Agro-Science Journal of Tropical Agriculture Food, Environment and Extension
Volume 6 Number 1 January 2007 pp. 46 – 55

ISSN 1119-7455

EFFECT OF NITROGEN, POTASSIUM AND MEDIA ON THE GROWTH AND FLOWERING OF MARIGOLD (*Tagetes erecta* L.)

[1]Ekwu, L.G and [2]Mbah, B.N.
[1]Department of Crop Science Ebonyi State University, Abakaliki, Nigeria.
[2]Department of Crop Science, University of Nigeria, Nsukka, Nigeria.

ABSTRACT

A greenhouse experiment was carried out to evaluate the effect of nitrogen, potassium and media on the growth and flowering of marigold (Tagetes erecta L.). The experiment was conducted as a 4 x 4 x 2 factorial laid out in Completely Randomized Design (CRD) with five replications. The treatments comprised four rates of nitrogen (0, 50, 100 and 150ppm N), four rates of potassium (0, 50, 100 and 150ppm K) and two media (9:1 ricehull: river sand and 3:2 topsoil : riversand). Topsoil medium produced a higher shoot dry weight and a wider plant canopy than the ricehull medium. In the topsoil medium, at all nitrogen levels, 50ppm K that produced the highest shoot and root dry weight also produced the highest flower diameter. Shoot dry weight, root dry weight and number of flowers were highest at 100ppm K for all nitrogen levels in the ricehull medium. The number of days to 50% flower bud initiation and anthesis was shorter in ricehull medium than topsoil medium. The results showed that with the availability of 150ppm nitrogen in the media, 50ppm K and 100ppm K in topsoil and ricehull media, respectively was sufficient for the production of pot marigold.

Key words: Nitrogen, potassium, growth media, marigold, *Tagetes erecta*

INTRODUCTION

Marigold (*Tagetes erecta L.)* is an ornamental plant which belongs to the family of compositae. The flowers are single and yellow or orange in colour. The dwarf marigold is excellent as pot plant and as bedding plant in edgings and borders while the tall types are used behind shorter plants in beds and as cut flowers.There is no one optimum growing medium for all pot plants. Materials used for potting media in commercial nursery production vary considerably in their physical and chemical properties. Materials suitable for amending soil for container plants must provide good drainage and aeration, must be low in soluble salts, readily available in a uniform grade and must be biologically and chemically stable when pasteurized. It must be light in weight, economical, and capable of retaining moisture and nutrients and releasing them as the need arises (Mastalerz, 1977).

Soilless growing media such as ricehull, peanut hulls, sawdust, wood chips, corn cobs, sugar - cane trash, perlite, vermiculite and shredded bark have been used in the production of container plants. The use of any of these materials depends on the availability, the cost and the amount of local experience in its usage (Bunt, 1976). Criley and Parvin (1978) reported that poinsettia cultivars grown on soilless media and fertilized with Osmocote 14-14-14 and 100ppm nitrogen and potassium produced a greater number of branches, flower diameter and flower height than those fertilized with Osmocote and water only. Thomas (1981) working with *Fatsia japonica* indicated that plants in peat-sand-sawdust (1:1:1) or sand-sawdust (1:1) medium with a base dressing of 150 and 300gN/m^3, respectively gave optimum growth. Banko (1981) showed that *Hetzi juniper* grown on a 1:1 pine-bark: sand media and fertilized with 200ppm nitrogen exhibited maximum growth. Bilderback *et al* (1982) found that peanut hulls increased particle size, total porosity, air space but reduced available water, water buffering capacity and bulk density of media. Johnson *et al* (1981) observed that *Ligustrum japonica* grown on peatmoss: pine bark: sand in the ratio of 0.5:1:1, 1:1:1, 2:1:1, 4:1:1 and fertilized with 1350 or 2700kgN/ha/year produced highest shoot and root dry weight in 0.5:1:1 peatmoss: pinebark: sand medium fertilized with 1350kgN/ha/year. They attributed the lower top growth observed in the higher volume of peatmoss to the lower container nutrient and moisture holding capacities of peatmoss.

Composts made from a good loam have more plant nutrients with respect to nitrogen and phosphorus. Potassium was more easily removed by both extractants (water and Morgan's solvent) from the peat-sand compost than from the John Innes compost. The amount of potassium present in organic mineral is usually much lower than that found in mineral soils. When fertilizers are added to peat based composts and mineral soils, the levels of available plant nutrients in the peat-based composts will be higher than those of mineral soils because of the lower amount of fixation that occur in peat-based composts. (Bunt, 1976).

Beardsell *et al* (1979) found that in potted *Tagetes* cultivar 'jubilee', coarse sand had a very low water holding capacity whereas sawdust, composted puppy straw waste, brown coal and peatmoss each had a high water holding capacity. Goh and Haynes (1977) reported that pot mixtures using soilless media have a lower capacity for fixing and storing nutrients especially when there is sawdust in the medium. They observed that plants grew well in medium with peat: sand ratio of 3:1 as well as peat: bark: wood shaving ratio of 2:1:1 but the former gave better result.

To improve the quality of our environment through floriculture, large volumes of potting soils and adequate information on the fertilizer need of ornamentals will be required for growing pot plants. Continual removal of topsoil for growing pot plants will encourage soil erosion. Erosion leads to increased food production costs due to loss of organic matter (Forth, 1990). It is estimated that between five and seven million hectares of land are lost annually through soil degradation (Davis *et al* 1992). There is an urgent need for a replacement in the growing media used for growing pot plants. The objective of this study was to evaluate the effect of nitrogen, potassium and media on the growth of pot marigold.

MATERIALS AND METHODS

A greenhouse experiment was carried out to determine the effect of media, different rates of nitrogen and potassium on the growth and flowering of marigold (*Tagetes erecta L*). The riversand used was obtained from Nsukka in Enugu state while the ricehull was obtained from Abakaliki Rice Mill Ltd in Ebonyi State. The experiment was a 4 x 4 x 2 Factorial laid out in Completely Randomized Design (CRD) with five replications. The treatments comprised four rates of nitrogen (0, 50, 100 and 150ppm N), four rates of potassium ((0, 50, 100 and 150ppm K) and two media (9:1 ricehull: riversand and 3:2 topsoil: riversand). Lime and single superphosphate were added as a blanket treatment at the rate of 3g/litre of lime and 2g/litre of single superphosphate respectively.

Fresh ricehull was composted for 30 days and the material was steam sterilized at a temperature of 80^0C for 30 minutes using the autoclave. Riversand was sieved with 2.0mm and 0.2mm sieves for the purpose of eliminating very coarse and very fine sand particles. Ricehull, riversand and topsoil were the materials used in compounding the growing media. Seedlings were raised in plant boxes and transplanted two weeks after sowing into 1.4 litre pots at the rate of three seedlings per pot. A total of 480 plants were used for the research.

The transplanted seedlings were fertilized with 200ppm nitrogen and 100ppm potassium for one week so as to enable the plants to acclimatize before receiving the different nitrogen and potassium treatments. Stock solutions of nitrogen and potassium fertilizer were prepared and a dilute solution of each fertilizer was applied twice weekly. The plants were watered daily. Shoot and root dry weight, plant canopy width, days to 50% flower bud initiation, days to 50% anthesis, number of flower buds at 30 days after transplanting, number of flowers at 45 days after transplanting and flower diameter at 60 days after transplanting were the parameters measured. Statistical analysis was done using the procedure outlined by Steel and Torrie (1980) for a Factorial experiment in a Completely Randomized

Design (CRD). Separation of treatment means for significant effect was done by the use of the Least Significant Difference as described by Obi (1986).

RESULTS AND DISCUSSION

The result showed that nitrogen, potassium and media interaction on shoot dry weight was significant (Table 1). In ricehull medium, at all nitrogen levels, 100ppm K produced the highest shoot dry weight while the least shoot dry weight was at 0ppm K.

In the topsoil medium, at all nitrogen levels, 50ppm K produced the highest shoot dry weight while the least was at 150ppm K. Topsoil medium produced a higher shoot dry weight than ricehull medium (Table 1).

Nitrogen x potassium x media interaction on root dry weight was significant (Table 2). In ricehull medium, at all nitrogen levels, 100ppm K, which produced the highest shoot dry weight, also produced the highest root dry weight. The least root dry weight was produced at 0ppm K (Table 2). In the topsoil medium, at all nitrogen levels, the highest root dry weight was at 50ppm K. Root dry weight was least at 0ppm K for all nitrogen levels (Table 2).

Nitrogen, potassium and media interaction on plant canopy width was significant (Table 3). In ricehull medium, plant canopy was widest at 150ppm K and narrowest at 0ppm K at all nitrogen levels. Ricehull medium produced the widest plant canopy at a higher potassium rate than topsoil medium. In topsoil medium, at all nitrogen levels, 100ppm K produced the highest and 0kppm K the least plant canopy width. Topsoil medium produced the highest plant width at a lower potassium rate than ricehull medium. Topsoil medium produced plants with wider canopy than ricehull medium (Table 3).

Shoot dry weight and plant canopy width were higher in topsoil medium than in ricehull medium. This may suggest that topsoil medium had a higher water and nutrient holding capacity than ricehull medium. It is in conformity with the report by Bunt (1976) who observed that composts made from a good loam have more plant nutrients with respect to nitrogen and phosphorus. Bilderback *et al* (1982) also reported that peanut hulls increased particle size and decreased easily available water of media.

Nitrogen x potassium x media interaction on the number of days to 50% flower bud initiation was significant (Table 4). In ricehull medium, 150ppm K which produced the highest plant canopy also took the longest number of days to initiate flower buds while the least number of days was at 0ppm K at all nitrogen levels. Ricehull medium initiated flower buds earlier than topsoil medium. In topsoil medium, at all nitrogen levels, 100ppm K took the longest and 0ppm K the least number of days to initiate flower buds (Table 4).

The interaction between nitrogen, potassium and media on the number of days to 50% anthesis was significant at $p = 0.05$ (Table 5). In ricehull medium at all nitrogen levels, 150ppm K which produced the widest plant canopy and took the longest number of days to initiate flower buds also took the longest time to 50% anthesis. Time to anthesis was least at 0ppm K. Ricehull medium had a shorter number of days to anthesis than topsoil medium. In topsoil medium, at all levels of nitrogen, 100ppm K took the longest and 0ppm K the least number of days to 50% anthesis (Table 5). Ricehull medium produced the highest number of flower buds at a lower potassium rate than topsoil medium at all nitrogen levels.

In ricehull medium, 50ppm K produced the highest number of flower buds and 150ppm K the least number of flower buds (Table 6). In topsoil medium, at all nitrogen levels, there was an increase in the number of flower buds from 0ppm K to 100ppm K beyond which the number of buds decreased. The number of flower buds was highest at 100ppm K and least at 0ppm K. Topsoil medium produced a higher number of flower buds than ricehull medium (Table 6).

Ricehull medium initiated flower buds and flowered earlier than topsoil medium. Ricehull also produced the highest number of flower buds at a lower potassium rate (50ppm K) than topsoil medium (100ppm K). The delay in the time of flower bud initiation in topsoil medium may be due to the excellent nutritional status of the medium which encouraged longer vegetative growth. Bunt (1976) reported that compost made from a good loam have more plant nutrients with respect to nitrogen and phosphorus. The lower potassium requirement of ricehull at the flowering stage could be attributed to a higher availability of potassium in this medium. This is in agreement with the report by Bunt (1976) who noted that when fertilizers are added to peat-based composts and mineral soils, the levels of available plant nutrients in the peat-based composts will be higher than those of mineral soils because of the lower amount of fixation that occur in peat-based composts.

Nitrogen x potassium x media interaction on the number of flowers produced was significant at $p = 0.05$ (Table 7). In ricehull medium, at all nitrogen levels, 100ppm K produced the highest and 0ppm K the least number of flowers. At all nitrogen levels, the number of flowers increased from 0ppm K to 100ppm K beyond which it decreased. In ricehull medium, 100ppm K which produced the highest shoot and root dry weight, also produced the highest number of flowers (Table 7).

In the topsoil medium, at all nitrogen levels, 50ppm K produced the highest and 150ppm K the least number of flowers. In topsoil medium, 50ppm K which produced the highest shoot and root dry weight also produced the highest number of flowers (Table 7)

Nitrogen x potassium x media interaction on flower diameter was not significant (Table 8). However, in both media and at all nitrogen levels, 50ppm K produced the highest and 150ppm K the least flower diameter (Table 8).

In the topsoil medium, 50ppm K which produced the highest shoot and root dry weight also produced the highest flower diameter while in ricehull medium, 100ppm K which produced the highest shoot and root dry weight also produced the highest number of flowers. The higher potassium requirement of the ricehull medium may be due to leaching losses that occur in such porous medium. Bunt (1976) reported that potassium was more easily removed from peat: sand compost by water and Morgan's solvent than from John Innes compost. He noted that the amount of potassium present in organic material is usually much lower than in mineral soils. Goh and Haynes (1977) asserted that pot mixtures using soilless media have a lower capacity for fixing and storing nutrients.

CONCLUSION

The result showed that with the availability of 150ppm nitrogen in the growing medium, 50ppm K in topsoil medium and 100ppm K in ricehull medium was sufficient for the production of pot marigold. Ricehull medium initiated flower buds and flowered earlier than topsoil medium.

Table 1. Effect of nitrogen, potassium, media and their interaction on shoot dry weight (g)

Meduim (MD)	Potassium (K) (ppm)	Nitrogen (N) (ppm) 0	50	100	150	MD x K mean	Media mean	Potassium mean
	0	1.90	1.80	1.78	2.58	3.18		3.11
	50	2.12	2.98	3.20	4.37	2.51		3.10
Ricehull	100	2.46	3.16	4.59	5.22	3.72	2.96	3.40
	150	1.39	1.52	4.14	4.07	2.41		3.04
MD x N mean		1.97	2.36	3.43	4.06			
	0	1.73	3.56	3.87	3.65	3.04		
	50	3.01	4.01	4.56	5.41	3.68		
Topsoil	100	2.46	3.94	4.19	3.49	3.07	3.37	
	150	1.38	2.93	3.62	2.05	3.67		
MD x N mean		2.14	3.61	4.06	3.65			
Nitrogen mean		2.05	2.99	3.75	3.86			

F-LSD$_{0.05}$				
	Nitrogen (N)	0.28	MD x N	0.40
	Potassium (K)	0.28	MD x K	0.40
	Media (MD)	0.20	MD x N x K	0.81
	N x K	0.57		

Table 2. Effect of nitrogen, potassium, media and their interaction on root dry weight (g)

Meduim (MD)	Potassium (K) (ppm)	Nitrogen (N) (ppm) 0	50	100	150	MD x K mean	Media mean	Potassium mean
	0	0.62	0.39	0.71	0.62	1.30		1.06
	50	0.65	0.87	0.94	1.32	0.87		0.90
Ricehull	100	1.07	1.25	1.88	2.40	1.10	1.01	1.00
	150	1.00	0.88	0.89	0.68	0.76		0.96
MD x N mean		0.83	0.85	1.11	1.25			
	0	0.62	0.57	0.93	0.70	0.81		
	50	0.92	1.00	1.58	2.18	0.93		
Topsoil	100	0.49	0.85	1.10	0.88	0.90	0.95	
	150	0.79	0.82	1.03	0.71	1.15		
MD x N mean		0.71	0.81	1.15	1.12			
Nitrogen mean		0.77	0.83	1.13	1.19			

F-LSD$_{0.05}$				
	Nitrogen (N)	0.17	MD x N	NS
	Potassium (K)	NS	MD x K	0.25

Table 3. Effect of nitrogen, potassium, media and their interaction on plant canopy width (cm)

Meduim (MD)	Potassium (K) (ppm)	Nitrogen (N) (ppm) 0	50	100	150	MD x K mean	Media mean	Potassium mean
	0	19.20	25.60	27.80	28.80	26.75		28.4
	50	23.60	25.60	28.20	29.80	27.30		27.8
Ricehull	100	24.20	28.80	30.20	30.00	26.95	27.61	28.7
	150	25.20	30.00	32.40	32.20	29.45		29.9
MD x N mean		23.05	27.50	29.70	30.20			
	0	21.60	27.20	28.20	30.60	29.95		
	50	25.20	31.00	28.80	32.00	28.30		
Topsoil	100	30.00	33.00	32.40	33.40	30.50	29.75	
	150	27.00	31.20	31.80	32.00	30.25		
MD x N mean		25.95	30.75	30.30	32.00			
Nitrogen mean		24.5	29.1	30.0	31.1			

F-LSD$_{0.05}$				
	Nitrogen (N)	1.02	MD x N	1.44
	Potassium (K)	1.02	MD x K	1.44
	Media (MD)	0.72	MD x N x K	2.87
	N x K	2.00		

Table 4. Effect of nitrogen, potassium, media and their interaction on number of days to 50% flower bud initiation.

Meduim (MD)	Potassium (K) (ppm)	Nitrogen (N) (ppm) 0	50	100	150	MD x K mean	Media mean	Potassium mean
	0	23.80	29.80	32.20	30.20	29.70		30.8
	50	23.80	31.00	33.00	31.00	31.50		31.8
Ricehull	100	26.20	32.20	33.80	31.00	29.40	30.28	30.4
	150	27.80	32.20	35.00	31.40	30.50		30.8
MD x N mean		25.40	31.30	33.50	30.90			
	0	26.60	29.80	29.80	31.80	31.85		
	50	30.20	31.00	30.60	31.80	32.00		
Topsoil	100	32.00	33.00	33.80	34.20	31.35	31.55	
	150	30.80	32.60	33.00	33.80	31.00		
MD x N		29.90	31.60	31.80	32.90			

F-LSD$_{0.05}$				
	Nitrogen (N)	1.07	MD x N	1.51
	Potassium (K)	NS	MD x K	NS
	Media (MD)	NS	MD x N x K	3.02
	N x K	NS		

Table 5. Effect of nitrogen, potassium, media and teir interaction on the number of days to 50% anthesis (days).

Meduim (MD)	Potassium (K) (ppm)	Nitrogen (N) (ppm) 0	50	100	150	MD x K mean	Media mean	Potassium mean
	0	39.00	36.00	27.80	36.20	43.60		44.2
	50	39.60	30.60	35.80	43.20	37.10		40.4
Ricehull	100	40.80	40.40	46.00	43.80	42.30	40.09	38.9
	150	41.40	43.40	46.00	45.40	37.35		38.3
MD x N mean		40.20	39.10	38.90	42.15			
	0	34.20	26.40	43.80	18.40	44.75		
	50	42.60	42.60	44.00	44.60	43.90		
Topsoil	100	45.40	45.20	45.20	45.60	35.40	40.81	
	150	40.20	45.00	44.80	45.00	39.20		
MD x N mean		40.60	39.80	44.45	38.40			
Nitrogen mean		40.4	39.5	41.7	40.2			

F-LSD$_{0.05}$				
Nitrogen (N)	NS		MD x N	NS
Potassium (K)	NS		MD x K	NS
Media (MD)	NS		MD x N x K	13.94
N x K	NS			

Table 6. Effect of nitrogen, potassium, media and their interaction on the number of flowr buds produced per pot.

Meduim (MD)	Potassium (K) (ppm)	Nitrogen (N) (ppm) 0	50	100	150	MD x K mean	Media mean	Potassium mean
	0	13.60	24.20	22.40	26.00	22.40		21.80
	50	14.40	25.60	27.40	28.60	16.90		18.9
Ricehull	100	13.60	13.80	18.40	25.80	23.10	19.10	20.6
	150	10.00	12.00	14.20	15.60	14.00		16.8
MD x N mean		12.90	18.90	20.60	24.00			
	0	12.20	18.00	43.80	18.40	21.10		
	50	12.80	18.40	44.00	44.60	20.80		
Topsoil	100	16.00	45.20	45.20	45.60	18.10	32.13	
	150	15.00	45.00	44.80	45.00	19.65		
MD x N mean		14.00	20.30	23.80	21.55			
Nitrogen mean		13.5	19.6	22.2	22.8			

F-LSD$_{0.05}$				
Nitrogen (N)	2.1		MD x N	NS
Potassium (K)	2.1		MD x K	3.01
Media (MD)	10.60		MD x N x K	13.94
N x K	4.3			

'able 7. Effect of nitrogen, potassium, media and their interaction on the number of flowers produced per pot.

ledium (MD)	Potassium (K) (ppm)	Nitrogen (N) (ppm) 0	50	100	150	MD x K mean	Media mean	Potassiu mean
	0	6.20	3.80	2.20	2.60	5.35		7.3
	50	8.40	13.20	7.80	8.20	10.80		9.4
icehull	100	9.60	13.80	12.60	12.60	11.40	8.24	9.7
	150	7.20	4.60	8.20	10.80	5.40		7.0
ID x N mean		5.03	5.02	5.00	5.01			
	0	7.00	7.40	8.60	8.60	9.25		
	50	10.00	12.40	12.20	14.00	7.90		
'opsoil	100	8.80	9.80	10.80	6.00	7.90	8.40	
	150	3.40	5.40	6.00	4.00	8.55		
ID x N mean		5.05	5.10	5.02	5.04			
litrogen mean		7.6	8.8	8.6	8.4			

F-LSD$_{0.05}$				
	Nitrogen (N)	NS	MD x N	NS
	Potassium (K)	1.79	MD x K	2.53
	Media (MD)	NS	MD x N x K	5.07
	N x K	3.60		

'able 8. Effect of nitrogen, potassium, media and their interaction on flower buds diameter. (cm)

ledium (MD)	Potassium (K) (ppm)	Nitrogen (N) (ppm) 0	50	100	150	MD x K mean	Media mean	Potassiu mean
	0	3.36	3.48	2.98	3.04	3.22		3.16
	50	3.40	3.54	3.56	3.34	2.61		2.93
icehull	100	3.24	2.30	2.74	3.28	3.46	2.92	2.98
	150	2.86	2.08	1.62	1.90	2.40		2.71
ID x N mean		2.60	2.57	2.61	2.62			
	0	3.06	3.32	2.98	3.10	3.10		
	50	3.38	3.34	3.46	3.48	3.24		
opsoil	100	3.34	3.02	3.32	3.24	2.49	2.96	
	150	2.54	1.80	2.94	1.10	3.02		
ID x N mean		2.50	2.45	2.53	2.56			
itrogen mean		3.15	2.86	2.95	2.81			

F-LSD$_{0.05}$				
	Nitrogen (N)	NS	MD x N	NS
	Potassium (K)	NS	MD x K	0.50
	Media (MD)	NS	MD x N x K	NS
	N x K	0.71		

REFERENCES

Banko, T.J. (1981). Effect of pine-bark sand media and fertilizer levels on the growth of containerized junipers. *Hort.Sci* 16 (3) 367.

Beardsell, D.V., Nichols, D.G., and Jones D.L. (1979). Water relations of nursery potting media. *Scientia Hort.* 11:9-17.

Bilderback, T.E., Fonteno, W.C. and Johnson, D.R. (1982). Physical properties of media composed of peanut hulls, pinebark, peatmoss and their effects on azalea growth. *J. Amer. Soc. Hort. Sci.* 107:522-525.

Bunt, A.C. (1976). Modern Potting Composts. Pennsylvania State Univ. Press, London. 277pp.

Criley, R.A., Parvin, E. (1978). Effect of nutrientregimes and minor elements on the growth and tissue composition of poinsettia cultivars in soilless media Departmental paper of College of Tropical Agriculture, Hawaii University. 534pp.

Davis, B. N. K., Walker, N., ball, D. F. and Fitter, A. H. (1992). The Soil Hape Collins Publishers, London. 192pp.

Foth, H. D. (1990). Fundamentals of Soil Science. John Wiley and Sons New York. 360pp.

Goh, K.M. and Hayness, R.J. (1977). Evaluation of potting media for commercial nursery production of container grown plants. *New Zealand Journ. Agric.Res.* 20:363-370.

Johnson, C.R., J.T. Midcap and D.F. Hamilton. (1981). Evaluation of potting media, fertilizer source and rate of application on chemical composition and growth of *Ligustrum japonicum* THUNB. *Scientia Hort* 14:157-163.

Mastalerz, J.W. (1977). The Greenhouse environment. John Wiley and Sons Inc. USA 629pp.

Obi, I.U. (1986). Statistical Methods of Detecting Differences between Treatment Means. SNAAP Press Limited, Enugu, Nigeria. 45pp.

Steel, R.G.D. and Torrie, J.H. (1980). Principles and Procedures of Statistics (2nd edition). McGraw Hill Book Company Inc. New York. 633pp.

Thomas, M.B. (1981). N.P.K Nutrition of container grown *Grevillea rosmarnifolia New Zealand Journ. Agric. Res* 24:379-384.