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Effect of straight fertilizer and water soluble fertilizer on growth and flowering of African marigold cv. Seracole

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Abstract

The present experiment was conducted to study the effect of different doses of fertilizer on growth and flowering of African marigold (*Tagetes erecta* L. cv. Seracole). The present investigation was carried out under All India Coordinated Research Project on Floriculture, at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India during winter season of the year 2015-16. The experimental results revealed that combination dose of 75% Water Soluble Fertilizer + 25% Straight Fertilizer (T₄) showed maximum stem girth (1.30 cm), duration of flowering (56.67 days), number of flowers per plant (48.00), yield of flower per plant (478.33 g), yield of flower per hectare (358.70 q) and minimum number of days taken to first flower bud appearance (41.67 days). The maximum plant height (35.53 cm) and plant spread (N-S: 39.13 cm and E-W: 49.20 cm) were recorded in 50% Water Soluble Fertilizer + 50% Straight Fertilizer (T₅). The treatment 125% of Water Soluble Fertilizer (T₃) showed maximum number of primary branches/plant (9.33), diameter of flower (7.33 cm) and pedicel length (5.33 cm). The application of T₄ and T₅ were found more effective regarding vegetative and flowering attributes in comparison to individual application of Straight Fertilizer or Water Soluble fertilizer.

Keywords: Straight fertilizer, water soluble fertilizer, African marigold, Seracole, yield

1. Introduction

Marigold 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 nation's loose flower production (Sreekanth *et al.*, 2006) [12]. Marigold belongs to the family *Asteraceae* and genus *Tagetes*, native of Central and South America especially Mexico (Kaplan, 1960) [6]. Successful production of marigold depends on several management factors, amongst which nutrition plays an important role in growth and flowering (Swaroop and Singh, 2007) [13]. Nitrogen is one of the major nutrients which affect the crop performance as it promotes vegetative growth, flowering and seed setting considerably. Recent researchers have shown that addition of nitrogenous fertilizers have increased ability to absorb phosphorus, potassium and calcium and cation exchange capacity of plant roots. To a great extent the production of flowers of seasonal flowering plants depend on phosphorus supply too. If phosphorus is not present in the requisite amount in the soil, nitrogen or other mineral cannot help the plant to grow properly. Plants with excess of potassium cause dark green leaves and suppressed plant growth, it may also decrease flower production. Due to these reasons it is essential to search out the adequate dose of Potassium for raising marigold crop satisfactorily. Keeping this in view, the present investigation was carried out to study the effect of different doses of fertilizer on growth and flowering of African marigold cv. Seracole.

2. Materials and methods

The present investigation was carried out under All India Coordinated Research Project on Floriculture at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India during winter season of the year 2015-16. The experiment was laid out in Randomised Block Design (RBD) with three replications. Different treatments applied were: T₁ (75% of RD of fertilizers using WSF), T₂ (100% of RD of fertilizers using WSF), T₃ (125% of RD of fertilizers using WSF), T₄ (75% WSF + 25% SF), T₅ (50% WSF + 50% SF), T₆ (25% WSF + 75% SF), T₇ [Control (100% SF)]. Four weeks old seedlings at 4-6 leaves stage were transplanted in the main field at 30 × 40 cm spacing on 29th

October, 2015. Transplanted seedlings were pinched 45 days after transplanting to accelerate vegetative growth. The detailed fertilizer doses (Table 1 & Table 2) and fertigation schedules (Table 3) are described in tabular form. Recommended cultural operations were followed during the experiment. Well matured and fully opened blooms were harvested at weekly interval and various parameters on growth and flowering were recorded by using standard methods. To record the observations five randomly selected plants were tagged from each plot. The data were analysed statistically according to the Fischer's analysis of variance techniques as given by Panse and Sukhatme (1989) [8].

3. Results and discussion

3.1 Vegetative parameters

The highest plant height of African marigold cv. 'Seracole' (35.53 cm) was obtained in T₅ and shortest plant height (30.50 cm) was observed in T₂ over others treatments (Table 4). From the above results, it has been found that there was no effect on plant height of African marigold cv. 'Seracole' with increment of doses of WSF fertilizer from 75% to 125% of recommended dose, but when plant was treated with WSF along with SF @ 50% of both were showed markedly influence on plant height (14.76% increase plant height over control). Similar findings were reported by Swaroop and Singh (2007) [13] in African marigold cv. Pusa Narangi Gaiinda.

Regarding the branching of African marigold cv. 'Seracole', T₃ produced maximum number of primary branches (9.33) per plant followed by T₅ (8.66) and the fewer number of primary branches per plant (6.30) was recorded in T₂ (Table 4). Branching of African marigold increases with increment of Water soluble fertilizer dose (27.28% increased more than control), here straight fertilizer of its own effect was found very poor, but combination effect of both of 50% showed satisfactory improvement (19.14% increased more than control). The result of this study was in accordance with the finding of Acharya and Dashora (2004) [1] in African marigold.

The horizontal plant spread towards North-South direction was recorded highest (39.13 cm) in T₅ followed by T₄ (37.23 cm) and T₂ showed negative response (31.56 cm) in this aspect over others treatments. On the other hand, T₅ recorded highest (49.20 cm) plant spread (East-West) and lowest (33.80 cm) in T₁ (Table 4). In case of horizontal plant spreading in both the direction increased with increment of water soluble fertilizers doses, but very pronounced effect was recorded, when plants were treated with 50% sharing of both the fertilizers of recommended dose (increase canopy area of N-S directions up to 14.75% and E-W directions up to 6.03% over control). Water soluble fertilizers from 75 to 100% gave very poor result in this aspect. Jamod (2001) [4] and Chadha *et al.* (1999) [2] also found similar result.

The influence of different fertilizer doses individually or in combinations were affect stem girth in African marigold are presented in Table 4. Amongst different treatment combinations, maximum stem girth (1.3 cm) was recorded in T₄, while in T₁ observed very thin girth (1.10 cm) over others treatments. Regarding diameter of stem girth development, it has been found that low dose of straight fertilizer with 25% along with water soluble fertilizer (75%) of recommended dose markedly improved stem girth up to 10.16% more than control. Very lanky growth of the stem was found in 75% water soluble fertilizer application. Individual effect of

straight fertilizer (100%) is better than water soluble fertilizers in this aspect. The result of the study is in accordance with the finding of Jamod (2001) [4] in African marigold cv. Local Orange.

3.2 Reproductive parameters

Significant differences were noticed among the treatments in African marigold regarding number of days taken to first flower bud emergence (Table 5). In this experiment, T₄ showed to early appear of flower bud by 41.67 DAT, whereas delayed flower bud appearance was observed in T₁ (46.33 DAT). It was observed that when plants were treated with higher doses of water soluble fertilizers (125%) to induce plant for early emergence of flower bud, but earliness was extended 3.33 days more with 75% WSF + 25% SF. Application of water soluble fertilizers (75%) and recommended dose of straight fertilizers (100%) were found most delayed flower bud emergence. Similar result was reported by Sehrawat *et al.* (2003) [10] with higher rate of nitrogen in African marigold cv. African Gaint Double Orange.

The least number of days taken to full bloom from the day of first flower bud emergence (14.33 days) were observed in T₂, while maximum number of days taken to full bloom (16.67 days) was observed in T₇. The maximum days (16.67) required for full bloom from the date of flower bud emergence with the use of recommended dose of straight fertilizer (100%) and flowers were harvested 2.34 days early by using 100% water soluble fertilizers.

In this experiment, plants were treated with T₄ recorded longer duration of flowering (56.66 days), whereas T₁ recorded the minimum flowering duration (52.33 days). There is no effect on duration of blooming by changing of water soluble fertilizers doses, but straight fertilizer (75% Water Soluble Fertilizer + 25% Straight Fertilizer) dose extended duration of blooming by 2.67 days over control and 4.34 days more than lower doses of water soluble fertilizer. The result of the study is in accordance with the finding of Mohanty *et al.* (2002) [7].

The mean data pertaining to diameter of flower as influenced by different doses of fertilizers treatments have been presented in Table 5. It was observed from the data that, significantly higher diameter of flower (7.33 cm) was recorded at peak period of flowering in T₃ closely followed by T₄ (7.16 cm), whereas T₁ obtained minimum flower diameter (6.53 cm). The diameter of flower improved continuously by increment of water soluble fertilizers doses from 75% - 100% - 125% (6.53-6.70-7.33cm) and negative response was observed by increase of straight fertilizers doses individually or in combination with water soluble fertilizer. The highest dose of water soluble fertilizer (125%) increased diameter of flower by 6.85%. Similar result was found by Joshi and Barad (2002) with increase in nitrogen rate, up to 150 kg ha⁻¹ significantly increased the diameter of flower in African marigold cv. Cracker Jack.

The highest pedicel length (5.53 cm) was observed at full bloom stage in T₃, closely followed by T₄ and T₅ with 5.40cm and 5.30 cm respectively, whereas the lowest pedicel length was recorded in T₆ (4.83 cm). Regarding pedicel length development a trend has been found that pedicel length (10.6% more than control) was improved with increment of water soluble fertilizers doses (125%). The present observation supports the earlier finding of Yadav *et al.* (2000) [14] in African marigold.

The maximum (48.00) number of flowers per plant was recorded in T₄, whereas T₁ produced minimum (27.00) number of flowers per plant. A combination effect of water soluble fertilizers (75%) and straight fertilizers (25%) was markedly increased the flower production up to 27.90% more than the control. The result is in accordance with finding of Sharma *et al.* (2006) [11] with increasing rate of nitrogen in African marigold.

It is evident from the data (Table 5) that T₆ recorded highest (10.50 g) average flower weight whereas T₁ registered the lowest (7.23 g) average flower weight. A combination effect of water soluble fertilizers and straight fertilizers showed tremendous improvement regarding weight of individual flower. The most luxuriant result was obtained with combination of 25% WSF + 75% SF (increased 4.95% more weight of flower over control). Similar result was found by Rathi (2003) [9] with increasing level of nitrogen in African marigold. The data in Table 5 revealed that maximum flower yield per plant (478.32 g) was recorded in T₄ closely followed by T₅ (471.89 g) and lowest flower yield per plant (196.33 g) was obtained in T₁. The present observation supports the earlier finding of Jadhav *et al.* (2002) [3] in African marigold. The treatment T₄ registered maximum (358.70 q ha⁻¹) flower yield per hectare followed by T₅ (353.90 q ha⁻¹) and treatment

T₁ recorded minimum (147.20 qha⁻¹) flower yield per hectare. It has found that water soluble fertilizer (75%) along with straight fertilizer (25%) showed maximum result (27.84% more yield over control). Highest flower yield with increased dose of nitrogen has been reported in marigold by Acharya and Dashora (2004) [11] in African marigold.

Table 1: Straight fertilizer doses

Sl. No.	Treatment	Urea	Super Phosphate	Muriate of potash
1.	100%	196	563	125
2.	75%	147	422	94
3.	50%	98	281	63
4.	25%	49	141	31

Table 2: Water soluble fertilizer doses (90:22.5*:75) kg NPK per ha.

Sl. No.	Treatment	19:19:19	13:00:45	Urea
1.	125%	148	146	145
2.	100%	118	117	116
3.	75%	89	88	87
4.	50%	59	59	58
5.	25%	30	29	29

*The balance 67.5 kg of 'P' will be applied form of Super phosphate as basal dose.

Table 3: Fertigation Schedule per ha. Recommended dose of fertilizer: 90:90:75 kg/ha (75% of P is applied as Super phosphate) as WSF: 90:22.5:75 kg/ha

Sl. No	Crop stage	Duration (day)	Fertilizer grade	Total fertilizer (Kg/ha)	Nutrient supply			% requirement		
					N	P	K	N	P	K
1.	Transplanting to establishment stage	20	19:19:19	11.80	2.25	2.25	2.25	10.0	10.0	10.0
			13:00:45	11.70	1.50	0.0	5.25			
			Urea	11.60	5.25	0.0	0.0			
			Sub-total		9.00	2.25	7.50			
2.	Vegetative stage	45	19:19:19	47.30	9.00	9.00	9.00	40.0	40.0	40.0
			13:00:45	46.60	6.00	0	21.00			
			Urea	46.60	21.00	0	0			
			Sub-total		36.0	9.0	30.0			
3.	Flowering stage	55	19:19:19	59.20	11.25	11.25	11.25	50.0	50.0	50.0
			13:00:45	58.30	7.50	0	26.25			
			Urea	57.50	26.25	0	0.00			
			Sub-total		45.0	11.25	37.50			
Total		120			90.0	22.5	75.0	100.0	100.0	100.0

Table 4: Effect of different doses of fertilizers individual or in combinations of WSF and SF on vegetative growth of African marigold cv. Seracole.

Treatments	Plant height (cm)	No. of Primary Branches per Plant	Plant spread (cm)		Stem girth (cm)
			N-S directions	E-W directions	
T ₁	30.93	8.33	31.93	33.80	1.10
T ₂	30.50	6.33	31.56	34.50	1.13
T ₃	30.73	9.33	35.70	47.23	1.23
T ₄	32.10	8.00	37.23	48.63	1.30
T ₅	35.53	8.66	39.13	49.20	1.23
T ₆	32.07	8.00	34.00	40.27	1.21
T ₇	30.96	7.33	34.10	46.40	1.18
S.Em. (±)	0.64	0.32	0.978	1.71	0.03
CD at 0.05	1.998	0.988	3.047	5.335	0.093

T₁: 75% of RD of fertilizers using WSF, T₂: 100% of RD of fertilizers using WSF, T₃: 125% of RD of fertilizers using WSF, T₄: 75% WSF + 25% SF, T₅: 50% WSF + 50% SF, T₆: 25% WSF + 75% SF, T₇: 100% SF (Control).

Table 5: Effect of different doses of fertilizers individual or in combinations of WSF and SF on reproductive growth of African marigold cv. Seracole.

Treatments	No. of days taken to first flower bud appearance (days)	No. of days taken to full bloom (days)	Duration of flowering (days)	Diameter of Flower (cm)	Pedicle length (cm)	No. of Flowers per Plant	Average weight of individual flower (g)	Yield of Flowers per Plant (g)	Yield of Flowers per hectare (q)
T ₁	46.33	15.33	52.33	6.53	5.00	27.00	7.23	196.33	147.20
T ₂	44.67	14.33	53.33	6.70	4.96	33.66	7.51	252.75	189.50
T ₃	44.33	16.00	52.67	7.33	5.53	42.00	9.65	404.71	303.53
T ₄	41.67	14.67	56.67	7.16	5.40	48.00	9.97	478.33	358.70
T ₅	42.67	15.67	54.67	7.06	5.30	45.00	10.50	471.89	353.90
T ₆	45.00	15.67	54.67	7.03	4.83	34.33	10.59	363.09	272.27
T ₇	45.00	16.67	54.00	6.86	5.00	37.00	10.09	373.49	280.57
S.Em. (±)	0.54	0.35	0.39	0.08	0.12	0.63	0.32	13.08	9.84
CD at 0.05	1.696	1.098	1.230	0.262	0.375	1.976	0.996	40.744	30.648

T₁: 75% of RD of fertilizers using WSF, T₂: 100% of RD of fertilizers using WSF, T₃: 125% of RD of fertilizers using WSF, T₄: 75% WSF + 25% SF, T₅: 50% WSF + 50% SF, T₆: 25% WSF + 75% SF, T₇: 100% SF (Control).

4. Conclusion

In the light of the present study above results showed that the combination treatment of Water Soluble Fertilizer and Straight Fertilizer i.e. treatment T₄ and treatment T₅ application in African marigold was found more effective regarding vegetative and flowering attributes in comparison to individual application of Straight Fertilizer or Water Soluble fertilizer.

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