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**Koshika Srinivas**  
Research scholar, College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS) Allahabad, Uttar Pradesh, India

**Sameer Daniel**  
Research Advisor, College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS) Allahabad, Uttar Pradesh, India

**Saumya Sharon Xaxa**  
Research scholar, College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS) Allahabad, Uttar Pradesh, India

**Alka Suren**  
Research scholar, College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS) Allahabad, Uttar Pradesh, India

**Imkongyapang Pongener**  
Research scholar, College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS) Allahabad, Uttar Pradesh, India

**Correspondence**  
**Koshika Srinivas**  
Research scholar, College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS) Allahabad, Uttar Pradesh, India

## Effect of NPK, Biofertilizers and Spacings on growth and yield of African marigold (*Tagetes erecta* L.) under *Jatropha* (*Jatropha curcas* L.) based Horti-Silvicultural system

**Koshika Srinivas, Sameer Daniel, Saumya Sharon Xaxa, Alka Suren and Imkongyapang Pongener**

### Abstract

A field experiment was conducted at College of Forestry, SHUATS, Allahabad, during the *rabi* season of 2017, to determine the "Effect of NPK, Biofertilizers and Spacings on Growth and Yield of African Marigold (*Tagetes erecta* L.) Under *Jatropha* (*Jatropha curcas* L.) based Horti-Silvicultural system." The experiment consisted of 7 fertility levels *i.e.* Control; 50% RDF of NPK; 50% RDF of NPK+ *Azotobacter* +PSB; 75% RDF of NPK; 75% RDF of NPK + *Azotobacter* +PSB; 100% RDF of NPK; 100% RDF of NPK + *Azotobacter* + PSB and 3 spacings *ie.*, 45 x 45 cm; 60 x 45 cm; 60 x 60 cm were laid out in Factorial Randomized Block Design and replicated thrice. The results revealed that the treatment (100% RDF of NPK + *Azotobacter* + PSB) recorded the plant height (49.98 cm), number of primary branches plant<sup>-1</sup> (14.77 DAT), plant spread E-W (55.46 cm<sup>2</sup>) & N-S (54.06 cm<sup>2</sup>), duration of flowering days (64.88) and number of flowers plant<sup>-1</sup> (53.44) and under spacing *i.e.* (60x60 cm), whereas plant height (41.75 cm), number of primary branches plant<sup>-1</sup> (11.09 DAT), plant spread E-W (41.73 cm<sup>2</sup>) & N-S (40.47 cm<sup>2</sup>), duration of flowering days (57.38) and number of flowers plant<sup>-1</sup> (44.85). post-harvest observations *viz.*, average weight of flower (8.63 g), average diameter of flower (7.22 cm), yield of flowers per plant (499.2 g), yield of flowers per plot (6.33 kg), yield of flowers per hectare (158.33 q ha<sup>-1</sup>) and under spacing *i.e.* (60 x 60 cm), whereas average weight of flower (7.34g), average diameter of flower (6.49 cm), yield of flowers per plant(356.5g), yield of flowers per plot (4.85 kg) and yield of flowers per hectare (121.42q ha<sup>-1</sup>).

**Keywords:** marigold, *jatropha*, NPK, spacing, *Azotobacter*, PSB, growth and yield

### Introduction

Agroforestry, as the name indicates, is a combination of practice of agriculture and forestry on the same piece of land. According to FAO, "Agroforestry is a land use that involves deliberate retention, introduction of mixtures or trees or other woody perennials in crop and animal production field to benefit from the resultant ecological and economic interactions".

*Jatropha curcas* L. is a monoecious shrub or small tree of on average 3-5 and up to 8 m height, with a single main straight stem and multiple secondary branches with leaves arranged alternately on the stem. The crop belongs to the genus *Euphorbiaceae* and can be found in many tropical and subtropical regions. *Jatropha* can be cultivated as a single tree, in hedges, in intercropping with other crops, or as a monoculture.

African marigold (*Tagetes erecta* L.) is a member of family compositeae, one of the commercially exploited flower crop, has a versatile use in decoration, landscaping, industries and medicinal sector. It is suitable for potted plants, bedding, edging, garland making, religious offerings and also for making different products. In India, marigold occupies an area of 55.89 thousand hectare with the production of 511.31 thousand MT and Rajasthan, occupies an area of 1079 hectare with the production of 1039 tonnes (Anonymous 2013-14).

Marigold also has a great medicinal importance. Both leaves and flower have been reported to be medicinally important. Leaf extract is good remedy for ear ache. All varieties of marigold are resistant to *Meloidogyne incognita* and can be used for control of *Meloidogyne incognita* in highly infected areas (Jadhav 2014) [2]. Marigold also produces thiophenes, which are naturally occurring biocides that active against nematodes (Singh 2015) [5].

Adequate supply of nutrients especially N, P and K are often considered important for realizing the maximum yield of any crop. Moreover, nitrogen compounds constitute 40-50 per cent of the dry matter of protoplasm and it is also an integral part of chlorophyll which is primary absorber of light energy needed for photosynthesis.

Phosphorus is also a major nutrient required by the crops. It is indispensable constituent of nucleic acid, phospholipids and several enzymes. The most essential function of phosphorus in a plant is energy storage and transfer for proper metabolism. (Laxmi *et al.* 2014) [3].

Potassium is not a constituent of any plant tissue or compounds but it is involved in the synthesis of amino acids. It imparts vigour and disease resistance to plants. It also regulates water loss from the plant by maintaining the balance between anabolism, respiration and transpiration.

Bio-fertilizers play an important role in increasing availability of nutrients and productivity in sustainable manner. *Azotobacter* is a free-living bacteria which may add 25-30 kg nitrogen ha/year in a field of non-legume crop under favorable condition and also secretes some growth promoting substances. Inoculation of seedlings with PSB culture increase nodulation, crop growth, nitrogenase activity, nutrient uptake and crop yield. Keeping this in view, the present experiment was undertaken to study the "Effect of NPK, biofertilizers and spacings on growth and yield of african marigold (*Tagetes Erecta* L.) Under jatropha (*Jatropha Curcas* L.) based horti-silvicultural system".

### Materials and Methods

The field experiment was during the Rabi 2017-18 on green gram crop at conducted at Forest Nursery, college of Forestry, SHUATS, Allahabad (U.P), which is located at 25°24'41.27" N latitude, 81°51'3.42" E longitude and 98 m altitude above mean sea level. The soil of experimental field was sandy loam having pH of 7.6, with 17 % of organic carbon, available N 43 kg/ha, available P is 14.6 kg/ha, available K is 232.8 kg/ha. The experiment consisted of 7 fertility levels *ie.*, Control; 50% RDF of NPK; 50% RDF of NPK+ *Azotobacter* +PSB; 75% RDF of NPK; 75% RDF of NPK + *Azotobacter* +PSB; 100% RDF of NPK; 100% RDF of NPK + *Azotobacter* + PSB and 3 spacings *ie.* 45x45cm; 60x45 cm; 60x60cm were laid out in Factorial Randomized Block Design and replicated thrice. All nursery management practices, seeds were sown in nursery bed to raise healthy seedlings. Thirty days old

seedlings were transplanted in the main field. Before transplanting the seedlings were treated with bio fertilizers (*Azotobacter* and PSB). Phosphorus and Potassium was applied as basal in full dose while, nitrogen was applied half dose as a basal at the time of transplanting and remain half was applied at the span of flowering. Pinching operation were done at 45 DAT. Weeding, irrigation and pesticide application were done under requisite. The observations on growth attributes *viz.* plant height, number of primary branches, plant spread, appearance of first flower, duration of flowering days, number of flowers plant<sup>-1</sup> and post-harvest observations *viz.*, average weight of flower, average diameter of flower, yield of flowers per plant, yield of flowers per plot, yield of flowers per hectare statistically analyzed and critical difference were calculated.

### Results and Discussions

#### Growth attributes

Data pertaining to growth attributes are presented in Table 1, which revealed that the growth attributes like plant height (49.98 cm), number of primary branches plant<sup>-1</sup> (14.77 DAT), plant spread E-W(55.46 cm<sup>2</sup>) & N-S (54.06 cm<sup>2</sup>), duration of flowering days (64.88) and number of flowers plant<sup>-1</sup> (53.44). It might be due to the combine application of NPK along with *Azotobacter* and PSB, mutually benefited each other by supplying of essential nutrients to plant. These findings are close corroborate with the Rolaniya *et al.* (2017) [4] and Kumar *et al.* (2006). Under spacing *ie.* (60x60cm), whereas plant height (41.75 cm), number of primary branches plant<sup>-1</sup> (11.09 DAT), plant spread E-W (41.73 cm<sup>2</sup>) & N-S (40.47 cm<sup>2</sup>), duration of flowering days (57.38) and number of flowers plant<sup>-1</sup> (44.85). The increased number of branches and plant spread may be attributed to the availability of more space for growth of roots and shoots as well as utilization of more nutrients by the plants and less competition among the plants for available resources in wider spacing Rolaniya *et al.* (2017) [7]. These results are close conformity with the findings of Sunitha *et al.* (2007) [7] and Singh *et al.* (2008) [6].

**Table 1:** Effect of NPK, biofertilizers and spacings on growth attributes of African marigold (*Tagetes erecta* L.) under Jatropha (*Jatropha Curcas* L.) based horti-silvicultural system

Treatments	Plant height (cm)	Number of primary branches plant <sup>-1</sup>	Plant spread (cm <sup>2</sup> )		Duration of flowering days	Number of flowers plant <sup>-1</sup>
			E-W	N-S		
<b>Fertility levels</b>						
Control	32.12	6.11	26.64	25.73	45.77	30.00
50% RDF of NPK	36.54	7.11	32.35	31.05	49.55	36.33
50% RDF of NPK+ <i>Azotobacter</i> + PSB	37.78	9.11	37.37	36.47	53.77	41.77
75% RDF of NPK	38.87	10.77	37.82	37.90	57.66	45.11
75% RDF of NPK + <i>Azotobacter</i> + PSB	43.73	13.00	42.54	41.01	63.33	49.22
100% RDF of NPK	47.54	14.22	49.70	47.53	63.88	49.88
100% RDF of NPK + <i>Azotobacter</i> + PSB	49.98	14.77	55.46	54.06	64.88	53.44
SEm+	0.31	0.29	0.67	0.72	0.43	0.48
CD at 5%	0.91	0.84	1.94	2.08	0.25	1.38
<b>Spacing</b>						
45x45cm	40.48	10.38	39.20	37.97	56.52	42.52
60x45cm	40.59	10.71	39.87	38.88	57.04	43.66
60x60cm	41.75	11.09	41.73	40.47	57.38	44.85
SEm+	0.20	0.19	0.44	0.47	0.28	0.31
CD at 5%	0.59	0.55	1.27	1.36	-	0.90

#### Post-harvest observations

Data pertaining to Post - harvest observations are presented in Table 1, which revealed that the average weight of flower (8.63 g), average diameter of flower (7.22 cm), yield of

flowers per plant (499.2 g), yield of flowers per plot (6.33 kg), yield of flowers per hectare (158.33 q ha<sup>-1</sup>) The positive effect of nutrients supplied through NPK fertilizers and inoculation of bio fertilizers through root dipping, it might

create the availability of nutrients in the vicinity of plant. Under spacing *i.e.* (60x60cm), whereas average weight of flower (7.34 g), average diameter of flower (6.49 cm), yield of flowers per plant (356.5g), yield of flowers per plot (4.85 kg), yield of flowers per hectare (121.42q ha<sup>-1</sup>). *Azotobacter*

and PSB are reported to produce growth promoting substances acids like acetic, formic, glycolic and succinic which were positively correlated with growth and flowering and helps in branching and development of side buds Rolaniya *et al.* (2017) [7] and Desmane *et al.* (2012) [1].

**Table 2:** Effect of NPK, bio fertilizers and spacings on yield post-harvest observations of African marigold (*Tagetes Erecta* L.) under Jatropa (*Jatropa Curcas* L.) based horti-silvicultural system

Treatments	Average weight of flower (g)	Average diameter of flower (cm)	Yield of flowers per plant (g)	Yield of flowers per plot (kg)	Yield of flowers (q ha <sup>-1</sup> )
<b>Fertility levels</b>					
Control	4.88	5.05	169.0	2.86	77.22
50% RDF of NPK	5.97	5.75	232.1	3.45	86.66
50% RDF of NPK+ Azotobacter +PSB	6.74	6.43	302.3	4.14	103.61
75% RDF of NPK	7.53	6.60	374.6	4.84	120.27
75% RDF of NPK + Azotobacter + PSB	8.17	6.91	423.2	5.25	131.38
100% RDF of NPK	8.44	7.08	459.6	5.77	144.44
100% RDF of NPK + Azotobacter + PSB	8.63	7.22	499.2	6.33	158.33
SEm+	0.05	0.03	2.42	0.12	1.55
CD at 5%	0.16	0.08	6.96	0.35	4.46
<b>Spacing</b>					
45x45cm	7.07	6.40	346.8	4.61	115.47
60x45cm	7.18	6.41	351.0	4.52	115.35
60x60cm	7.34	6.49	356.5	4.85	121.42
SEm+	0.03	0.02	1.50	0.08	1.02
CD at 5%	0.10	0.05	4.56	0.23	2.92

### Conclusion

On the basis of results, the study were revealed that the treatment 100% RDF of NPK + *Azotobacter* + PSB recorded the significantly higher values of growth and flower yield of marigold under jatropa. Though, it also concluded that spacing (60x60 cm) recorded the higher values of flower yield under jatropa.

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