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NK Sutariya
Department of Horticulture, B. A. Collage of Agriculture, Anand Agriculture University, Anand, Gujarat, India

MJ Patel
Department of Horticulture, B. A. Collage of Agriculture, Anand Agriculture University, Anand, Gujarat, India

NG Patel
Department of Horticulture, B. A. Collage of Agriculture, Anand Agriculture University, Anand, Gujarat, India

DJ Sindha
Department of Horticulture, B. A. Collage of Agriculture, Anand Agriculture University, Anand, Gujarat, India

HJ Chaudhary
Department of Horticulture, B. A. Collage of Agriculture, Anand Agriculture University, Anand, Gujarat, India

Correspondence
NK Sutariya
Department of Horticulture, B. A. Collage of Agriculture, Anand Agriculture University, Anand, Gujarat, India

Effect of integrated nutrient management on yield attribute of phalsa (*Grewia subinaequalis* L.) cv. Local

NK Sutariya, MJ Patel, NG Patel, DJ Sindha and HJ Chaudhary

Abstract
An experiment to evaluate effect of integrated nutrient management on yield of phalsa (*Grewia subinaequalis* L.) cv. Local" was carried out at Department of Horticulture at B.A. College of Agriculture, Anand Agricultural University, Anand during *summer* 2017. Yield attributing characters like hundred fruit weight, hundred fruit volume and fruit yield per plant and per hectare were found significantly maximum under treatment T_7 (50% N through urea + 25% N through vermicompost per plant + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant + AAU PGPR consortium). While, number of days to fruit set after pruning (57.00) and number of days to first picking after pruning (94.60) were observed significantly minimum with T_7 (50% N through urea + 25% N through vermicompost per plant + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant + AAU PGPR consortium) as compere to rest of treatments.

Keywords: INM, PGPR and phalsa

Introduction
The phalsa (*Grewia subinaequalis* L.) belongs to the family Tiliaceae. The center of its origin is believed to be India. Botanically the fruit is a berry, highly delicious, sour to sweet in taste with a desired pleasant flavour. Phalsa is one of the sub-tropical and tropical fruit crop. The plant is hardy and drought resistant, which requires little care. It can be grown throughout the country, except at higher elevation. It is commercially cultivated in Punjab, Haryana, Uttar Pradesh and Andhra Pradesh. In Gujarat it is grown in some parts of Ahmedabad, Vadodara, Kutch, Valsad and Saurashtra region. The exact acreage under phalsa crop in our country is not known.

Phalsa plant is a shrub or a small tree reaching to four meters of sometimes more in height (Sastri, 1956) [19]. The ripe phalsa fruits are consumed as fresh, in desserts or processed in to refreshing fruit and soft drinks viz; juice, squash, syrup, etc. and enjoyed during hot summer months. It has a cooling effect. Ripe fruits contain 50-60 % juice, 10-11 % sugar and 2.0-2.5 % acid and good source of Vitamin A and C. They are also a fair source of phosphorus and iron (Abid, 2012) [1]

In South India, no pruning is practiced and the plant is allowed to grow in to a good sized tree (Singh and Sharma, 1961). On other hand in North India and in Andhra Pradesh, some fruit growers use very drastic methods of cutting the plant or burning them to the ground level. This practice is also followed in Kutch area of the Gujarat state (Singh and Singh, 1983).

The phalsa plants are usually planted on comparatively poor soil which are mostly deficient in nitrogen and organic matter. The phalsa plants show good response to nitrogen application. High level of phosphorus supply increase the sugar content in the fruit while higher potassium suppress sugar and promote acidity. The use of fertilizer proved effective for increasing the size of fruit breadth and improved quality in phalsa.

Use of different chemical fertilizers, organic manures and bio-fertilizer had been found to increase the fruit length, fruit breadth, weight of fruits, juice percentage, pulp/stone ratio, TSS, total sugars, reducing sugar, non-reducing sugar and ascorbic acid while minimum acidity in phalsa (Ram *et al*., 2012) [15]. Application of inorganic fertilizer has been found to increase the fruit size, fruit weight and also TSS: acid ratio in phalsa (Gill *et al*., 2015) [6]. There is no systematic work on organic manure, chemical fertilizer as well as bio-fertilizer on phalsa, but a few references are available. Keeping these in view, the present experiment was undertaken to

to see the "Effect of integrated nutrient management on growth, yield and quality of phalsa (*Grewia subinaequalis* L.) cv. Local" with the following objectives.

Materials and Methods

The present experiment was carried out at Horticultural Research Farm and P. G. Laboratory, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand during January to May 2017. The experiment was laid out in completely randomized design with three repetitions comprising eight treatments.

The phalsa bushes were pruned up to 1.0 m height from ground level in the first week of January with the help of sharp secateurs. Immediately after pruning, the cut ends were pasted with Bordeaux paste to prevent the fungal infection. After pruning ring basins were prepared for application of fertilizer and irrigation.

The chemical fertilizers like nitrogen, phosphorus and potash were applied in the form of urea, single super phosphate and murate of potash, respectively as per treatments. Half dose of nitrogen and full dose of phosphorus and potash was given one week after organic fertilizer application and remaining half dose of nitrogen given in the 1st week of March. Well decomposed FYM @ 20 kg per plant was given as common dose of all treatments after pruning whereas, vermicompost and castor cake were given one week after pruning. Biofertilizer *i. e.* AAU PGPR consortium was obtained from department of Agricultural Microbiology, Anand Agricultural University, Anand. It was applied 2.5 ml per plant 1 m away from main stem as drenching in the soil as per requirements after 3 days of fertilizer application.

The fruits were harvested when the skin of mature fruit turns deep purple coloured and ripe harvested by skilled labours start from 13th April, 2017. Ripe fruits are more perishable and so it requires careful hand picking.

Results and Discussion

The results obtained from the present investigation are presented in table 1 and 2.

Table 1: Integrated nutrient management on number of days to fruit set, number of days to first picking and fruit weight and fruit volume

Sr. No.	Treatments	Number of days to fruit set after pruning	Number of days to first picking after pruning	Hundred fruit weight (g)	Hundred fruit volume (cc)
1	T_1:100 % N (200 g) through urea + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant	66.33	99.60	60.00	53.00
2	T_2:75 % N through urea + 25 % N through castor cake + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant	64.00	95.75	65.18	58.32
3	T_3:75 % N through urea + 25 % N through vermicompost + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant	60.66	97.30	67.90	60.87
4	T_4:50 % N through urea + 50 % N through castor cake + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant	64.66	98.60	66.55	58.55
5	T_5:50 % N through urea + 50 % N through vermicompost + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant	61.66	96.60	61.38	53.80
6	T_6:50 % N through urea + 25 % N through castor cake + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant + AAU PGPR consortium (2.5 ml per plant)	60.33	95.50	61.80	53.92
7	T_7:50 % N through urea + 25 % N through vermicompost per plant + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant + AAU PGPR consortium (2.5 ml per plant)	57.00	94.60	72.43	64.70
8	T_8:37.5% N through castor cake + 37.5 % N through vermicompost + AAU PGPR consortium (2.5 ml per plant)	63.16	96.50	68.80	61.83
S.Em. ±		1.29	0.99	2.50	2.32
C.D. at 5%		3.87	2.98	7.49	6.97
C.V. %		3.59	1.78	6.61	6.92

Table 2: Integrated nutrient management on fruit yield

Sr. No.	Treatments	Fruit yield (kg/plant)	Fruit yield (kg/ha)
1	T_1:100 % N (200 g) through urea + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant	2.05	2277.55
2	T_2:75 % N through urea + 25 % N through castor cake + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant	2.10	2336.80
3	T_3:75 % N through urea + 25 % N through vermicompost + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant	2.08	2310.88
4	T_4:50 % N through urea + 50 % N through castor cake + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant	2.06	2292.36
5	T_5:50 % N through urea + 50 % N through vermicompost + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant	2.30	2559.00
6	T_6:50 % N through urea + 25 % N through castor cake + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant + AAU PGPR consortium (2.5 ml per plant)	2.25	2499.75
7	T_7:50 % N through urea + 25 % N through vermicompost per plant + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant + AAU PGPR consortium (2.5 ml per plant)	3.05	3388.55
8	T_8:37.5% N through castor cake + 37.5 % N through vermicompost + AAU PGPR consortium (2.5 ml per plant)	2.14	2377.54
	S.Em. ±	0.19	132.39
	C.D. at 5%	0.36	396.92
	C.V. %	9.15	9.15

Number of days to fruit set after pruning

The data pertaining to the number of days to fruit set as influenced by different nutrient management are presented in table 1.

Results from the data indicated that the effect of different dose of nutrient on number of days to fruit set after pruning was significantly affected by the various treatments. The significantly minimum number of days (57.00) taken for fruit set after pruning were recorded with the treatment T_7 (50 % N through urea + 25 % N through vermicompost per plant + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant + AAU PGPR consortium) which was at par with the treatment T_3 and T_6. While, significantly maximum number of days (66.33) was recorded in T_1. This might be due increased in total metabolites in plant cell. Therefore the production and supply of photosynthesis at critical stage induced more flowering as well as early fruit setting. These results are also in accordance with the findings of Ram *et al.* (2012) [15] in phalsa, Varma *et al.* (2014) [21] in phalsa and Godage *et al.* (2013) [11] in guava.

Number of days to first picking after pruning

The data pertaining to the number of days to first picking after pruning as influenced by different nutrient are presented in table 1.

Results from the data indicated that the effect of different dose of nutrient on number of days to first picking after pruning was found significant. The significantly minimum number of days (94.60) for first picking after pruning were recorded in treatment T_7 (50 % N through urea + 25 % N through vermicompost per plant + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant + AAU PGPR consortium) which was at par with the treatment T_2, T_3, T_5, T_6 and T_8 Whereas, the significantly maximum number of days (99.60) was recorded in T_1. This might be due increase nutrient use efficiency, increase nutrient availability from NPK, FYM, vermicompost which increase photosynthesis at critical stage induce early flowering and fruiting. These findings are also in accordance with the Ram *et al.* (2012) [15] in phalsa, Godage *et al.* (2013) [11] in guava.

Fruit yield kg /plant and kg/ha

The data pertaining to the influence of various treatments on the fruit yield per plant are presented in table 2. The data revealed that fruit yield per plant and per hectare was significantly influenced due to the application of nutrient.

It is quite apparent from the data that the significantly maximum fruit yield per plant (3.05 kg) and per hectare (3388.55 kg) was recorded in the treatment T_7 (50 % N through urea + 25 % N through vermicompost per plant + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant + AAU PGPR consortium), While, the significantly minimum fruit yield per plant (2.05 kg) was observed with T_1.

An increase in fruit yield per tree might be due to increased continuous supply of nutrients which stimulated cell division, cell elongation and increase the number of fruits. This may be attributed due to the improved fertilizer use efficiency with the application of organic sources of nutrients and biofertilizers also helps in increasing fruit volume, diameter and weight ultimately the fruit yield per tree was obtain maximum. Similar types of results were also obtained by Ram *et al.* (2012) [15] in phalsa, Musmade *et al.* (2010) [10] in acid lime and Ramamurthy *et al.* (2006) [16] in mandarin, Reddy and Swami (1986) [18], Dheware and Waghmare (2009) [3] and Patel *et al.* (2009) [13] in sweet orange, Baviskar *et al.* (2011) [2] in sapota

Fruit weight (g)

Results pertaining to the effects on various treatments on hundred fruit weight are presented in table 1. The perusal of the data revealed that hundred fruit weight was significantly affected due to various treatments

It is evident from the data that the treatment T_7 (50 % N through urea + 25 % N through vermicompost per plant + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant + AAU PGPR consortium) recorded significantly maximum hundred fruit weight (72.43 g) which was at par with the treatment T_2, T_3, T_4 and T_8. While, the significantly minimum hundred fruit weight (60.00g) was recorded in T_1. through MOP per plant). An increase in fruit weight is highly correlated with dry matter content, balance level of hormones. Superior physical fruit quality may be due to fact that, organic manure and microbial fertilizer enhance the nutrient availability by enhancing the capability of plants to better solute uptake from rhizosphere, also these nitrogen fixer are known for accumulation of dry matter and their translocation as well as favour synthesis of different growth regulators. The result is conformity with finding of Ram *et al* (2012) [15] in phalsa, Nurbhanej *et al.* (2014) [11] in acid lime, Musmade *et al.* (2010) [10] in acid lime, Baviskar *et al.* (2011) [2] in sapota, Ram *et al*. (2007), Dutta *et al.* (2009) [5] and Godge *et al.* (2013) [11] in guava.

Fruit volume (cc)

The mean data pertaining to hundred fruit volume as influenced by the different nutrient management are presented in table 1.

From the data revealed that hundred fruit volume was significantly influenced due to application of nutrient. It is evident from the data treatment T_7 (50 % N through urea + 25 % N through vermicompost per plant + 100 g P_2O_5 through SSP + 50 g K_2O through MOP per plant + AAU PGPR consortium) recorded significantly highest hundred fruit volume (64.70 cc) which was at par with the treatment T_2, T_3, T_4 and T_8. While, the significantly lowest hundred fruit volume (53.00 cc) was observed in T_1. A continuous supply of nutrient and induction of growth promoting substance which stimulate cell division, cell elongation in fruits during the period at rapid rate. Continuous increase the volume of fruits findings are in accordance with Ram *et al.* (2012) [15] in phalsa, Thakkar (2015) [20] in guava, Patel *et al* (2017) [12] in sapota, Nurbhanej *et al.* (2014) [11] in acid lime and Bhaviskar *et al.* (2011) [2].

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