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Effect of water soluble fertilizers through drip irrigation on yield attributes of marigold crop

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Abstract

Drip irrigation is an irrigation method that saves water and provides the most economical method of applying fertilizer by utilizing fertilizer injectors that operate without any external power supply. Fertigation use soluble fertilizer that flow directly towards the plant root zone through the drip system, drip emitters or micro sprinkler system. A liquid fertilizer solution or soluble fertilizer is injected into the system at the desired rate. Proper application of fertilizers through different source play a vital role enhancing vegetative growth and quality flower production. The field experiment was conducted to study the effects of fertigation on growth parameters of African marigold in the farm, College of Agricultural Engineering, Madakasira, Anantapuram district nearest to Karnataka state border, which is geographically situated at 13°56'56.7" N latitude, 77°18'42" E longitude and at an altitude of 641 m above the mean sea level in the Southern Agroclimatic Zone (Zone IV) of Andhra Pradesh. The annual rainfall of Madakasira is 508 mm. Due to water scarcity, the available water resources should be very effectively utilized through water saving irrigation technologies. African marigold is a popular flower crop grown throughout the world on commercial scale. Marigold stands first among the loose flowers in Goa and its requirement increases in many folds on special occasions like Ganesh Chaturthi, Dussera, Diwali, weddings etc. The soil was collected and analysed in Regional Agricultural Research Station (RARS), Tirupathi and water for irrigation is taken from bore existed at College of Agricultural Engineering, Madakasira was tested. The experiment field with 810 m² (18x 45m) installed with drip irrigation system was selected for experimentation. The field was divided into 6 sub plots and laid out in randomised block design with different doses of water soluble fertilizers given through drip with following treatments viz., T1 – Control (no fertilizers), T2 – 100% RDF (Recommended Dose of Fertilizers) through conventional (Urea, SSP, MOP) fertilizers, T3 – 100% Nitrogen through drip, T4, T5 and T6 – 100%, 75% and 50% RDF through water soluble fertilizers. The yield attributes like number of flower buds, number of flowers, flower surface area, fresh weight of flowers, no of pickings, no of flowers per kilogram and flower yield per plot were studied. The average number of branches, flower buds and maximum flower sizes were highest in T₄ – 100% RDF and lowest was observed in T₁ – Control (no fertilizers). The highest yield was recorded in T₄ followed by T₅, T₃, T₂, T₆, and T₁.

Keywords: Drip irrigation, African marigold, fertilizers, yield attributes

Introduction

Marigold (*Tagetes* spp.) a member of family Asteraceae, is native of central and South America, especially Mexico. Marigold is broadly divided into two groups, viz., *African marigold* (*Tagetes erecta* Linn.) and French marigold (*Tagetes patula* Linn). 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 French marigold is dwarf and grow up to 20-60 cm height which bears small, lemon yellow golden yellow or orange tinged red flowers. Its habit of free flowering, short duration to produce marketable flowers, wide spectrum of attractive colors, shape, size and good keeping quality has attracted the attention of flower growers.

Accroding to Rachanakolambkar *et al.* (2014) In India, during 2014, the area under floriculture is (60487 ha). The highest area under floriculture was found in Karnataka (20,780 ha), followed by Tamil Nadu (16,745 ha), West Bengal (13,720 ha), Andhra Pradesh (8,420 ha). These states together accounted for 98.64 % of the total area in the country. Karnataka alone accounts for nearly 75 % of total floriculture exports from the country at 10 million and rose dominating at 90 %. The area under floriculture in Maharashtra during 2010-11 was is 15000 ha, out of which marigold contributes 29 % share with an area of 4350 hectares. While the production of floriculture is 64,400 million tones out of which marigold contributes 33,488 million tones which is account to about (52 %).

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Marigold only need enough water to dampen the soil. The base of the plant should receive the water, and the plant should not be watered from over the head. Drip irrigation in marigold increases in yield up to 20 – 30 percent saves water compare to flood irrigation. More land can be irrigated with the water, cost of fertilizer, inter-culturing and labor use get reduced.

The Drip irrigation provides the most economical method of applying fertilizer by utilizing fertilizer injectors that operate without any external power supply. Fertigation use soluble fertilizer that flow directly towards the plant root zone through the drip system, drip emitters or micro sprinkler system. A liquid fertilizer solution or soluble fertilizer is injected into the system at the desired rate.

Proper application of fertilizers through different source play a vital role enhancing vegetative growth and quality flower production. Proper combination of fertilizers play a vital role in a production of vigorous plants having maximum number of shoots and leaves, which have a positive impact and quality flower production and prolonged flowering period. Keeping all the views above stated, the present project entitled “Effect of water soluble fertilizers through drip fertigation on yield of African Marigold (*Tagetes erecta* L.) with the following objectives.

1. Study of effect of water soluble fertilizers through drip irrigation on yield attributes of marigold crop.
2. Study of suitable water soluble fertilizers in Marigold.

Materials and Methods

African marigold is a popular flower crop grown throughout the world on commercial scale. Marigold stands first among the loose flowers in Goa and its requirement increases in many folds on special occasions like Ganesh Chaturthi, Dussera, Diwali, weddings etc. Flowers are extensively used in the preparation of garlands and as loose flower on the occasion of religious ceremonies, festive occasions, offerings etc. Apart from loose flowers, carotenoids extracted from flowers are used for industrial purpose. It is being used commercially in pharmaceuticals, food supplements, animal feed additives and colorants in food and cosmetics. The commonly cultivated species of marigold are African marigold (*Tagetes erecta* L) and French marigold (*Tagetes patula*). The common demand of African marigold is more when compared to French marigold. African marigold responds well to fertilizers. It gives good yield under drip irrigation. Keeping this in mind Marigold crop was selected for study with different fertigation levels.

Location of the experimental site

The field experiments were carried out in the farm, College of Agricultural Engineering, Madakasira, Anantapuram nearest to Karnataka state border, which is geographically situated at 13°56'56.7" N latitude, 77°18'42"E longitude and at an altitude of 641 m above the mean sea level in the Southern Agroclimatic Zone (Zone IV) of Andhra Pradesh. The annual rainfall of Madakasira is 508 mm and it is found to draught prone area.

Soils

In experimental plot a composite soil sample was collected at random from 0-30cm soil depth and analysed in RARS, Tirupathi for soil sample prior to start of the experiments. The particulars of methods employed for each of them and results obtained are presented in table 1. The soils were sandy loam

in texture, low in organic carbon and available nitrogen and high in available phosphorus and potassium.

Table 1: Pre-cropping soil sample analysis of the experimental plot

S. No	Soil Characteristic	Value	Indication
1	pH	9.4	Sodic
2	EC	0.88 ds/ m	-
3	Organic carbon	0.54 %	Low
4	Nitrogen	176 kg/ha	Low
5	Phosphorus	32 kg/ha	High
6	Potassium	325 kg/ha	High

Water analysis

The water for irrigation for cultivation of Marigold crop was taken from bore existed at College of Agricultural Engineering, Madakasira. The report of water was given as below table 2.

Table 2: Water analysis report irrigation water used for cultivation of marigold crop

S. No	Parameter	Values
1	pH	7.44
2	EC	1215 µS/cm
3	TDS	900 mg/l
4	Total Hardness	284 mg/l
5	Total Alkalinity	600 mg/l
6	Fluoride	1.9 mg/l
7	Sulfate	16 mg/l
8	Nitrate	0.0 mg/
9	Iron	0.0 mg/l
10	Chloride	540 mg/l

Source: Values of chemical properties and inorganic compounds, unpublished thesis, Development and fabrication of low cost pedal operated reverse osmosis defluoridization equipment, unpublished thesis, College of Agricultural Engineering, Madakasira.

Experimental Details

Design and Layout

Drip irrigation system already installed at College of Agricultural Engineering, Madakasira was used for fertigation. The layout of the drip system is shown in Fig. 3.2. Water was pumped through 10 hp motor through water meter for measuring quantity of water. The main components of the drip irrigation system includes Head control unit, Water carrying unit and water distribution unit. The head control unit consists of Non return valve, 30 lit fertilizer tank, pressure gauge. The layout consists of 40 mm mains and sub mains. The experiment was planned for six treatments; six treatments contain six separate sub mains and are controlled by six separate control valves. Each sub main is fitted with flush valve at the end for flushing/ cleaning. The field was laid with 16 mm inline laterals with a spacing of 40 cm. The discharge of each dripper is 4 lph.

Treatments

A scheme of experiments has been planned and performed. The experimental field with 810 m²(18x 45m) installed with drip irrigation system was selected for experimentation. The field was divided into 6 sub plots. Each subplot was randomized and allocated with 18 laterals. For each lateral 64 marigold seedlings were transplanted at 40cm spacing. Each plot was planted with the experiment was a Complete Randomized Design (CRD) with 6 treatments as different fertigation levels as follows. Generally the recommended dose of fertilizers is 80:80:80 (NPK) kg/ha. Recommended water

soluble fertilizers for this experiment were Urea, Urea Phosphate and Murate of Potash.

T₁ - Control (no fertilizers)

T₂ - 100% RDF through conventional (Urea, SSP, MOP) fertilizers

T₃ - 100% Nitrogen through drip and P, K through soil application

T₄ - 100% RDF through Water soluble fertilizers

T₅ - 75% RDF through Water soluble fertilizers

T₆ - 50% RDF through Water soluble fertilizers

Variety

The test variety was "INCA II" marigold. The seedlings of the Marigold were brought from Sri Sai Flower and Vegetable Nursery, Madanapalli. The seedlings grown in portraits under shade net with the age of 20 days were selected for present study. The colour of the seedlings are maxima yellow. The duration of the crop is 90-100 days.

Cultivation Details

Field Preparation

The field was ploughed twice with tractor drawn cultivator, followed by harrowing in order to obtain fine tilth. After levelling, plots and channels were formed and necessary micro levelling was done in each plot to take up transplanting.

Transplanting

The seedlings were transplanted into the field on 17th February 2016. The seedlings were transplanted at a spacing of 40 x 40 cm. Light irrigation was done immediately after transplanting. Gap filling was done on fourth day of transplanting.

Gap Filling

Gap filling was done on fourth day of transplanting to maintain optimum plant population.

Pinching

Pinching is the process of cutting of terminal portion of shoots at the early stage of the crop so that it will help in breaking of apical dominance mechanically and emergence of side branches starts earlier and more number of branches and flowers of good quality and uniform size are produced. Pinching was done 20 days after transplanting and before bud formation. The pinching was done by living 6-7 leaves.

Weeding

Weeds are a major problem in marigold especially in rainy season crop. If the weeds are not removed in time, a great loss would occur in terms of growth and productivity of marigold. Normally 3-4 manual weeding and hoeing are required to check weed growth and to keep the field clean. The experimental plot was completely maintained weed free manual weeding. Weeding was done in the experimental plot as and when necessary. Totally 6 manual weeding were done in the entire cropping period.

Water Management

Irrigation was given through drip irrigation for all treatments. Irrigation was done by every day evening hours. Daily light irrigation was given only to dampen the soil at the rate of 80% to 100 % of ET. For measuring ET open pan Evaporimeter was installed in the field. Water stagnation over the surface was avoided. The Quantity of applied to the field was

measured with the help of water meter.

Harvesting

Marigold flowers were harvested when they have attained full size and opened completely. Picking of the flowers were done once in week along with a portion of stalk.

Marketing of the flowers

The nearest available flower markets like Madakasira, was selected for selling of marigold flowers. After harvesting of marigold flowers, immediately send to flower market by bus. The marketing is done by local market dealers. The cost of flowers varied based on demand in local market.

Bio-metric observations

Five plants in each plot were selected at random and tagged for taking observations on growth parameters at 20 days interval and yield attributes at harvest.

Yield parameters

For the same tagged plants number of flower buds, number of flowers, flower surface area, fresh weight of flowers, no of pickings, no of flowers per kilogram and flower yield per plot were recorded as yield parameters.

Number of flowers per plant

Number of flowers were measured at every 20 days at the time of picking and the number of fresh flowers picked was summed up to the previous number. Finally total number of flowers was calculated.

Size of flowers

The size of the marigold flower was measured by tracing the flower size on to the paper as shown in and the diameter was measured with scale. The size of the flower was measured initially in first picking that was noted as initial size. Again the flower size was measured at ending stage of flowering and that was noted as final size.

Number of flowers per Kilogram

Number of fresh flowers per Kilogram was weighed from each plot with weighing balance. The readings were taken two times and averaged to know no of fresh flowers per kg. The readings were taken at the time of first picking and last picking.

Yield per plot

Yield per each plot was measured at each time of picking as shown in the and was summed to get total yield per plot.

Statistical analysis

The data recorded on various yield attributes, yield, quality, economics and nutrient uptake parameters during the course of investigation were statistically analysed following the analysis of variance procedure as suggested by Panse and Sukhatme (1985). Wherever the treatment differences were found significant ('F' test) critical differences was worked out at 0.05 probability level and the values were furnished. Treatment differences those found non -significant were denoted as NS.

Results and discussion

The results of the present study entitled "Effect of water soluble fertilizers through drip Irrigation on Growth and

Flowering of African Marigold (*Tagetes erecta* L.)” conducted at the college Farm, College of Agricultural Engineering, Madakasira during the year 2015-2016 are given below. The experimental field with 810 m² (18x 45m) installed with drip irrigation system was selected for experimentation. The field was divided into 6 sub plots. Each treatment was allotted to each sub plot and randomized within the sub plot. Inca II variety of marigold crop was selected for experimentation. Inca II variety plants have less height and more number of short branches and are majorly used for growing as cut flowers, land scaping in lawns and gardens.

Yield Parameters

Number of flowers per plant at harvest

The maximum number of flowers was recorded with the treatment 100% RDF through water soluble fertilizers (T₄), which was significantly higher than the other two treatments tried. Treatment with 75% RDF through water soluble fertilizers (T₅) was the next best treatment followed by 100% Nitrogen through drip and P, K through Soil application (T₃) with significant disparity between them. The increase in number of flowers per plant in this treatment was mainly due to efficient utilization of growth resources by the crop. The minimum number of flowers was recorded with the treatment control (T₁), which was on par with 50% RDF through water soluble fertilizers (T₆), 100 % RDF through conventional fertilizer (T₂) at 20, 40, 60, 80, 100 days after transplanting as shown in the fig 1.

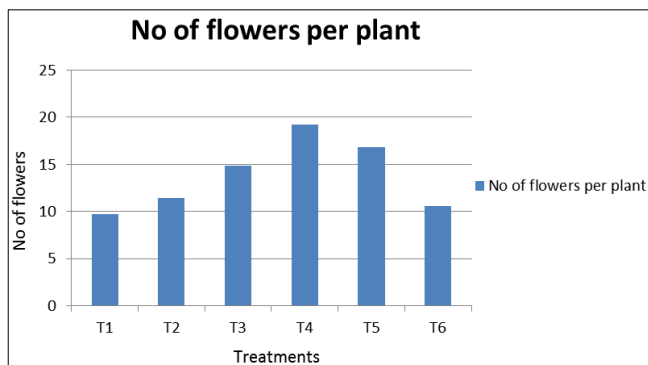


Fig 1: Average no of flowers per plant of marigold crop in different treatments

Flower size

Increasing levels of nutrient supply progressively enhanced the flower size up to the highest level of nutrients tried. The size of flower is most important factor which decides the selling cost and income to the farmer. The maximum size of flower (7.4cm) was registered with treatment 100% RDF through water soluble fertilizers (T₄), followed by 75% RDF through water soluble fertilizers (T₅), 100% water nitrogen through drip P,K soil application (T₃) with significant disparity between treatments tried. This might be due to supply of nitrogen in adequate amounts at all the critical stages. The minimum size of flower was registered with the treatment control (T₁) which was comparable with 50% RDF through water soluble fertilizers (T₆) and 100 % RDF through conventional fertilizer (T₂) at harvest as shown in the fig 2.

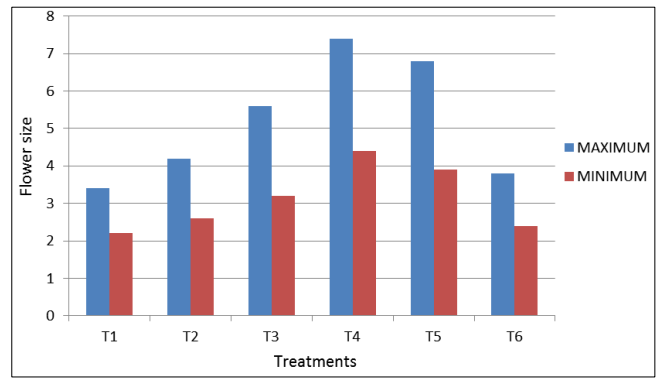


Fig 2: Maximum and minimum flower size (cm) in different treatments

Number of flowers per kilogram

The treatment with 100% RDF through water soluble fertilizers (T₄) produced more number of flowers, which was significantly superior to rest of the treatments. The next best treatment to marigold was the 75% RDF through water soluble fertilizers (T₅), followed by 100% Nitrogen through drip and P, K through Soil application (T₃) with significant disparity with between them. The lowest no of flowers per kg was registered with control (T₁) which was on par with 50% RDF through water soluble fertilizers (T₆) and 100 % RDF through conventional fertilizer (T₂) at harvest as shown in the fig 3.

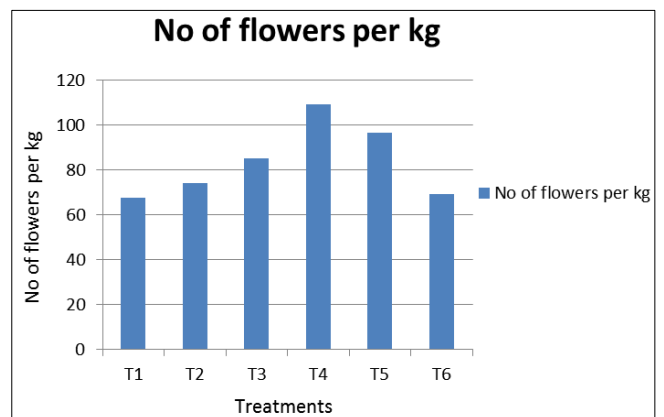


Fig 3: Average no of flowers per kg in different treatments

Yield

The highest flower yield was recorded with the nutrient level of 100% RDF through water soluble fertilizers (T₄). The next best flower yield recorded in 75% RDF through water soluble fertilizers (T₅), 100% water nitrogen through drip P, K soil application (T₃), with significant disparity between them. Higher level of biomass accrual and efficient translocation of photosynthates to the reproductive parts due to supply of adequate nutrient levels might be responsible for the production of elevated level of yield structure. The lowest yield was recorded in control (T₁) which was on par with 50% RDF through water soluble fertilizers (T₆) and 100 % RDF through conventional fertilizer (T₂), at harvest due to non-availability of sufficient quantity of assimilates to sink. as shown in the fig 4.

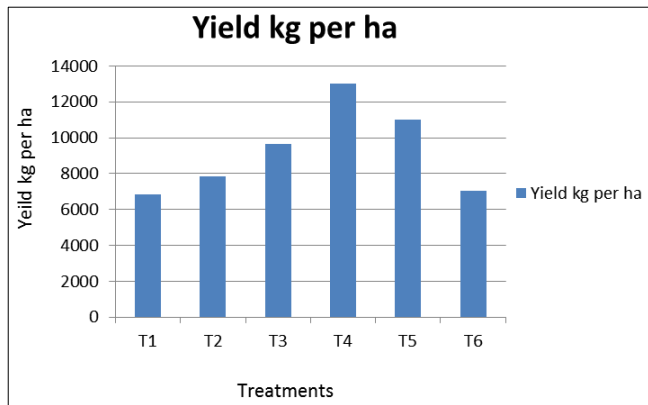


Fig 4: Percentage of yield of marigold in different treatments

Conclusions

Each plot was planted with the experiment was a Complete Randomized Design (CRD) with 6 treatments. Inca II variety of marigold crop was selected for experimentation. In the present study, the effect of fertigation through drip irrigation on yield attributes were studied in detail. The following conclusions were drawn:

The highest duration of flowering was observed T1 and lowest duration was observed in T4. The average number of flowers per plant fully opened was highest in T4 followed by T5, T3, T2, T6, and T1. There is significant difference between maximum flower sizes in T4 followed by T5, T3 and minimum flower size recorded in T2, T6 and T1. The highest yield was recorded in T4 followed by T5, T3, T2, T6, and T1.

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