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Response of Physico-Chemical Attributes in Cape Gooseberry (*Physalis peruviana* L.) to Integrated Nutrient Management

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A B S T R A C T

Field 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 physico-chemical attributes 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 maximum fruit size (length and width), weight and volume were recorded in the plants treated with 100% NPK + FYM + AZB + PSB followed by 75% NPK + FYM + AZB + PSB and minimum were found in the plant treated with 50% NPK. The maximum TSS, ascorbic acid, reducing sugar, non-reducing sugar, total sugar, pH and TSS/Acid ratio were recorded in the fruits produced from the plants treated with 75% NPK + FYM + AZB + PSB followed by 75% NPK + FYM + PSB. The minimum acidity was recorded in 75% NPK + FYM + AZB + PSB treated plants, whereas, the highest acidity were recorded in 100% NPK. The highest juice percent and pH were recorded in the 100% NPK + FYM + AZB + PSB whereas, the minimum juice percent and pH were recorded in 50% NPK treated plants.

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). 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). 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 Physico-Chemical Attributes 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 60 kg/ha, farm yard manure (15 t/ha) along with bio-fertilizers (*Azotobacter* and PSB). Five morphological or physical characters (Table 1) and ten chemical attributes (Table 2) of fruits were used to characterizes and describe the 15 treatment of cape gooseberry. The experiment was laid out in randomized block design with fifteen treatments and three replications. Five fruit were randomly harvested from each treatment having uniform shape and size.

The fruits were weighed and volume of fruits was determined by water displacement method. The fruit size was recorded by measuring length and diameter of fruits with the help of Vernier Callipers. The TSS of pulp was determined with the help of Erma Hand Refractometer. However, the rest quality parameters such as ascorbic acid, acidity and dry-matter content were analysed by using standard methods (AOAC, 1990). Sugars were estimated by Fehling 'A' and 'B' solution method given by Lane and Eynon, 1943. The statistical analysis was done according to method given by Panse and Sukhatme (1985).

Results and Discussion

Physical characters of the fruits

In the present investigation the fruit size (length × width) was significantly increased by the use of INM. The mean data presented in Table 1 clearly revealed that maximum fruit size, weight and volume were recorded in the plants treated with 100% NPK + FYM + AZB + PSB followed by 75% NPK + FYM + AZB + PSB. Similar results were obtained by Gajbhiye *et al.,* (2003), Shukla *et al.,* (2009) and Meena *et al.,* (2014) in tomato.

The increase in fruit size, weight and volume during the present investigation might be due to an increased photosynthetic ability of plants fertilized with 100% NPK + FYM + AZB + PSB, which in turn favored and increased accumulation of dry matter. Fruit size, weight, fruit volume and specific gravity are highly correlated with dry matter content, balanced level of hormone and nitrogen fixers which are known for accumulation of dry matter and their translocation as well as synthesis of different growth regulators (Kachot *et al.,* 2001).

Chemical attributes of the fruits

Juice, TSS, reducing sugar, non-reducing sugar, total sugar, pH and TSS/Acid ratio of fruits were significantly increased by adoption of INM. The mean data presented in Table 2 clearly revealed that maximum TSS, reducing sugar, non-reducing sugar, total sugar, pH, TSS/Acid ratio and dry matter were recorded with 75% NPK + FYM + AZB + PSB followed by 75% NPK + FYM + PSB.

Table.1 Response of physical characteristics of fruits in cape gooseberry (*Physalis peruviana* L.) to integrated nutrient management (mean data of two year)

Name of treatments	Fruit length (mm)	Fruit width (mm)	Fruit weight (g)	Fruit volume (cc)	Specific Gravity
50% NPK	18.50	21.48	5.723	5.78	0.991
50% NPK + FYM	19.08	21.87	6.178	6.05	1.022
50% NPK + FYM + AZB	19.17	22.11	6.548	6.53	1.003
50% NPK + FYM + PSB	20.42	22.61	6.757	6.53	1.035
50% NPK + FYM + AZB + PSB	21.20	23.74	7.457	7.19	1.038
75% NPK	20.75	23.02	6.857	6.99	0.981
75% NPK + FYM	21.06	23.16	7.270	7.08	1.028
75% NPK + FYM + AZB	21.50	23.90	7.518	7.64	0.984
75% NPK + FYM + PSB	22.16	24.47	8.388	8.13	1.032
75% NPK + FYM + AZB + PSB	23.64	25.07	8.950	8.69	1.031
100% NPK	21.49	24.09	7.585	7.72	0.983
100% NPK + FYM	21.87	24.28	8.023	8.05	0.997
100% NPK + FYM + AZB	22.42	24.76	8.343	8.48	0.984
100% NPK + FYM + PSB	22.53	25.09	8.770	8.58	1.023
100% NPK + FYM + AZB + PSB	23.85	25.65	9.330	9.38	0.994
CD at 5%	2.091	1.447	1.310	1.31	0.008

Table.2 Response of chemical characteristics of fruits in cape gooseberry (*Physalis peruviana* L.) to integrated nutrient management (mean data of two year)

Name of treatments	Juice %	TSS (^{0}Brix)	Titratable acidity (%)	Ascorbic acid (mg/100g)	Reducing sugar (%)	Non reducing Sugar (%)	Total sugar (%)	pH	TSS/Acid ratio (%)	Dry matter (%)
50% NPK	59.64	12.62	1.025	39.42	2.93	2.792	5.72	4.21	12.34	11.62
50% NPK + FYM	60.69	14.26	0.978	44.42	3.56	3.458	7.02	4.25	14.58	12.18
50% NPK + FYM + AZB	61.43	13.87	1.018	46.49	3.07	2.938	6.00	4.17	13.62	11.65
50% NPK + FYM + PSB	63.45	15.71	0.848	49.53	4.84	3.678	8.51	4.67	18.55	13.50
50% NPK + FYM + AZB + PSB	66.42	16.29	0.778	50.64	4.98	4.762	9.74	4.82	20.95	13.62
75% NPK	62.35	10.54	1.122	38.57	2.39	2.245	4.64	3.74	9.40	10.44
75% NPK + FYM	64.98	14.59	0.957	42.57	3.77	3.615	7.38	4.36	15.26	12.66
75% NPK + FYM + AZB	66.98	11.24	1.133	48.68	2.55	2.355	4.91	3.75	9.94	10.68
75% NPK + FYM + PSB	68.51	16.40	0.775	51.69	5.25	4.955	10.21	5.02	21.15	14.55
75% NPK + FYM + AZB + PSB	69.38	16.80	0.748	52.68	5.47	5.263	10.73	5.08	22.48	14.83
100% NPK	62.72	10.75	1.135	40.02	2.68	2.550	5.23	3.94	9.47	10.60
100% NPK + FYM	65.57	13.88	0.998	45.82	3.27	3.132	6.40	4.35	13.91	11.72
100% NPK + FYM + AZB	67.72	11.78	1.087	40.50	2.75	2.632	5.38	4.15	10.84	10.95
100% NPK + FYM + PSB	70.22	14.67	0.878	41.94	4.04	3.842	7.88	4.42	16.72	12.95
100% NPK + FYM + AZB + PSB	70.73	12.14	0.832	40.60	4.49	4.305	8.80	4.75	14.60	13.95
CD at 5%	1.74	1.59	0.050	1.92	0.25	0.154	0.31	0.43	1.97	1.72

Increase in TSS, reducing sugar, non-reducing sugar, total sugar, pH and TSS/Acid ratio with INM application may be attributed to the quick metabolic transformation of starch and pectin into soluble compounds and rapid translocation of sugars from leaves to the developing fruits. These findings are in agreement with the results of Singh *et al.*, (2009) in ber, Baksh *et al.,* (2008) in guava and Rathi and Bist (2004) in pear.

The maximum titratable acidity was recorded in the fruits which received 100% NPK, whereas the minimum acidity was recorded in 75% NPK + FYM + AZB + PSB. Although, there is no report in the literature to support the results, yet it can be corroborated with the findings of Singh *et al.*, (2009), Baksh *et al.*, (2008), Rathi and Bist (2004) and Meena *et al.*, (2014).

The maximum content of ascorbic acid was recorded in fruits produced with 75% NPK + FYM + AZB + PSB whereas, the minimum amount of ascorbic acid was recorded in 75% NPK treated plants. The respective increase in ascorbic acid content might be due to the increased efficiency of microbial inoculants to fix atmospheric nitrogen, increase in availability of phosphorous and secretion of growth promoting substances which accelerates the physiological processes like carbohydrates synthesis etc. The results obtained also got the support of the findings of Tripathi *et al.,* (2010), Yadav *et al.,* (2010) and Umar *et al.,* (2009) in strawberry.

From the results obtained during the present investigation with different treatment combinations of INM on physico-chemical attributes of cape gooseberry, it is concluded that highest length, width, weight, volume, specific gravity fruit yield and juice percentage were recorded with application of 100% NPK + FYM + AZB + PSB. So far as the quality characters of cape goosebery fruits are concerned, it was observed that application of 75% NPK + FYM + AZB + PSB exhibited highest TSS, reducing sugar, non-reducing sugar, total sugar, ascorbic acid, TSS/Acid ratio, pH, minimum titratable acidity, and dry matter content whereas maximum titratable acidity was recorded under 75% 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 75% NPK + FYM + AZB + PSB in the plains of Uttar Pradesh, India.

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