control plants were sprayed with distilled water at the same time.

Results and Discussion

Maximum canopy temperature at 21 days after transplanting (°C)

Different concentrations of exogenous application of BA on maximum canopy temperature of African marigold cv. Pusa Narangi Gainda at 21 days after transplanting was found statistically significant. Application of 200 ppm BA on marigold plants gave the highest canopy temperature (22.76 °C) followed by 150 ppm BA application (21.33 °C) which was found at par with application of 175 ppm BA (21.30 6C) and 50 ppm BA (20.75 °C). All the plant growth regulator applications (Table & figure-1) showed higher canopy temperature than control (16.12 °C) recoded the least maximum canopy temperature.

Minimum canopy temperature at 21 days after transplanting (°C)

Foliar application of different doses of BA on minimum canopy temperature of African marigold cv. Pusa Narangi Gainda at 21 days after transplanting was noticed statistically significant. The minimum canopy temperature was recorded highest in the 200 ppm BA treatment (22.12 °C) which was statistically at par with the foliar application of 175 ppm BA (20.81 °C). The moderately performing treatment was 150 ppm BA application (20.33 °C) and was found to be statistically a par with 50ppm (19.73^{0}C), 100 ppm (19.62 °C), 125ppm (19.37 °C), 250 ppm (19.07 °C) and 25 ppm (19.03 °C) BA treated marigold plants. All the BA treatments showed higher minimum canopy temperature over control. The minimum canopy temperature (Table & figure-1) was found lowest with control plants (15.01 °C).

Leaf chlorophyll content (SPAD)

Foliar application of different doses of BA treatments on African Marigold cv. Pusa Narangi Gainda showed statistically significant effects regarding leaf chlorophyll content (Table -4.4). Plants treated with 125ppm BA was found as the best in terms of leaf chlorophyll content (52.42 SPAD) which was found statistically at par with the treatments *viz*., 150 ppm (52.14 SPAD), 75 ppm (50.67 SPAD), 300 ppm (50.02 SPAD), 250 ppm (49.56 SPAD), 100 ppm (48.75) BA applications as well as control Plants (49.95 SPAD). The least leaf chlorophyll was recorded with 50ppm BA treated plants (44.21 SPAD), as expressed in Table 1 & Fig 1.

Table 1: Effect of different concentrations of BA on maximum canopy temperature and minimum canopy temperature at 21 days after transplanting and leaf chlorophyll content of African Marigold cv. Pusa Narangi Gainda

Treatments	Maximum canopy temperature at 21 days after transplanting (°C)	Minimum canopy temperature at 42 days after transplanting (°C)	Leaf Chlorophyll Content (SPAD)
T_1	19.74	19.03	46.74
T_2	20.75	19.73	44.21
T_3	20.04	18.95	50.67
T_4	20.64	19.62	48.75
T_5	20.29	19.37	52.42
T_6	21.33	20.33	52.14
T_7	21.30	20.81	46.93
T_8	22.76	22.12	45.80
T_9	19.54	18.54	44.85
T_{10}	19.99	19.07	49.56
T_{11}	19.39	18.53	46.95
T_{12}	20.01	18.91	50.02
T_{13}	16.12	15.01	49.95
S. Em (±)	*0.30*	*0.46*	*1.28*
C. D. at 5%	0.61	1.32	3.74

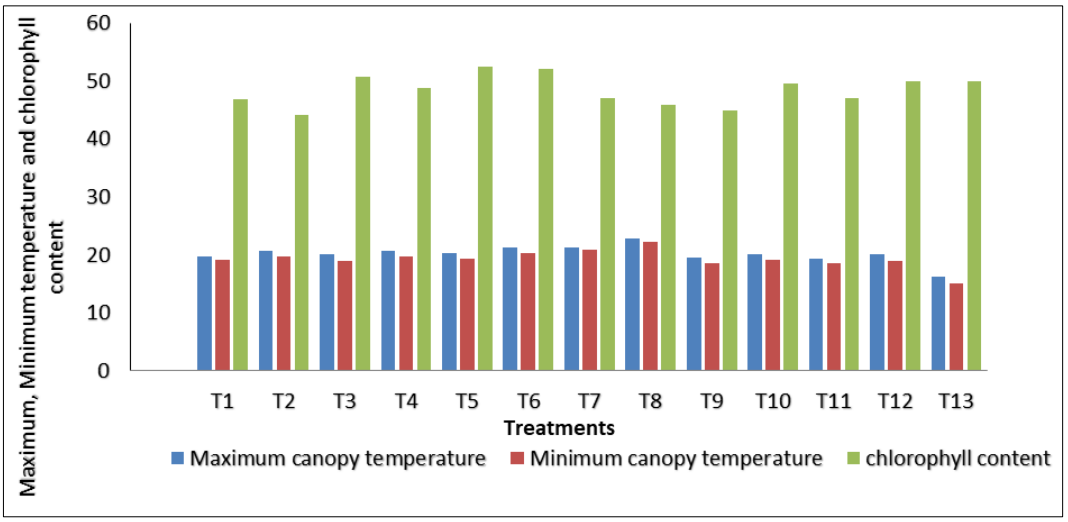

Fig 1: Effect of different concentrations of BA on maximum and minimum canopy temperature and leaf chlorophyll content of African marigold cv. Pusa Narangi Gainda

Number of flowers per plant

The effect of different concentrations of BA on floriferousness of African marigold cv. Pusa Narangi Gainda was found statistically significant. The highest number of flowers per plant was obtained from 50 ppm BA application (44.13) which was statistically at par with 275 ppm (43.80), 125 ppm (42.26) and 25 ppm (41.87) BA applications. Next improved performers were 175 ppm (40.60) and 100 ppm (40.47) BA treated plants. Control plants produced 37.40 numbers of flowers per plants which was found on par with 75 ppm (37.93) and 200 ppm (39.46) BA applications. Plants treated with 150 ppm BA solution produced the minimum number of flowers (32.80) per plant (table & figure-2).

Diameter of flower (cm)

Application of different concentrations of BA on African Marigold cv. Pusa Narangi Gainda was found statistically significant in respect of diameter of flowers. The maximum diameter of flowers was recorded from the 175 ppm BA treated plants (7.25 cm) which was observed statistically at par with 125 ppm (7.08 cm), 150ppm (7.07 cm), 100 ppm (7.05 cm) and 25 ppm (7.04 cm) BA applications. All the plant growth regulator applications showed larger flower diameter than control (6.61 cm) except 50 ppm and 250 ppm BA applications out of which 50 ppm BA treated plants showed (Table & figure-2) the least flower diameter (6.48 cm).

Fresh weight of 10 flowers (g)

The effect of different concentrations of BA on fresh weight of 10 flowers of African Marigold cv. Pusa Narangi Gainda was found statistically significant. The maximum fresh weight of 10 flowers (87.42 g) was obtained from 175 ppm BA treated plants followed by 150 ppm BA application (75.34 g) and 100 ppm BA application (71.32 g) which was found statistically at par with 125 ppm (71.29 g), 25 ppm (70.74 g) and 275 ppm (69.96 g) BA applications. Moderate performances were shown by 200 ppm (69.02 g), 75 ppm (67.52 g) and 300ppm (66.84 g) BA applications and control (distilled water treated) plants (66.01 g). Minimum fresh weight of ten flowers was (Table & figure-2) obtained from 50 ppm BA application (58.36 g).

Table 2: Effect of different concentrations of BA in number of flowers per plant, diameter of flowers and fresh weight of 10 flowers of African marigold cv. Pusa Narangi Gainda

Treatments	Number of flowers per plant	Diameter of flowers (cm)	Fresh weight of 10 flowers(g)
T_1	41.87	7.04	70.74
T_2	44.13	6.48	58.36
T_3	37.93	6.78	67.52
T_4	40.47	7.05	71.32
T_5	42.26	7.08	71.29
T_6	32.80	7.07	75.34
T_7	40.60	7.25	87.42
T_8	39.46	6.89	69.02
T_9	35.86	6.83	61.21
T_{10}	36	6.57	65.63
T_{11}	43.80	6.82	69.96
T_{12}	38.53	6.68	66.84
T_{13}	37.40	6.61	66.01
S. Em (±)	0.90	0.08	0.60
C. D. at 5%	2.64	0.22	1.74

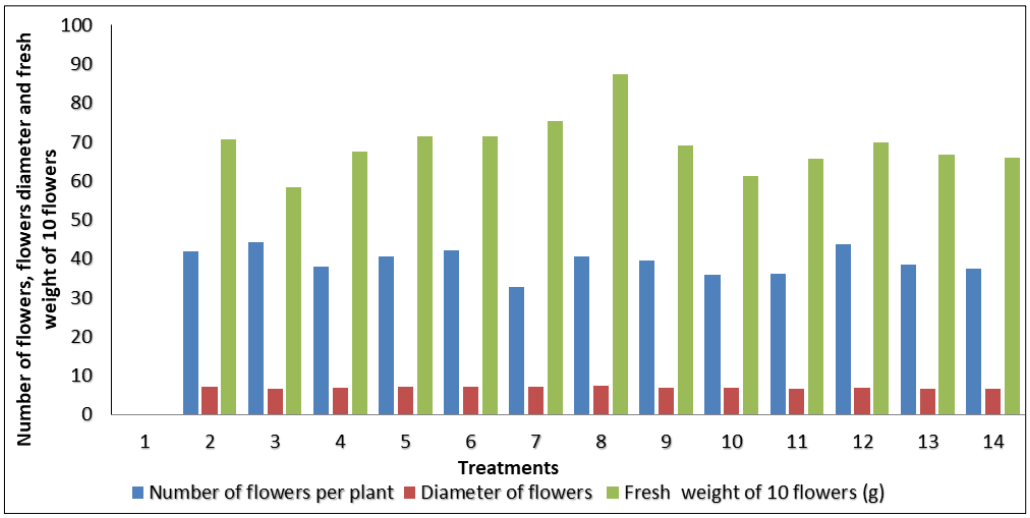

Fig 2: Effect of different concentrations of BA on number of flowers per plant, flower diameter and fresh weight of 10 flowers of African Marigold cv. Pusa Narangi Gainda

Post-harvest life of cut flowers in distilled water (days)

All the cytokinin applications proved beneficial in respect of post-harvest life of cut flowers of African marigold cv. Pusa Narangi Gainda. Flowers generated from 25 ppm BA treated plants showed maximum days of post-harvest life (6 days) which was statistically at par with 200 ppm BA application (5 days). The minimum days of post-harvest life of flowers was obtained (Table-3 & figure-3.1) from control plants (3 days) which was found statistically at par with 250 ppm (3.3 days), 225 ppm (4 days), 175 ppm (4 days), 100 ppm (4 days) and 75 ppm (4 days) BA applications.

Post-harvest life of loose flowers in ambient condition (days)

Cytokinin proved useful in respect of post-harvest life of loose flowers of African Marigold in ambient condition. All the 12 different levels of BA showed higher statistically significant days of post-harvest life as compared to control plants recorded the minimum days (2.00). Application of 25 ppm BA on African Marigold resulted the maximum days of post-harvest life (3.67 days) which was found statistically at par with 150 ppm BA application (3.33 days) and the later was (Table-3 & figure-3.1) found on par with the rest of the BA treatments showing similar result (3.00 days).

Post-harvest life of loose flowers in refrigerator (days)

Foliar application of different concentrations of BA on post-harvest life of loose flowers of African marigold cv. Pusa Narangi Gainda in freezing condition was found statistically significant. Plants treated with 200ppm BA solution resulted the maximum post-harvest life (13.00 days) which was found statistically at par with 225 ppm (11.33 days), 150 ppm (11.33 days) and 175 ppm (10.66 days) BA applications. All the levels of plant growth regulators showed higher post-harvest life than control (table-3 & figure-3.1) recorded the least days of post-harvest life period (8.33 days).

Carotenoid content of flowers (mg/1000g)

Significant difference was observed in respect of carotenoids biosynthesis in flowers of African marigold as influenced by exogenous BA application. All the levels of plant growth regulator application were proved effective in this regard. Plants treated with 200ppm BA solution showed increased synthesis of carotenoids in flowers (373.99 mg/1000 g) which was statistically at par with 175 ppm BA application (368.56 mg/1000 g).The least amount of total. Carotenoids in African marigold flowers were observed with control plants (150.80 mg/1000 g), as depicted in table-3 & figure-3.2.

Table 3: Effects of different concentrations of BA on post-harvest life of cut flower in distilled water, loose flowers in ambient condition and refrigerator, carotenoids content of flowers and B: C ratio of African marigold cv. Pusa Narangi Gainda

Treatments	Post-harvest life of cut flowers in distilled water (days)	Post-harvest life of loose flowers in ambient (days)	Post-harvest life of loose flowers in refrigerator (days)	Carotenoid content of flowers (mg/1000 g)	B:C Ratio
T_1	6	3.67	8.67	192.42	3.19
T_2	4.67	3.00	9.33	355.89	2.63
T_3	4	3.00	9.00	223.19	2.49
T_4	4	3.00	10.00	193.03	2.67
T_5	4.67	3.00	9.33	372.18	2.66
T_6	4.67	3.33	11.33	364.94	2.09
T_7	4	3.00	10.66	368.56	2.87
T_8	5	3.00	13.00	373.99	2.12
T_9	4	3.00	11.33	214.14	1.64
T_{10}	3.33	3.00	10.00	235.86	1.7
T_{11}	4.67	3.00	9.33	190.61	2.13
T_{12}	4.33	3.00	9.67	202.08	1.73
T_{13}	3	2.00	8.33	150.80	2.82
S. Em (±)	0.37	0.21	0.85	3.01	0.07
C. D. at 5%	1.07	0.61	2.49	8.77	0.21

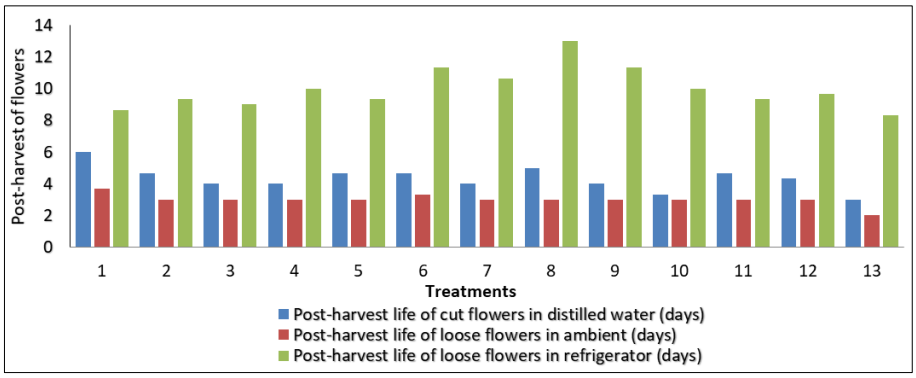

Fig 3: Effect of different concentrations of BA on post-harvest life of cut flowers in distilled water and loose flower in ambient and freezing condition of African Marigold cv. Pusa Narangi Gainda

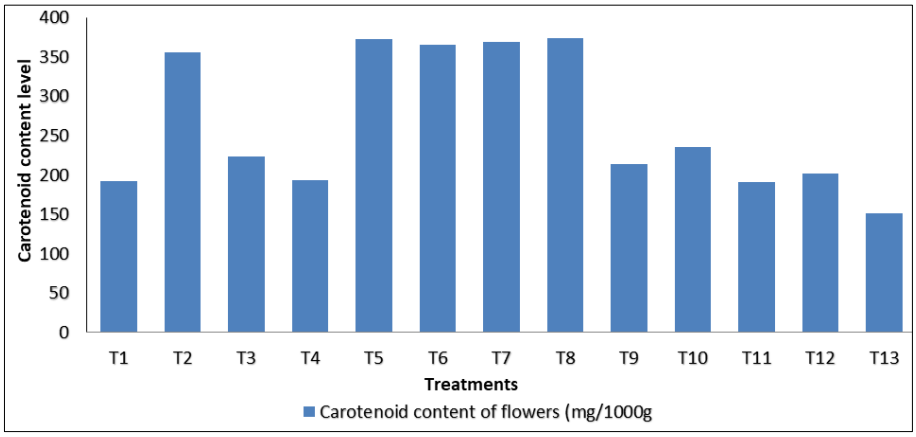

Fig 4: Effect of different concentrations of BA on carotenoids content of flowers of African marigold cv. Pusa Narangi Gainda

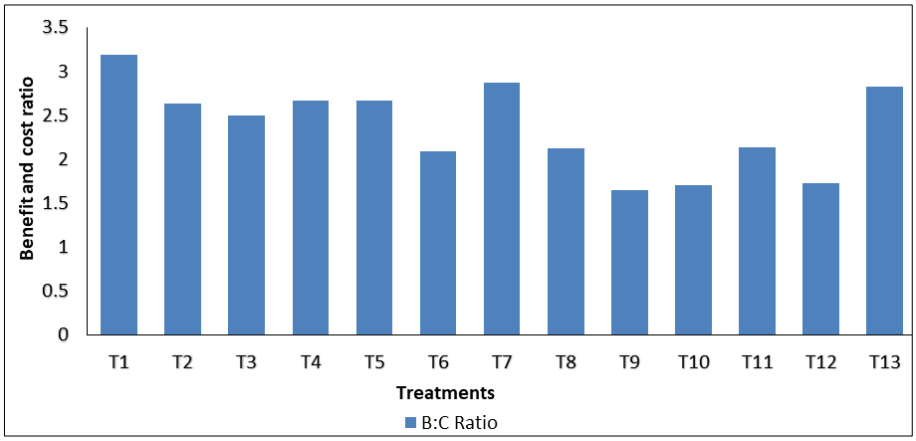

Fig 5: Effect of different concentrations of BA on benefit and cost ratio of African marigold cv. Pusa Narangi Gainda

B:C ratio of yield

The benefit: cost ratio of African marigold cultivation as influenced by the exogenous cytokinin application through foliar spray was found statistically significant. The value of ratio is derived by dividing the total return with total cost, hence, the wider value indicates a higher net return and a lesser value indicates a lower net return. Results revealed that foliar application of 25 ppm BA showed the highest B:C ratio (3.19) followed by 175 ppm BA application (2.87) which was statistically at par with control (2.82), 125 ppm BA application (2.66) and 100 ppm BA application (2.67). Rest of the treatments showed lesser B:C ratio over control out of which 225 ppm BA application recorded the least value (1.64) which was found statistically at par with 250 ppm BA application (1.70) and 300 ppm BA application (1.73), as described in table-3 & figure-3.3.

References

1. Ahmad I, Asif M, Amjad A, Ahmad S. Fertilization enhances growth, yield, and Xanthophyll contents of marigold. Turkey Journal of Agriculture. 2011;35:641-648
2. Anonymous; c2013. http://en.wikipedia.org/wiki/plant hormone (retrieved on 20.06.2017)
3. Barkley TM, Brouillet L, Strother JL. Asteraceae Martinov. Flora of North America north of Mexico. Oxford University Press, New York. 2006;21:459-553
4. Gowle SK, Chaturvedi MK, Yadaw KN. Adoption

pattern of improved marigold production technologies by the farmers in Bilaspur district of chhattishgar. Agriculture update. 2012;7(3/4):324-329.
5. Komalpreet K, Ramninder K. Marigold: Beyond Beauty and Décor. American Journal of Phyto medicine and Clinical Therapeutics. 2013;5:480-485.
6. Kumar S, Srinivasa V, Praneeth SY, Jayasheela, SD, Gokavavi N. Evoluation of marigold (*Tagetes erecta* l.) genotypes for growth, yield and quality under hill zone of Karnataka. Ecology, Environment and Conservation Paper. 2015;21:1743-1747.
7. Panero JL, Funk VA. Toward a phylogenetic subfamilial classification for the Compositae (Asteraceae). Proceedings of the Biological Society of Washington. 2002;115(4):909-922
8. Raghava SPS. Marigold versatile crop with golden harvest. Floriculture Today. 2000;4(11):40-41.
9. Soule JA. Tagetes minuta: A potential new herb from South America. In: J. Janick and J.E. Simon (eds.), new crops. Wiley, New York; c1993a. p. 649-654.
10. Soule JA. Systematics of Tagetes (Asteraceae-Tageteae). Unpublished Ph.D thesis; c1993b. p. 89-91.