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Evaluation of African Marigold (*Tagetes erecta* L.) Varieties for Flower Yield and Xanthophyll Content

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A B S T R A C T

A field experiment was carried out at Jambuwadi Farm, Department of Horticulture, Junagadh Agricultural University, Junagadh in winter season during 2015. Ten varieties of afican marigold were evaluated. The experiment was conducted in RBD with three replications. There were significant differences among the varieties with respect to flower yield attributes and xanthophyll content yield. The result revealed that variety Ashwini recorded maximum weight of 10 flowers (63.60 g) and flower yield per plant (379.65 g). However, maximum number of flowers per plant (68.53) and flower yield per hectare (14.05 t ha^{-1}) were recorded in Suvarna which was at par with Ashwini. Marigold Yellow registered maximum petal meal yield per kilogram fresh flowers (122.00 g) and petal meal yield per hectare (23.99 q) followed by Ashwini. Besides the above, Pusa Narangi Gainda was observed superior in xanthophyll content (17.36 mg/g petal meal) followed by Suvarna under south Saurastra region.

Introduction

The African marigold is a hardy annual plant, grows up to one meter and above, bears single or fully double, large sized globular heads of yellow, orange and white shades, whereas, the French marigold is dwarf and grows up to 20-60 cm height, bears small, yellow-golden or orange or tinged red flowers. Both the species are exploited as a source of xanthophyll pigments. Marigold can be cultivated easily and their petals are the most concentrated source of xanthophyll, can be extracted either from fresh or after having pressed in silose, to remove water. The resulting cake is dried pelletized and extracted with hexane.

In India, the present area under marigold cultivation is 19,600 ha with a production of 2, 00,000 metric tonnes. It is cultivated commercially in most parts of India (Naik, 2003). Karnataka alone has 3000 ha under its cultivation for xanthophyll extraction. Presently, in our country the commercial extraction of marigold carotenoids is done in Cochin (Kerala), Hyderabad, near Satyamangalam forest (Tamil

Nadu) and Telagi near Harihar and Bangalore (Karnataka), it is being regularly exported to Mexico, Peru, USA, Japan, Spain, Romania, Netherlands, Turkey, Poland, Italy, Australia, Canada, Africa *etc*. Therefore, large area in Karnataka, Andhra Pradesh and Maharashtra are under contract farming of marigold for xanthophyll extraction.

Recently marigolds are grown commercially for extraction of carotene pigments mainly xanthophyll. The carotene extracted from petals are added to poultry feed for intensification of yellow colour of egg yolk (Bird, 1996). Supplementation of poultry feed with marigold pigments helps to improve colour of ornamental fishes as well as fish fillet (Boonyaralpalin, 1989). Lutein which is a major constituent of xanthophyll is used for colouring food stuffs, purified extracts of marigold petals containing lutein di-palmitate is marketed as an ophthalmologic agent under the name adaptinol (Singh, 2006). Dietary carotenoids can be used to treat cancer and photosensitivity diseases. Lutein and zeaxanthin obtained from the marigold petals are the key carotenoids in human physiology.

Materials and Methods

Plant material

All marigold varieties were obtained from different sources like IARI (New Delhi), Keyonic seeds, Biocarve seeds, Namdhari seeds, yelahanka seeds (Bangalore) and Suttind seeds (Gujrat) and are grown in Jambuvadi Farm, Department of Horticulture, College of Agricultural University, Junagadh during the August, 2015 to February, 2016. Flower yield and xanthophyll content in all the varieties are different. For consider above factor, the trial was conducted to fulfil the following objective.

The experiment was laid out in a Randomized Block Design (RBD) with three replications. The treatments in each replication were allotted randomly. This experiment having ten varieties *viz.*, Marigold Yellow (V_1), Hawaii Orange (V_2), Double Orange (V_3), Ashwini (V_4), Semi Dwarf Yellow (V_5), Suvarna (V_6), Bhuvana (V_7), Pusa Narangi Gainda (V_8), Local Variety (V_9) and Pusa Basanti Gainda (V_{10}). These varieties are raised according to the package of practices like land preparation, fertilizer application, transplating, weeding, plant protection etc. The observations were recorded on important yield parameters and xanthophylls content. Petal meal yield per kilogram of flower is calculated by taking one kilogram of fresh flower variety wise at peak flowering stage and kept for shade drying.

Results and Discussion

Flower yield attributes

The weight of 10 flowers was found maximum (63.60 g) in variety Ashwini but was at par with Marigold Yellow (61.47 g) and Pusa Basanti Gainda (60.34 g). However, minimum weight of 10 flowers (30.07g) was registered in variety Hawaii Orange followed by Semi Dwarf Yellow (35.46 g).

This variation in flower weight among the varieties might be attributed to the higher water and carbohydrates level in the flower and also might be due to their genetic makeup.

Water plays a very important role to maintain flower turgidity, freshness and petal orientation. Similar results were observed by Mathad (2003); Verma *et al.*, (2002); Singh and Misra (2008); Rao *et al.*, (2005) in marigold; Dhahiya *et al.*, (2003) in chrysanthemum and Singh *et al.*, (2001) and Singh *et al.*, (2003) in carnation. Significantly maximum number of flowers (68.53) was recorded in the variety Suvarna but was at par with Ashwini (59.40). Similarly, minimum (20.60) was registered in Hawaii Orange. The number of flowers per plant may be directly related to vigour of genotypes or varieties for the production of more plant height, number of leaves, plant spread, number of branches, there by synthesis of more photosynthates result in production of good number of buds on the branches.

Table.1 Flower yield attributes and xanthophyll yield of different marigold varieties.

Name of varieties	Weight of 10 flowers	Flower yield per plant	Number of flowers per plant	Flower yield per hectare	Petal meal yield (g/kg)	Petal meal yield (q/ha)	Xanthophyll content (mg/g)
V_1	61.47	323.76	52.67	12.03	122.00	23.99	0.82
V_2	30.07	61.90	20.60	1.13	62.00	11.59	1.25
V_3	53.67	254.39	47.40	9.44	103.67	13.80	12.00
V_4	63.60	379.65	59.40	13.96	109.67	19.49	0.86
V_5	35.46	158.87	44.80	5.79	70.67	10.73	1.30
V_6	55.31	379.03	68.53	14.05	80.00	7.73	14.32
V_7	50.20	229.56	45.73	8.54	74.67	7.87	8.43
V_8	58.67	238.96	40.73	8.86	75.67	9.06	17.36
V_9	52.00	291.86	56.13	10.50	83.33	9.73	13.57
V_{10}	60.34	289.63	48.00	10.77	99.34	15.73	1.92
S.Em ±	1.62	11.21	3.09	0.69	1.54	0.71	0.359
CD @ 5%	4.82	33.31	9.20	2.05	4.57	2.13	1.066
CV	5.40	7.45	11.09	12.58	3.03	9.56	8.65

V_1- Marigold Yellow, V_2- Hawaii Orange, V_3- Double Orange, V_4 -Ashwini, V_5- Semi Dwarf Yellow, V_6 – Suvarna, V_7-Bhuvana, V_8- Pusa Narangi Gainda, V_9- Local Variety, V_{10}- Pusa Basanti Gainda

Fig.1 Petal meal yield (g/kg), Petal meal yield (q/ha) and flower yield (t/ha) in different varieties of marigold

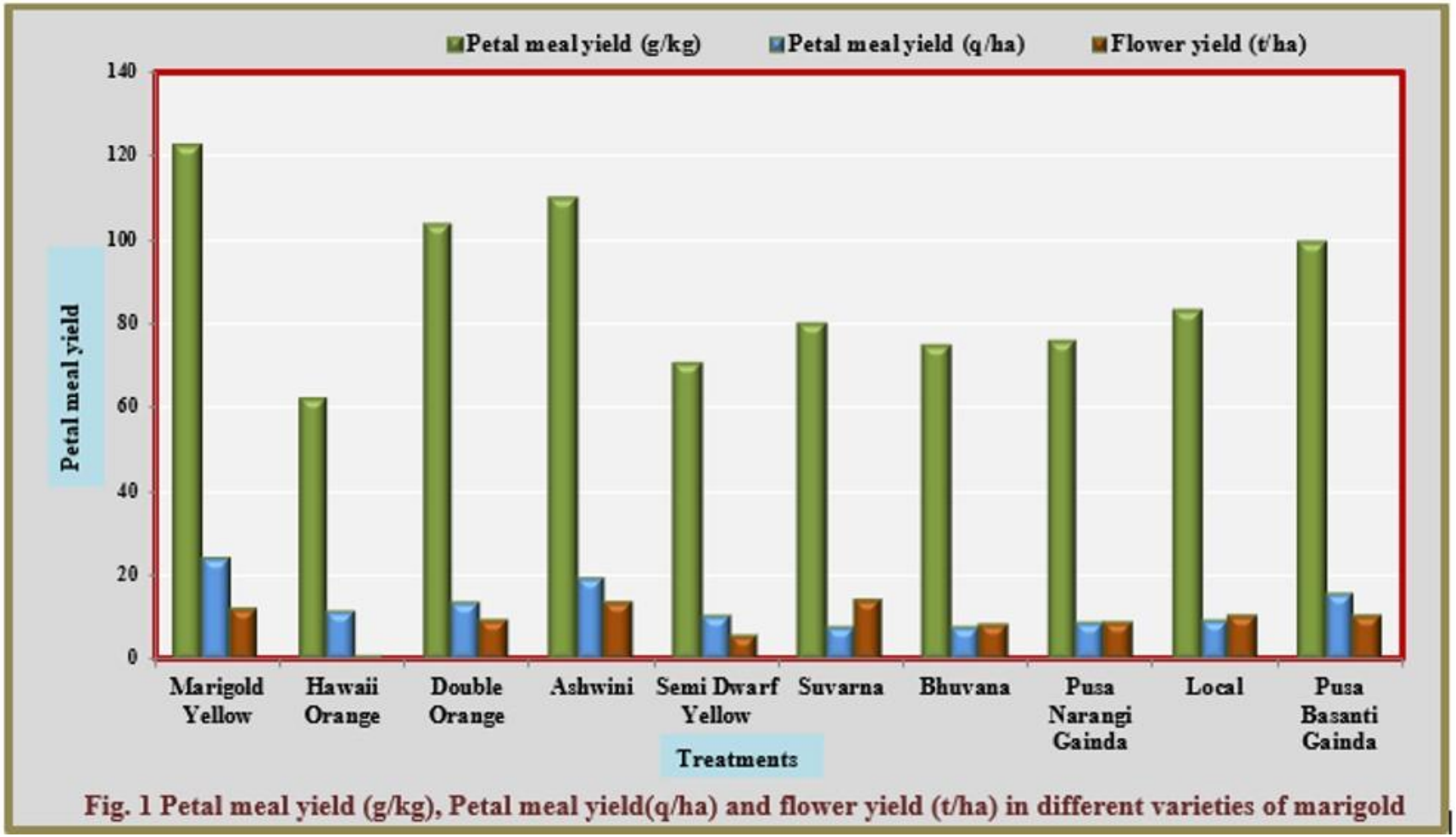
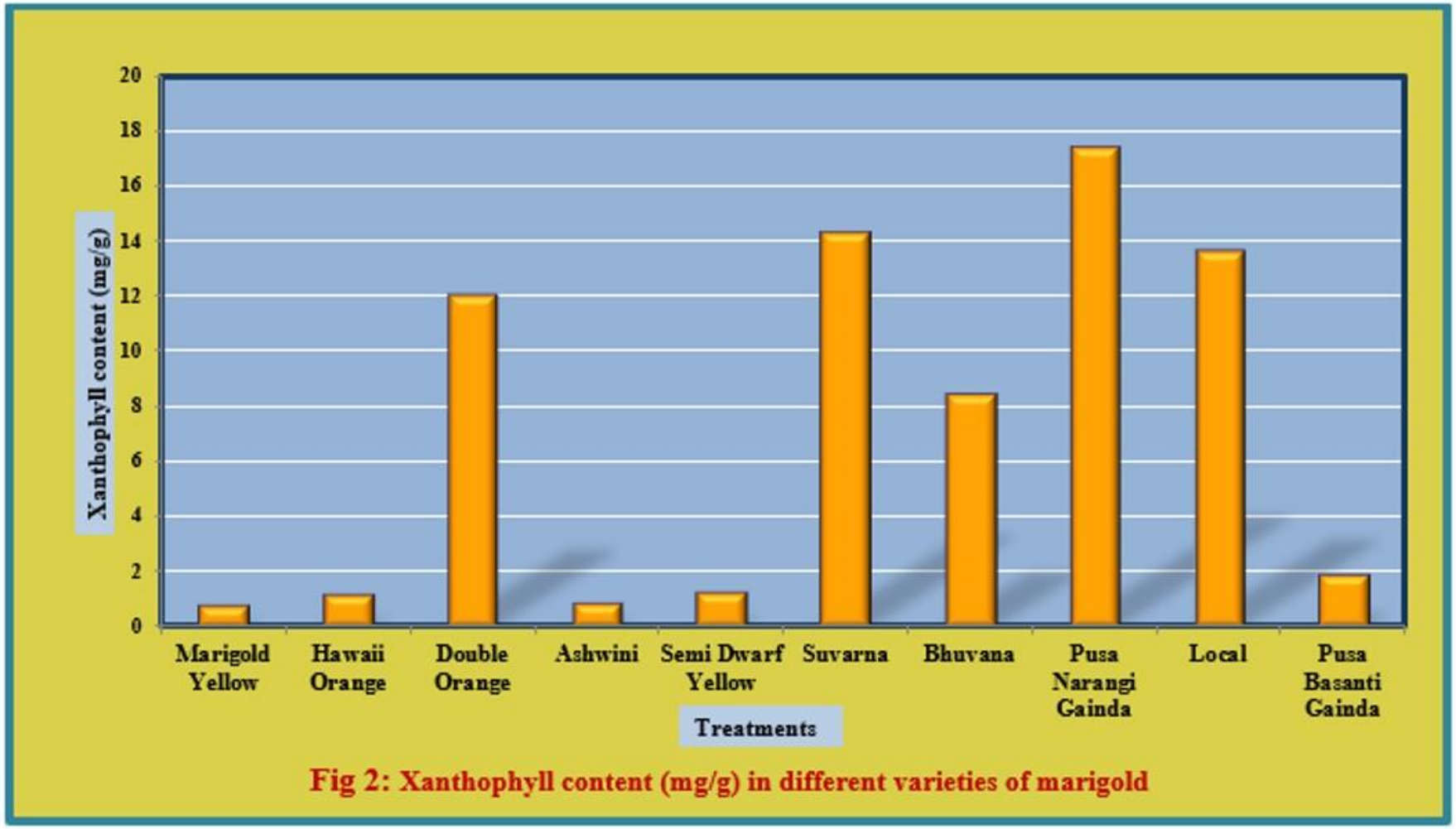


Fig. 1 Petal meal yield (g/kg), Petal meal yield(q/ha) and flower yield (t/ha) in different varieties of marigold

Fig.2 Xanthophyll content (mg/g) in different varieties of marigold



Similar results were reported by Patil *et al.,* (2011) and Naik *et al.,* (2005) in marigold. The flower yield per plant was also registered maximum (379.65 g) in Ashwini but was found at par with Suvarna (379.03 g). Similarly, lowest flower yield per plant (61.90 g) was obtained in variety Hawaii Orange. With the increase in number of flowers per plant, the yield per plant too increases. These results are in conformity with the results reported earlier by Bhanupratap *et al.,* (1999); Naik *et al.,* (2005); Narsude *et al.,* (2010) and Patil *et al.,* (2011) in marigold.

Maximum flower yield per hectare (14.05 t ha^{-1}) was recorded maximum in the variety Suvarna but was found at par with Ashwini (13.96 t ha^{-1}) and Marigold Yellow (12.03 t ha^{-1}). While the lowest flower yield (1.13 t ha^{-1}) was noticed in the variety Hawaii Orange. Similar results were observed by Singh and Kumar (2008); Narsude *et al.,* (2010); Raghuvanshi and Sharma (2011) in marigold.

Xanthophyll yield and its attributes

Significant differences were also recorded for petal meal yield and maximum petal meal yield per kilogram of fresh flowers and Petal meal yield per hectare (q) was recorded in Marigold Yellow (122.00 g and 23.99 q, respectively) followed by Ashwini (109.67 g and 19.49 q, respectively). Likewise, lowest (62.00 g and 11.59 q, respectively) was registered in Hawaii Orange (Fig 1). Similar results were reported by Anuradha *et al.,* (1990) and Naik *et al.,* (2005) in marigold and Roelants (1973) in carnation.

The xanthophyll content of flower is most important character and significant variation with respect to xanthophyll content was noticed (Fig 2). There was wider range of xanthophyll content which was 0.82 mg/g petals to 17.37 mg/g petal meal. The flower petals of Pusa Narangi Gainda had the maximum xanthophyll content (17.36 mg/g petal meal) followed by Suvarna (14.32 mg/g petal meal). The lowest xanthophyll content (0.82 mg/g petal meal) was noticed in Marigold Yellow. The xanthophyll content varies with varieties, apart from the genotypic factor, petal meal yield also plays a vital role. Higher the petal meal yield, greater the xanthophyll yield. These findings are parallel to the findings of Ingle *et al.,* (2012); Patil *et al.,* (2011); Chandrashekhara Rao *et al.,* (2005); Anuradha *et al.,* (1990) and Naik *et al.,* (2005) in marigold.

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