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# Effect of integrated nutrient management on bio chemical parameters of phalsa (*Grewia subinaequalis* L.) cv. local

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## Abstract
An experiment to evaluate "Effect of integrated nutrient management on quality 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. Quality attributing characters like juice, TSS, total sugar, reducing sugar and ascorbic acid (mg/100 g of fresh pulp) content were significantly higher 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). While, acidity was 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). Whereas, non-reducing sugar was found non-significant differences

**Keywords:** INM, PGPR and phalsa

## Introduction
The phalsa (*Grewia subinaequalis* L.) belongs to the family Tilliaceae. The centre of its origin is believed to be India. Botanically the fruit is a berry, delicious, sour to sweet in taste with a desired pleasant flavour. Phalsa is one of the sub-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). 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) [11]. 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) [4]. 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 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 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 $1^{st}$ 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. Bio fertilizer *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. The observations bio-chemical characters like total soluble solids, acidity, total sugar, reducing sugar, non-reducing sugar, ascorbic acid were recorded. The data collected for different observations were subjected to statistical analysis by adopting 'Analysis of variance' techniques as described by Panse and Sukhatme (1967).

## Results and Discussion

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

**Table 1:** Integrated nutrient management on juice, TSS, total sugar, reducing sugar and non-reducing sugar

| S. No. | Treatments | Juice (%) | TSS (ºBrix) | Total sugar (%) | Reducing sugar (%) | Non reducing sugar (%) |
|---|---|---|---|---|---|---|
| 1 | $T_1$:100% N (200 g) through urea + 100 g $P_2O_5$ through SSP + 50 g $K_2O$ through MOP per plant | 43.70 | 19.50 | 5.85 | 2.01 | 3.84 |
| 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 | 45.51 | 20.50 | 6.15 | 2.19 | 3.96 |
| 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 | 47.22 | 20.67 | 6.35 | 2.57 | 3.78 |
| 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 | 44.78 | 22.67 | 5.95 | 2.10 | 3.85 |
| 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 | 48.92 | 21.50 | 6.27 | 2.53 | 3.74 |
| 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) | 51.00 | 20.17 | 6.47 | 2.61 | 3.86 |
| 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) | 53.07 | 23.17 | 6.55 | 2.77 | 3.78 |
| 8 | $T_8$:37.5% N through castor cake + 37.5% N through vermicompost + AAU PGPR consortium (2.5 ml per plant) | 50.93 | 22.83 | 6.23 | 2.25 | 3.98 |
| S.Em. ± | | 1.30 | 0.80 | 0.14 | 0.08 | 0.16 |
| C.D. at 5% | | 3.91 | 2.38 | 0.42 | 0.24 | NS |
| C.V. % | | 4.69 | 6.44 | 3.93 | 5.87 | 7.27 |

**Table 2:** Integrated nutrient management on acidity and ascorbic acid content in phalsa fruit

| S. No. | Treatments | Acidity (%) | Ascorbic acid (mg/100 g of fresh pulp) |
|---|---|---|---|
| 1 | $T_1$:100% N (200 g) through urea + 100 g $P_2O_5$ through SSP + 50 g $K_2O$ through MOP per plant | 2.92 | 27.83 |
| 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 | 2.71 | 33.47 |
| 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 | 2.66 | 35.06 |
| 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 | 2.80 | 34.20 |
| 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 | 2.20 | 34.30 |
| 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) | 2.54 | 37.33 |
| 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) | 2.02 | 38.20 |
| 8 | $T_8$:37.5% N through castor cake + 37.5% N through vermicompost + AAU PGPR consortium (2.5 ml per plant) | 2.48 | 34.95 |
| S.Em. ± | | 0.06 | 1.01 |
| C.D. at 5% | | 0.19 | 3.04 |
| C.V. % | | 4.26 | 5.10 |

**Juice (%)**

The data regarding the percentage of juice as influenced by various levels of nutrient are presented in table 1.

The percentage of juice (53.07%) significantly, increased with the application of 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 $T_6$ and $T_8$. The significantly lowest percentage of juice (43.70%) was recorded with the treatment $T_1$. This is might be due to fertilizer application result in more uptake of nutrient due to which concentration of nutrient in plant cell and plant absorb more water along with minerals because of increase turger pressure resulting in increasing juice percentage Kumar *et al.* (2014) [5], Ram *et al* (2012) [11], Varma *et al.* (2014) [14] in phalsa.

**Total soluble solids ($^0$Brix)**

The data regarding the TSS of phalsa fruits affected by various levels of nutrient are presented in table 1.

The significantly maximum TSS (23.17 $^0$Brix) 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), which is at par with $T_4$, $T_5$ and $T_8$. The significantly minimum TSS (19.50 $^0$Brix) was recorded in the treatment $T_1$. The increase in total soluble solids might be due to beneficial role of nutrient on the process of photosynthesis which ultimately led to the accumulation of large amount of carbohydrates and increase in TSS content of fruits. The vermicompost play important role in placing the nutrient and plant hormones, which are directly or indirectly involved in improving the fruit quality. Similar results were also obtained by Ram *et al.* (2012) [11], Gill *et al.* (2015) [4] in phalsa. Ingle *et al.* (2001) in acid lime, Dubey and Yadav (2003) [3] and Ramamurthy *et al.* (2006) in mandarin, Patel *et al.* (2009) [9] in sweet orange, Yadav *et al.* (2011) [15, 17] in papaya, Yadav *et al.* (2013) [16] in aonla.

**Total sugar (%)**

The mean data pertaining to total sugar (%) as influenced by various levels of nutrient are presented in table 1.

It is evident from results that there was significant increase in total sugar percent of phalsa. The significantly highest total sugar (6.55%) 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), which was at par with the treatment $T_2$,$T_3$,$T_5$, $T_6$ and $T_8$. While, the significantly lowest total sugar (5.85%) was recorded in the treatment $T_1$. This might be attributed to the involvement of N in various energy sources like amino acids and amino sugars. These findings are supported by the results obtained by Ram *et al.* (2014) [11] in phalsa, Thakkar (2015) [13] in guava, Bhaviskar *et al.* (2011) [2] and Mahindra *et al.* (2009) [6] in ber.

**Reducing sugar (%)**

The mean data pertaining to reducing sugar (%) as influenced by various levels of nutrient are presented in Table 1.

The significantly highest reducing sugar percentage of phalsa berries (2.77%) was observed 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). Which was at par with $T_5$ and $T_6$. While, the significantly lowest reducing sugar (2.01%) was recorded in the treatment $T_1$. This might be attributed to the involvement of N in various energy sources like amino acids and amino sugars which increase the sugar level. These findings are supported by the results obtained by Ram *et al*. (2012) [11] in phalsa, Thakkar *et al*. (2015) [13] in guava, Bhaviskar *et al.* (2011) [2] and Patel and Naik (2010) [8] in sapota, Patel and Patel (2011) in banana, Mahindra *et al.* (2009) [6] in ber.

**Non-reducing sugar (%)**

The data pertaining to non-reducing sugar are presented in table 1.The results revealed that effect of integrated nutrient management on non-reducing sugar was found non-significant.

**Acidity (%)**

The data in changes in acidity percentage of the phalsa fruits influenced by various levels of nutrient are presented in table 2.

The application of nutrient significantly reduced acidity. The significantly minimum acidity (2.02%) was noted 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 + AAU PGPR consortium) which was at par with $T_5$. Whereas, the significantly maximum acidity (2.92%) was recorded in the treatment $T_1$. Acidity decreases due to increase in the total soluble solids and total sugar. The results reported by Ram *et al.* (2014) in phalsa, Dubey and Yadav (2003) [3] in mandarin, Patel *et al.* (2009) in sweet orange, Nurbhanej *et al* (2016) in acid lime, Yadav *et al.* (2013) [16] in aonla, Ram *et al.* (2007) [10] in guava.

**Ascorbic acid (mg/100 g of fresh pulp)**

The data revealed that the effect of different levels of nutrient significantly increased ascorbic acid of the phalsa fruit presented in table 2.

The application of nutrient significantly increased ascorbic acid (mg/100 g of fresh pulp). The significantly highest ascorbic acid content (38.20 mg/100 g of fresh pulp) was observed 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 $T_6$. Whereas, the significantly lowest ascorbic acid content (27.83) was recorded in the treatment $T_1$. This is might be due to nutrient stimulated the functioning of number of enzymes in the physiological process and FYM supply major and some essential micronutrient and proper supply of nutrient induced the photosynthesis carbohydrate and sugar metabolisms which improve the quality of fruits. Similar trends were also observed by Ram *et al.* (2012) [11] in phalsa. Ingle *et al.* (2001) in acid lime, Dubey and Yadav (2003) [3] in mandarin, Patel *et al.* (2009) in sweet orange, Yadav *et al.* (2011) [15, 17] in papaya, Yadav *et al.* (2011) [15, 17] in mango, Yadav *et al.* (2013) [16] in aonla.

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