Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; SP1: 946-948

Akhilendra Verma
Research Scholar, Department of Horticulture, Institute of Agricultural Sciences Banaras Hindu University, Varanasi, (U.P.), India

SP Singh
Professor, Department of Horticulture, Institute of Agricultural Sciences Banaras Hindu University, Varanasi, (U.P.), India

Bijendra Kumar Singh
Research Scholar, Department of Horticulture, Institute of Agricultural Sciences Banaras Hindu University, Varanasi, (U.P.), India

Rajiv Kumar Singh
Subject Matter Specialist, KVK Ballia (UP), India

Correspondence
Akhilendra Verma
Research Scholar, Department of Horticulture, Institute of Agricultural Sciences Banaras Hindu University, Varanasi, (U.P.), India

Response of Yield and Yield Attributing traits in Cape gooseberry (*Physalis peruviana* L.) to integrated nutrient management

Akhilendra Verma, SP Singh, Bijendra Kumar Singh and Rajiv Kumar Singh

Abstract
Research experiment was conducted during 2013-14 and 2014-15 at the Horticulture Research Farm, analysed in the Laboratory Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, to study the response of yield and yield attributing traits in cape gooseberry (*Physalis peruviana* L.) to integrated nutrient management. The experiment was laid out in Randomized Block Design with fifteen and three replications. The minimum number of days taken to first flower bud appearance, days to first flowering and days to 50% flowering were recorded in the plants which were treated with 100% NPK + FYM + AZB + PSB, however, the maximum number of days was recorded in 50% NPK. The maximum number of flowers per plant, fruits set, fruit number per plant, fruit weight, yield$plant^{-1}$ and per ha^{-1} was recorded with100% NPK + FYM + AZB + PSB followed by 100% NPK + FYM + PSB, whereas the minimum recorded with application of 50% NPK. The maximum benefit: cost ratio was found with 100% NPK + FYM + AZB + PSB which was followed by 100% NPK + FYM + PSB treatment.

Keywords: Cape gooseberry, yield, fertilizers, farm yard manure and biofertilizers

Introduction
The cape gooseberry (*Physalis peruviana* L.) which belongs to the family *Solanaceae*, has more than 70 species but only a few have economic value. It is native to Brazil. The cape gooseberry is an annual in temperate regions and a perennial in the tropics. It is an herbaceous, semi-shrub that is upright, perennial in subtropical zones and can grow until reaches 0.9 m. The fruit is 4–5 g in weight, remains protected by a calyx and covered by a brilliant yellow peel (Mayorga, *et al.*, 2001) [5]. In North India, the fruit ripens in February, but in South India the main crop extends from January to May. The fruit is rich in vitamins A (3,000 I.U.), C and B-complex namely (thiamine, niacin, and vitamin B 12). The fruit contains 78.9-85.5% moisture, 0.3-1.5% protein, 0.15-0.5% fat, 11-19.6% carbohydrate, 0.4-4.9% fiber, 0.7-1% ash and pulp is composed of 1.6 mg/100g carotene, 0.1-0.18 mg/100g thiamine, 0.03-0.18 mg/100g riboflavin, 0.8-1.7 mg/100g niacin, 20-43 mg/100g vitamin C, 210-467mg/100g K, 7-19 mg/100g Mg, 8-28 mg/100g Ca, 27-55.3 mg/100g P, 0.3-1.2 mg/100g Fe, 0.28-0.40 mg/100g Zn (Puente *et al*., 2011; Ramadan and Morsel, 2009) [9, 10]. Intensive cultivation coupled with use of unbalanced and inadequate fertilizers accompanied with restricted use of organic manures and biofertilizers has made the soils not only deficient in nutrients, but also deteriorated the soil health which ultimately resulted declined yield level. Under such situation, the use of chemical fertilizers along with organic manures and biofertilizers has assumed a great significance for the maintenance of soil productivity.

Materials and methods
The present investigation entitled "Response of Yield and Yield Attributing traits in Cape Gooseberry (*Physalis peruviana* L.) to Integrated Nutrient Management" was carried out during winter season of 2013-14 and 2014-15 at the Vegetable Research Farm, analysed in the Laboratory of Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The treatment comprised with different doses of NPK@ 100, 80 and 60kg/ha, farm yard manure (15 t/ha) along with bio-fertilizers (*Azotobacter* and PSB). Seven floral attributes (Table-1) and six yield characters and economic observation (Table-2) were used to characterizes and describe the 15 treatment of cape gooseberry. The experiment was laid out in randomized block design with fifteen treatments viz., T1- 50% NPK, T_2 - 50% NPK + FYM, T_3 - 50% NPK + FYM + AZB, T_4 - 50% NPK + FYM + PSB, T_5 -50% NPK + FYM + AZB + PSB, T_6 -75% NPK, T_7 -75% NPK + FYM, T_8 -75% NPK + FYM + AZB, T_9 -75%

NPK + FYM + PSB, T_{10} -75% NPK + FYM + AZB + PSB, T_{11} -100% NPK, T_{12} -100% NPK + FYM, T_{13} -100% NPK + FYM + AZB, T_{14} -100% NPK + FYM + PSB and T_{15} -100% NPK + FYM + AZB + PSB and three replications. Five plants were randomly selected from each treatment having uniform canopy for recording observation.

To determine the, observation at 10 days interval was recorded and average number was calculated. Number of days taken for phonological characters calculated from date of transplanting from ten randomly selected plants. The average was worked out and expressed in days. The total amount of fruits produced per treatment was weighed and recorded at the time of each harvesting and expressed as yield of fruits/plant in grams (g). In order to find out returns announcement of one rupee the gross return obtained from individual treatment was divided by its respective cost incurred in its application. The statistical analysis was done according to method given by Panse and Sukhatme (1985) [7].

Results and Discussion

Floral Characters

The minimum number of days taken to produce first flower bud appearance, days to first flowering, days to 50% flowering and days taken to first fruit set were recorded in the plants which were treated with 100% NPK + FYM + AZB + PSB. However, the maximum number of days taken to produce first flower was recorded in 50% NPK. This phenomenon may be on account of prolonged growth of plant in the presence of INM. These results corroborate the findings of Mishra and Tripathi (2012) [6] and Kumar *et al.* (2007) [4].

Further, it was also observed during this investigation that the maximum number of flowers per plant was recorded with application of100% NPK + FYM + AZB + PSB. However, the minimum number of flowers per plant was observed with 50% NPK. This might be due to fact that INM application accelerated the development of inflorescence and leaf number in autumn, which in turn gave more number of flowers and fruits in the following spring. Similar observations have also been reported by Tripathi *et al.* (2010) [11] in strawberry who reported that higher dose of *Azotobacter*and PSB (7 kg ha^{-1}) increased number of flowers per plant.

The maximum fruits set and fruit number per plant was observed when the plants treated with 100% NPK + FYM + AZB + PSB followed by 100% NPK + FYM + PSB, whereas the least fruit set per plant and fruit number per plant was noted with 50% NPK. These results are in conformity with the findings of Gajbhiye *et al.* (2003) [2], who noted that increase in *Azotobacter* and PSB concentration resulted in higher fruit set in tomato.

Yield

Days to first fruit picking was significantly decreased with INM applications. The minimum days to first fruit picking was observed when the plants were fed with 100% NPK + FYM + AZB + PSB followed by 75% NPK + FYM + AZB + PSB treated plants. Similar results were also recorded by Tripathi *et al.* (2010) [11], Singh and Singh (2009) in strawberry, who got advanced duration of harvesting (earliness) by approximately one month which obviously extended the period of harvesting.

During the present investigation, it was observed that INM application gave remarkable increase in the yield of cape gooseberry fruits. The maximum yieldplant^{-1} and per ha^{-1} was recorded with100% NPK + FYM + AZB + PSB followed by 100% NPK + FYM + PSB, whereas the minimum yield plant^{-1}and ha^{-1}was recorded with applicationof 50% NPK. These findings are in line with the Subbiah (1994) [14] in chilli, Wange *et al.* (1998) [15] in strawberry, Kadlag *et al.* (2007) [3] in tomato and Tripathi *et al.* (2010) [11] in strawberry, who recorded higher yield with *Azotobacter*application. The increase in yield might be due to increased fruit set per plant, fruit length and fruit width as well as fruit weight influenced by nitrogen fixers.

Economics of Treatment

The maximum benefit: cost ratio was found with 100% NPK + FYM + AZB + PSB which was followed by 100% NPK + FYM + PSB treatment. The maximum net income was also obtained from treatment 100% NPK + FYM + AZB + PSB, followed by treatment 100% NPK + FYM + PSB. The minimum benefit: cost ratio and net incomewere obtained with 50% NPKtreatment.

This might be due to the reason that the plant consumed nutrient provided them through inorganic and organic sources along with bio-fertilizers. This combination improved the quality as well as fruit yield of plant. Similar results were reported by Selvi *et al.* (2000) [12], Prabhu *et al.* (2002) [8] and Bairwa *et al.* (2009) [1].

Conclusion

From the results obtained during the present investigation with different treatment combinations of INM on Yield and Yield Attributing traits of cape gooseberry, it is concluded that minimum days to first flower bud appearance, days to first flowering, days to 50% flowering, days to first fruit set, days to first picking and maximum number of flowers/plant, number of fruits/plant, fruit setting percentage was recorded in 100% NPK + FYM + AZB + PSB followed by 100% NPK + FYM + PSB.

Maximum benefit: cost ratio was achieved through application of 100% NPK + FYM + AZB + PSBwhich was followed by100% NPK + FYM + PSB. Highest net income was obtained with100% NPK + FYM + AZB + PSB, followed by100% NPK + FYM + PSB. Lowest benefit: cost ratio was found with 50% NPK, whereas lowest net income was achieved with50% NPK.

On the basis of above findings, it may be concluded that for getting quality fruits the plants of cape gooseberry should be fed with 100% NPK + FYM + AZB + PSB and 100% NPK + FYM + PSB in the plains of Uttar Pradesh, India.

Table 1: Response of floral Characters in Cape Gooseberry (*Physalis peruviana* L.) to Integrated Nutrient Management (mean data of two year).

Name of treatments	Days to first flower bud appearance	Days to first flowering	Days to 50% flowering	Number of flowers/plant	Days to first fruit set	Number of fruits/plant	Percentage (%) of fruit setting
50% NPK	59.26	65.83	70.50	51.79	74.50	43.71	84.46
50% NPK + FYM	58.28	64.83	69.50	56.28	73.50	47.57	84.57
50% NPK + FYM + AZB	58.09	64.50	68.50	56.72	72.17	48.28	85.15
50% NPK + FYM + PSB	57.05	63.50	67.50	67.78	71.83	61.08	90.12
50% NPK + FYM + AZB + PSB	55.78	62.17	66.83	80.14	70.17	72.79	90.84
75% NPK	56.11	63.83	68.83	60.07	72.83	51.58	85.90

75% NPK + FYM	56.52	63.33	68.00	70.59	71.67	62.57	88.66
75% NPK + FYM + AZB	55.28	61.83	67.17	84.46	69.50	76.94	91.13
75% NPK + FYM + PSB	53.06	58.50	63.50	92.26	65.17	85.83	92.87
75% NPK + FYM + AZB + PSB	51.83	56.83	61.17	95.00	62.50	87.89	92.53
100% NPK	54.42	60.67	66.67	65.59	69.33	55.69	84.94
100% NPK + FYM	53.84	59.17	64.17	75.82	65.83	67.45	88.96
100% NPK + FYM + AZB	52.95	58.17	62.50	86.49	64.50	79.11	91.46
100% NPK + FYM + PSB	52.04	56.83	60.83	98.85	62.50	91.81	92.88
100% NPK + FYM + AZB + PSB	51.60	56.50	60.50	104.00	61.83	96.07	92.38
CD at 5%	1.75	2.17	3.17	3.57	2.76	3.46	3.91

Table 2: Response of Yield and Economics of Cape Gooseberry (*Physalis peruviana* L.) to Integrated Nutrient Management (mean data of two year).

Name of treatments	Days to first fruit picking	Fruit yield/plant (g)	Projected yield of fruit (qt/ha)	Gross Income	Net Income	B:C Ratio
50% NPK	122.75	65.83	70.50	403089	350592	6.68
50% NPK + FYM	119.69	64.83	69.50	470937	412200	7.02
50% NPK + FYM + AZB	118.54	64.50	68.50	516771	457826	7.77
50% NPK + FYM + PSB	113.94	63.50	67.50	667287	607718	10.20
50% NPK + FYM + AZB + PSB	108.37	62.17	66.83	881049	821272	13.74
75% NPK	116.06	63.83	68.83	564872	510565	9.40
75% NPK + FYM	110.67	63.33	68.00	728718	668171	11.04
75% NPK + FYM + AZB	106.65	61.83	67.17	939273	878518	14.46
75% NPK + FYM + PSB	99.64	58.50	63.50	1163524	1102145	17.96
75% NPK + FYM + AZB + PSB	95.66	56.83	61.17	1276475	1214888	19.73
100% NPK	104.48	60.67	66.67	672738	616624	10.99
100% NPK + FYM	101.41	59.17	64.17	866536	804182	12.90
100% NPK + FYM + AZB	98.66	58.17	62.50	1066441	1003879	16.05
100% NPK + FYM + PSB	96.51	56.83	60.83	1301279	1238093	19.59
100% NPK + FYM + AZB + PSB	92.81	56.50	60.50	1456969	1393575	21.98
CD at 5%	1.65	2.17	3.17			

Reference

1. Bairwa HL, Mahawer LN, Shukla AK, Kaushik RA, Mathur SR. Response of integrated nutrient management on growth, yield and quality of okra. Ind. J Agril. Sci., 2009; 79(5):381-384.
2. Gajbhiye RP, Sharma RR, Tewari RN. Effect of bio-fertilizers on growth and yield parameters of tomato. Ind. J. Hort., 2003; 60(4):368-371.
3. Kadlag AD, Jadhav AB, Bharti R. Yield and quality of tomato fruit as influenced by biofertilizers. Asian J. Soil Sci. 2007; 2(2):95-99.
4. Kumar A, Kumar J, Babu R. Effect of inorganic and biofertilizers on growth, yield and quality of tomato. Prog. Agri. 2007; 7(1, 2):151-152.
5. Mayorga H, Knapp H, Winterhalter P, Duque C. Glycosidically bound flavor compounds of cape gooseberry (*Physalis peruviana* L.). J. Agri. Food Chem. 2001; 49:1904-1908.
6. Mishra AN, Tripathi VK. Effect of biofertilizers on vegetative growth, flowering, yield and quality of strawberry cv. chandler. Proceedings of the International Symposium on Minor Fruits and Medicinal Plants for Health and Ecological Security (ISMF & MP), West Bengal, India, 2012, 211-215.
7. Panse VG, Sukhatme PV. Statistical methods for Agricultural Workers, 4th Edn. ICAR, New Delhi, 1985.
8. Prabhu T, Narwadkar PR, Sajindranath AK. Economics of integrated nutrient management in Okra. J. Maharastra Agril. Univ. 2002; 27(3):316-318.
9. Puente LA, Pinto SA, Castro ES, Cortés M. *Physalis peruviana* L., The multiple properties of a highly functional fruit: a review. Food Res. 2011; I(44):1733-1740.
10. Ramadan MF, Morsel JT. Oil extractability from enzymatically-treated goldenberry (*Physalis peruviana* L.) pomace: Range of operational variables. Int. J. of Food Sci. Tech. 2009; 44:435-444.
11. Tripathi VK, Kumar N, Shukla HS, Mishra AN. Influence of *Azotobacter*, *Azospirillum*and PSB on growth, yield and quality of strawberry cv. Chandler, Paper presented in *National Symposium on Conservation Hort.*, during March, 21-23, 2010 at Dehradoon, 2010, 198-199.
12. Selvi D, Perumal R. Effect of integrated nutrient management on yield and economic of okra in an inceptisol. Veg. Sci., 2000; 27(2):207-208.
13. Singh M, Singh HK, Singh JK. Effect of INM on yield and quality of ber *cv*. Banarsi Karaka. Asian J. Hort. 2009; 4(1):47-49.
14. Subbiah K. Effect of nitrogen, phosphorous and biofertilizers on yield and nutrient uptake in chilli and bellary onion. Madras Agri. J. 1994; 81(5):277-279.
15. Wange SS, Patil MT, Singh BR. Cultivar biofertilizer interaction study in strawberry. Recent Hort. 1998; 4:43-49.