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Influence of Integrated Nutrient Management on the Yield attributes and uptake of nutrients by *Tagetes erecta* (Marigold-A. Yellow) in semi-arid eastern plain zone of Rajasthan

Influence de la gestion intégrée des éléments nutritifs sur les composantes du rendement et prélévements de nutriments par *Tagetes erecta* (Marigold-A. Yellow) dans les plaines semi-arides de l'Est du Rajasthan

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INTRODUCTION

Based on the Physiographic division of the state, its rainfall pattern, soil types, availability of irrigation water, cropping patterns the state of Rajasthan is divided in five principle zones. Jaipur is situated in north-eastern plain zone, characterized by high summer temperature, hot winds, high evapotranspiration rates. In this semi-arid climate the mean daily temperature ranged from 22^0 C to 40^0 C maximum from January to may and minimum temperature 8.3 ^{0}C in January to 27.3^0 C in June. The average production of flowers in this zone is low but there is a tremendous scope of improvement in the agro-technology of flowers. T.erecta (Marigold) is a commercially important flowering annual, and is extensively cultivated. It is known by local names "genda" and "hazara"in Hindi. This flower is used for worshipping making garlands, interior decorations in ceremonial functions. It can be grown easily in varied agro-climatic conditions. Its habit of free flowering, short duration to produce marketable flowers, wide spectrum of attractive colours, shape, size and good keeping quality attracted the attention of flower growers. Besides the use of this flower as a cut flower it can be used for beautification and land scape planning. It has a great medicinal value. The leaf paste is used externally against boils and carbuncles. Leaf extract is a good remedy for ear-ache. Flower extract is considered as blood purifier, a cure of bleeding piles, and is a good remedy for eye diseases and ulcers. Bose & Yadav (1993)[1].

The essential oil present in different species of Tagetes can find a use in the perfume industry. The yellowish oil has a strong sweet and lasting odour. The flowers of T.erecta are fragrant and contains essential oils. The chemical composition of leaf and flower of T.erecta was investigated by Sharma et.al (1961)[2], Gupta and Bhandari (1975)[3], Basalas (1981)[4]. A wide variation in composition of oil is reported, this may be due to changes in climatic and soil conditions, under which the plants are grown, Sharma et.al (1961)[2] extracted 1-limoneue, ocemene, 1-linalyl acetate, 1-linalool from T.erecta. Ocemene constituent of the oil was shown to cause 100% mortality of mosquito larvae. The oil of T.minuta was reported to posses bronchodilatory, tranquilizing, hypotensive, spasmolytic and anti inflamatory properties. Chandhoke and Ghatok (1969)[5]. The oil acts as an repellent to flies and vermin. The natives of East Africa hang Tagete plants in their huts to keep out swarm of flies which are a terrible nuisance. Attempts were made to develop an effective larvicide that would kill maggots in wound. An emulsion of water, carbon tetra chloride, some wool fat, five percent of Tagetes oil and a preserving agent was found effective. The oil is extracted from fully matured Tagetes plants with petroleum ether and obtained 56.7% alcohol soluble viscous absolute. Extraction of plants with benzene gave much larger yields, but of less floral odour then obtained by petroleum ether. The oil is yellow reddish liquid, readily polymerises on standing and turns into a solid gel. Jones & Smith (1925)[6], Igolen (1936) [7], lbid, reported that oil contains, d-limonene, Ocimene, Tagetone 2-6, dimethyl-7-octane-4.one. The aerial parts and flowers are aromatic and on steam distillation yield essential oil. The crop harvested in full bloom yields approximate 2,500 kg flowers, 2500 kg herb and 35 kg of essential oil per hectare per annuam. The Tagetes are good source of helenine which varies with flower colour. Oil of Tagetes is used as a modifier in hair lotions.

Pyrethrin contents in T.erecta are reported by Khanna et.al (1975)[9]. They indicated the presence of six pyrethrins and explored the possibility of exploiting it industrially. The plant is a hardy annual and a native of tropical countries, it is extensively cultivated and being a source of natural pyrethrins, it may solve the problem of insecticidal substances to some extent. The continuous and indiscriminate use of synthetic insecticides, for vector control has posed the problem of acute and chronic toxicity to human beings. The natural pyrethrins have long history of safety, effectiveness, virtually non-toxic to mammalian life. The use of pyrethrum of T.minuta is suggested for the control of cyclops. The pyrethrins destroy different species of mosquito larvae the carrier of malaria disease. Kamal et.al (1988) [10].

The plants of Tagetes are found to be highly effective in keeping the population of nematodes under control and is used as trap crop. Marked reduction in growth of nematodes was observed by growing T.erecta and T.patula. Considerable decrease in population of meadow nematodes and root knot nematode was observed by Visser and Vythilingham (1959) [1] , Caryoll[1,] Oosteubrink (1960)[1], Tarjan (1960)[1] recommended nematode control in bulb crops by green manuring or intercropping with African marigold. Growth of rosa species, grapes and apple seedlings were improved when grown after marigold or with marigold. Marked reduction in nematode population was observed in soil when grown with T.erecta. and T.Patula, Bose and Yadav (1993)[1] . Marigold can be grown very successfully as intercrops in the interspaces of forest tree plantation Khanna (1994)[11] . A beautiful yellow coloured dye is also extracted to dye sheep wool.

Tagetes are adaptable to wide variety of soil conditions, but the ideal conditions for its growth is fertile sandy loam, well drained soils, with good water holding capacity and pH near to neutral. This can be grown thoughtout the year, however, temperature between 14.5^0C to 28.6^0C greatly improved flowering and ideal for its production.

Although Tagetes are commercially and medicinally important aromatic flowering ornamental with tremendous economic value but the information's about its nutrient requirements is very scanty and fragmentary, particularly micronutrient requirements of this flowering annual is totally unidentified, ignored and unexplored. To increase the quality and productivity of flowers serious attention should be paid to mineral nutrition, nutritional disorders and balanced fertilizer use (BFU), to achieve maximum economic yield (MEY), and move towards a better utilization of fertilizers.

The objective of this experiment was to obtain higher yields and higher returns and to generate a wealth of understandings on its nutritional needs and Minimum Nutrient Requirement (MNR) . The information's regarding mineral nutrition to floral crops in semi-arid eastern plain zone of Rajasthan and in state of Rajasthan is unexplored. However, the total cultivated area for flower production in the state is 8.4% and due to most suitable agro-climatic conditions for cultivation of flowers and to meet out the demand and supply ratio in global market the work should be given due importance. It is also required to develop suitable technology for management of nutrients in this agro- ecological zone which is ideally suitable for cultivation of flowers, vegetable and spices. Pushkar in Ajmer, and Haldi-ghati in Udaipur are famous for the cultivation of local rose variety, known as "desi" and "cheti" gulab and supports ages old industry of "gulkand" (rose jam), mainly used for conditioning of gastro-intestinal tract, and gulab scent (perfume). The perfume thus obtained is very expensive in global markets and is of very high quality.

METHOD AND MATERIALS

The soils of experimental fields are light-textured sandy loams belonging to Torripssamment with irrigated coarse textured (I-CT) microfarming situations. The soils are defficient in Zinc which can be easily identified by reduced vigour, stunted growth and small flowers. The addition of organic manures to sandy soils increase the moisture and availability of nutrients. The addition of FYM stimulates enzymatic acivities, and promote recycling of nutrients in soil eco-system. Information is meagre on effect of micronutrient on Tagetes. Investigations were carried out to evaluate the optimum rate of FYM and fertilizer Zinc and their integrated effects on T.erecta. Field experiments were conducted for two consecutive years 1995-96 , 1996-97 . The initial characteristics of the soil are pH-8.2, Ec 0.1 dsm-1, organic carbon 0.28% , available nitrogen 183 kg ha $^{-1}$ phosphorus 24 kg $P_2 O_5$ ha^{-1}, Potash 125 kg K_2 Oha^{-1}, Zinc 0.49 ppm DTPA extractable, The treatments included a basal dose of 100 kgN ha-1 , 60 kg K_2Oha$^{-1,}$ 60 Kg P_2 0_5 ha $^{-1}$ respectively. The main treatments comprised three levels each of 0,5,10 kg ha $^{-1}$. Zinc as Zinc sulphate, 10, 20, 30 T ha $^{-1}$ FYM. The statistical design of the experiment was R.B.D. with nine treatments replicated four times. Well decomposed FYM was broadcast and mixed in plough layer before transplanting the seedlings. Equal no. of plants were grown in all plots, row to row and plant to plant distance was maintained. All improved cultural practices were followed throughout the season. Five pickings of fresh flowers were taken. Dry seed yield was recorded at the time of harvesting. Initial soil samples and samples after harvesting the crop are collected and analysed for their soil available Zinc and organic carbon. Removal of nutrients by dry seeds of Tagetes was also analysed, oil is extracted by petroleum ether. The dried seeds were digested in HNO $_3$-$HClO_4$ mixture (4:1) for the estimation of micronutrients by A.A.S.

RESULTS AND DISCUSSION

Tagetes erecta shows a significant response to direct application of fertilizer FYM and Zinc in both the years on yield and yield attributing characters. Meagre information is available on effect of micronutrients on T.erecta. Bandopadhyay (1994)[12] reported a significant increase in flower, number/plant, flower weight, length of stalk, average seed yield/plot, seed no/flower by application of micronutrients. Chaturvedi et.al (1986)[13] reported the effect of agromin (a micronutrient mixture) on growth and flowering of gladiolus. Application @ 3000 ppm improved the plant height, no. of leaves and floret size. An interspecific response to manganese concentration as well as nitrogen source influence the uptake of manganese in Tagetes erecta grown under hydroponic conditions. (1991)[14]. The fresh flower yield significantly increased during both the years. The initial soil test values for these soils were already (0.49 ppm) low and therefore such a response was not unexpected. The application of Zinc @ 5 kg Zn ha $^{-1}$ increased the fresh flower yield (table-1) and dry seed yield (table-2) further addition of zinc sulphate @ 10 kgZn ha $^{-1}$ did not make any substantial difference staistically and the treatment was at par with the application of 5 kg Zn ha^{-1} . The pooled data of two years indicate that application of Zinc to Tagetes erecta is beneficial upto 5 kg Zn ha $^{-1}$ level of application. The interactive effects with FYM were found to be non-significant in the year 1996-97 and pooled data. In the year 1995-96 the interactive effects were found to be significant . The FYM application @ 30 T ha $^{-1}$ was at par with 20 T ha $^{-1}$ level of application.
Up take of Zinc by dry seeds of T.erecta shows a linear increase in Zinc uptake upto 30 T ha $^{-1}$ FYM and 10 kg Zn ha $^{-1}$ level of application, however, no statistical difference is observed between 30 T ha $^{-1}$ and 20 T ha $^{-1}$ FYM and 10 kg Zn ha $^{-1}$ and 5 kg Zn ha $^{-1}$ level of application. A significant increase was observed between zinc stress condition and zinc applied condition . Zinc uptake is significantly correlated with seed yield (r = 0.94067*)

The oil yield shows a substantial increase with levels of FYM and Zn when compared with Zinc stress condition and it varied from 26.29 kg ha $^{-1}$ to 39.88 kgha $^{-1}$. The oil yield is significantly correlated with dry seed yield (r = 0.97321*).

Addition of FYM and Zinc increased the uptake of Nitrogen, Phosphorus, Potash Copper, Manganese, Iron in plants. Due to FYM addition there is an improvement in physico-chemical properties of soil which increase mineralization of nitrogen and hence improve the quality of seeds and other quality aspects pigmentation, optimum growth, flower production, Ravindran et al (1986) [15] Monanty et.al (1993) [16] Carter et al (1973) [17] Jaggi et.al (1985)[18] , The percent protein also increased significntly with their application. FYM additions resulted in improvement in soil health, and reduce the activities of complexing agents and in turn contribute towards soil available pool and make more nutrients available to crop.

Addition of FYM and Zinc increase Nitrogen, Potash, Copper, Manganese and Iron uptake in dry seeds. However, there is sudden decrease in values of copper uptake which was observed with the application of 10kg Zn ha $^{-1}$ level of application. This may be due to antagonistic effects of Zinc and Copper , but this kind of relationship needs a thorough investigation. (Table-3) Increase in K uptake may be due to release of K from total K of soil in the soil and also from FYM and ultimately its absorbance by plant.

A perusal of data in (Table-4) shows the influence of FYM and Zinc application on T.erecta. They significantly increased the fodder yield, no. of flowers per plant, height of plants, size of flowers and weight of dry flowers. Combined effect of FYM and Zinc was found non-significant.

Addition of Zinc and organic manures increased the DTPA extractable Zinc and organic-carbon in post harvest soils. The combined application increased the yield, (Devrajan) et.al. (1987) [19] . An increase in Zinc availability due to addition of organic manure is indicated by Mann et.al (1978) [20]. The DTPA extractable Zn shows an increase with only 5kg Zn $ha^{-1,}$ 10 kg Zn ha^{-1} application was at par statistically. DTPA extractable Zn ranged from 0.66 in Zinc stress condition to 4.66 mg kg^{-1} , where 10 kg Zn ha^{-1} was applied. DTPA extractable zinc is significantly correlated with Zn uptake (r = 0.85321*) (Table-6) . Organic carbon is increased significantly with the application of FYM and Zinc and significantly correlated with dry seed yield (r = 0.68211*). The interactive effects in most of parameteres were found non-significant, which shows that FYM is beneficial for long term effects.

SUMMARY

Floriculture is an important sector of horticultural crops. The investigations shows that plant is of tremendous economic and medicinal value. However the application of FYM and Zinc shows a significant increase in yield and other yield attributes, and they significantly contribute towards the quality of flowers, the combined and interactive effects in most of the parameteres was found non-significant, which needs a thorough investigation. Few parameters are significantly corelated e.g. Zinc uptake vs dry seed yield, Zinc uptake Vs DTPA extractable, Zinc, oil yield vs dry seed yield. Few more parameteres could be studied, if financial constraints were not there. There is a tremendous scope of improvement in Agro-technology of floriculture crops. A wealth of data can be generated for better understandings and better quality of flowers, and improved varieties.

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Keywords : integrated nutrient management, yield attributes, uptake of nutrient, *T.erecta,* Rajasthan

Mots clés : gestion intégrée des nutriments, composantes du rendement, prélévements de nutriments, *T.erecta*, Rajasthan

APPENDIX

TABLE-1

Fresh flower yield (Q ha $^{-1}$) of T. erecta as influenced by influenced by integrated effect of FYM and Zinc application in Torripssamments in semi-arid eastern plain zone of Rajasthan

Treatments	1995-96	1996-97	Pooled (Two Years)	% Response
Levels of FYM T ha $^{-1}$				
10.0 T ha^{-1}	64.63	59.35	61.99	98.53
20.0 T ha^{-1}	70.23	67.15	68.69	88.90
30.0 T ha^{-1}	70.12	66.88	68.50	89.16
SEM ±	0.33	1.36	0.996	--------
L.S.D. (P =0.05)	0.98*	3.96*	3.15*	--------
Levels of of Zinc				
0.0 kg ha^{-1}	62.82	59.35	61.08	--------
5.0 kg ha^{-1}	71.21	67.02	69.11	88.38
10.0 kgha^{-1}	70.95	67.01	68.98	88.54
SEM±	0.33	1.36	0.966	--------
L.S.D. (P =0.05)	0.98*	3.96*	3.15*	--------
C.V. (%)	1.71	7.28	--------	--------
Interaction FYM x Zn	Significant	N.S.	N.S.	-------
SEM±	0.58	--------	---------	--------
C.D. (P= 0.05)	1.71	--------	---------	-------

*Significant

TABLE -2

Dry seed yield uptake of Zn, protein, oil yield, of T. erecta as influenced by application of FYM and Zinc in Torripssamments in semi-arid eastern plain zone of Rajasthan

Treatments	Dry Seed Yield ($q\text{-}ha^{-1}$)	Protein (%)	Oil Yield ($kg\ ha^{-1}$)	Uptake of Zinc ($mg\ kg^{-1}$)
Levels of FYM				
10.O T ha^{-1}	2.81	8.91	30.111	24.13
20.0 T ha^{-1}	3.09	10.12	35.79	33.02
30.0 T ha^{-1}	3.18	10.24	37.87	33.78
SEM+	0.059	0.16	0.886	0.562
C.D. (P = 0.05)	0.192*	0.48*	2.89*	1.59*
Levels of Zinc				
0.0 kg ha^{-1}	2.55	8.56	26.29	21.31
5.0 kg ha^{-1}	3.28	10.12	37.57	33.98
10.0 kg ha^{-1}	3.25	10.59	39.88	35.63
SEM+	0.059	0.16	0.886	0.562
C.D. (P = 0.05)	0.192*	0.35*	2.89*	1.593*
Interection				
FYM x Zn	N.S.	Significant	N.S.	Significant
SEM+				0.973
C.D. (P = 0.05)				2.758

***Significant**

TABLE - 5

DTPA extractable zinc and organic carbon after harvesting T. erecta as influenced by applicatiom of FYM and zinc in Torripssamments in semi-arid eastern plain zone of Rajasthan.

(Pooled data for two years)

Treatments	DTPA extractable zinc	Organic Carbon
	Kg ha $^{-1}$	(%)
Levels of FYM		
10.0 T ha $^{-1}$	3.038	0.320
20.0 T ha $^{-1}$	3.324	0.325
30.0 T ha $^{-1}$	3.447	0.377
SEM$\pm$	0.182	0.008
C.D. (P = 0.05)	N.S.	0.027
Levels of of Zinc		
0.0 kg ha $^{-1}$	0.667	0.310
5.0 kg ha $^{-1}$	4.482	0.346
10.0 kg ha $^{-1}$	4.660	0.365
SEM$\pm$	0.182	0.008
C.D. (P = 0.05)	0.592*	0.027*
Interections		
FYM x Zn	N.S.	N.S.
SEM $\pm$-		
C.D. (P = 0.05)		

*Significant

TABLE - 6

Various Parameters correlated for T. erecta as influenced by FYM and zinc application in Torripssamments in semi-arid eastern plain zone of Rajasthan.

S.No.	Factors Correlated	"r" values
1.	Zn uptake vs Dry seed yield	0.94067*
2.	Zn uptake vs DTPA extractable Zn	0.85321*
3.	Oil yields vs Dry seed yield	0.97321*
4.	% O.C. vs Dry seed yield	0.68211*

TABLE-3

Nutrient uptake by T. erecta as influenced by of FYM and Zinc application in Torripssamments in semi-arid eastern plain zone of Rajasthan.

(Mean of Two years)

Treatments	Kg ha^{-1}			g ha^{-1}		
	N	P	K	Cu	Mn	Fe
Levels of FYM						
10.0 T ha^{-1}	3.99	0.42	1.63	1.29	3.03	18.63
20.0 T ha^{-1}	5.00	0.54	2.10	1.33	3.37	21.29
30.0 T ha^{-1}	5.22	0.54	2.45	1.40	3.56	22.06
Levels of Zn						
0.0 Kg ha^{-1}	4.23	0.40	1.37	1.15	2.73	17.16
5.0 Kg ha^{-1}	5.31	0.59	2.34	1.64	3.54	22.89
10.0 Kg ha^{-1}	5.49	0.58	2.50	1.23	3.70	21.90

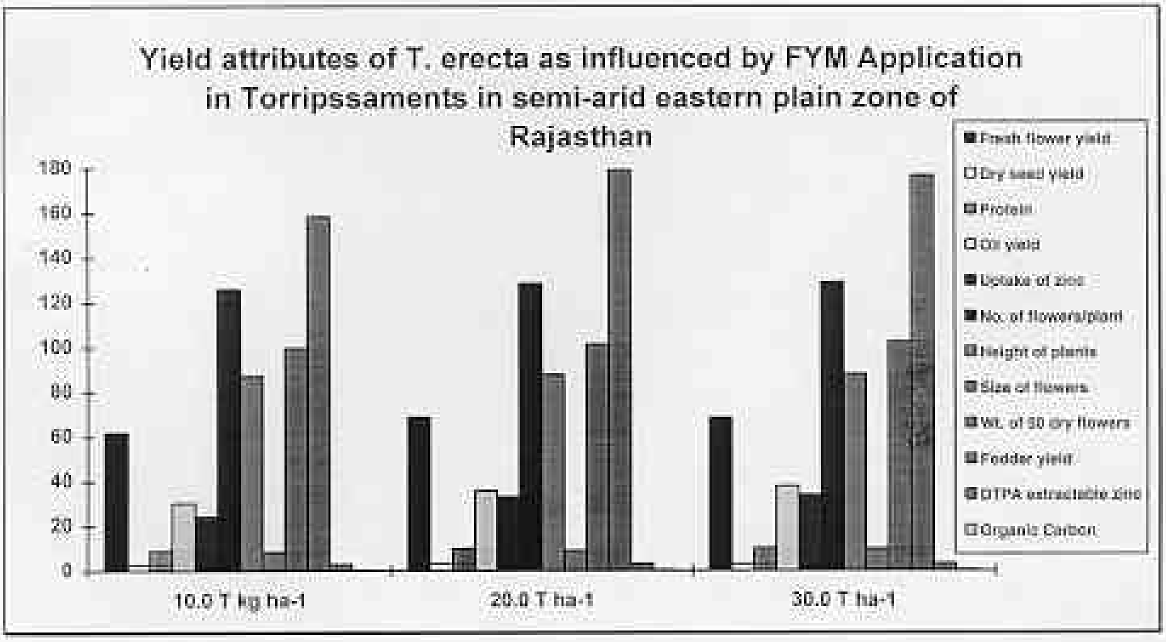
TABLE-4

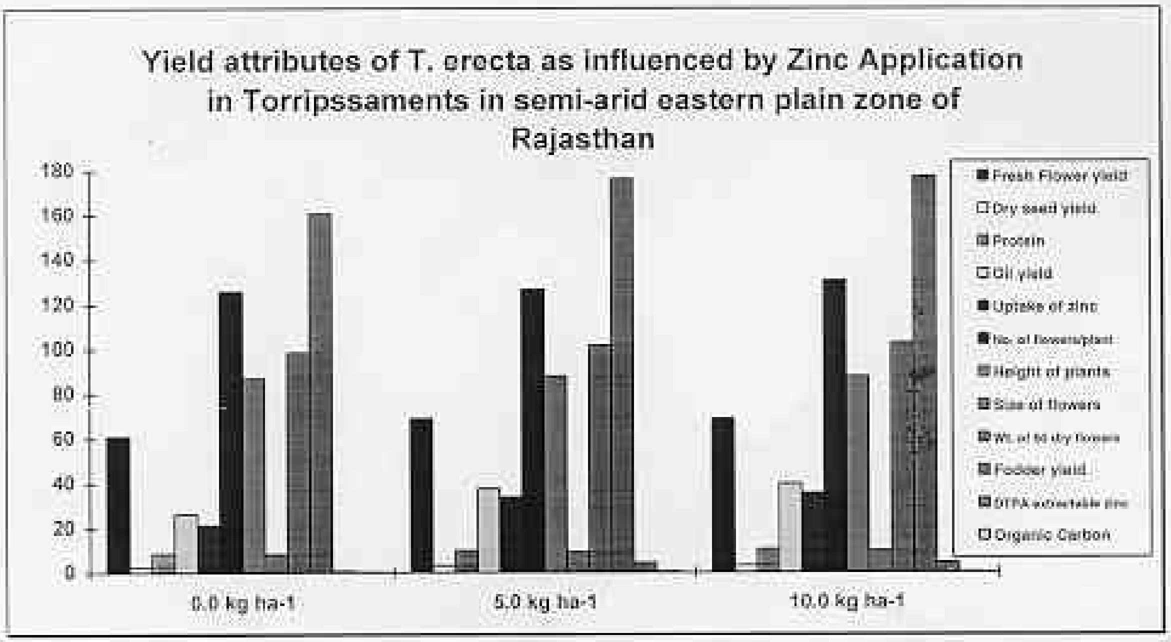
Yield attributes as influenced by application of FYM and Zinc in Torripssamments in semi-arid eastern plain zone of Rajasthan.

(Mean values of two years)

Treatments	No. of flowers/plant	Height of plants (cm)	Size of flowers (cm)	Wt. of 50 dry flowers (gm)	Fodder yield (Q. ha^{-1})
Levels of FYM					
10.0 T ha^{-1}	125.87	87.07	8.48	99.69	158.39
20.0 T ha^{-1}	128.33	87.63	9.16	101.37	179.21
30.0 T ha^{-1}	128.87	87.95	9.94	102.50	176.82
SEM±	2.07	0.40	0.15	0.22	2.2
C.D. (P=0.05)	0.32*	0.68*	0.46*	0.66*	6.42*
Levels of Zinc					
0.0 Kg ha^{-1}	125.83	86.99	8.33	98.60	160.60
5.0 Kg ha^{-1}	126.71	87.84	9.40	101.79	176.39
10.0 Kg ha^{-1}	130.54	87.83	9.85	103.02	177.44
SEM±	2.07	0.40	0.15	0.22	2.2
C.D. (P=0.05)	0.32*	0.68*	0.46*	0.66*	6.42*
Interaction					
FYM x Zn	N.S.	N.S.	N.S.	N.S.	N.S.

*Significant


Yield attributes of T. erecta as influenced by FYM Application in Torripssaments in semi-arid eastern plain zone of Rajasthan
180
160
140
120
100
80
60
40
20
0
10.0 T kg ha-1
20.0 T ha-1
30.0 T ha-1
Fresh flower yield
Dry seed yield
Protein
Oil yield
Uptake of zinc
No. of flowers/plant
Height of plants
Size of flowers
Wt. of 50 dry flowers
Fodder yield
DTPA extractable zinc
Organic Carbon


Yield attributes of T. erecta as influenced by Zinc Application in Torripssaments in semi-arid eastern plain zone of Rajasthan
180
160
140
120
100
80
60
40
20
0
0.0 kg ha-1
5.0 kg ha-1
10.0 kg ha-1
Fresh Flower yield
Dry seed yield
Protein
Oil yield
Uptake of zinc
No. of flowers/plant
Height of plants
Size of flowers
Fodder yield
DTPA extractable zinc
Organic Carbon