Int.J.Curr.Microbiol.App.Sci (2019) *8*(2): 3341-3349

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 8 Number 02 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.802.389

Response of Integrated Nutrient Management on Different Physical Characters of Bael (*Aegle marmelos* Correa) cv. Narendra Bael-9

Govind Vishwakarma[1*], Bhanu Pratap[2], Dinesh Yadav[3] and Satya Pal Singh[4]

[1]*Horticulture, DCAST, Selaqui, Deharadun (U.K.) 248 011, India*
[2]*Fruit Science, NDUA&T, Kumarganj, Faizabad (U.P.) 224 229, India*
[3]*KVK, Basti, (U.P.), India*
[4]*KVK, Barabanki, (U.P.), India*

**Corresponding author*

Keywords

Bael (*Aegle marmelos* Correa), *Azotobacter*, Nutrient management

Article Info

Accepted:
22 January 2019
Available Online:
10 February 2019

A B S T R A C T

The present investigation entitled "Response of Integrated Nutrient Management on different physical characters of bael (*Aegle marmelos* Correa) *cv.* Narendra Bael-9" was carried out at Main Experiment Station, Horticulture, N. D. University of Agriculture and Technology, Kumarganj Faizabad (U.P.) 224 229 under sodic soil condition during the years 2014-15 and2015-16 to access the response of organic manure, inorganic fertilizer and Bio-fertilizers on different physical characters of bael fruit. There were nine treatments and were randomly replicated four times each treatments have different doses of organic manure, inorganic fertilizer and Bio-fertilizers like T1-100% NPK, T2-50 Kg FYM, T3-50 Kg FYM+ 100% NPK, T4-50 Kg FYM + 75% NPK, T5-50 Kg FYM + 50% NPK, T6-50 Kg FYM + 200g each (*Azotobacter*+ PSB),T7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter*+ PSB), T8-50 Kg FYM + 75% NPK + 200g each (*Azotobacter*+ PSB) and T9-50 Kg FYM + 50% NPK + 200g each (*Azotobacter*+ PSB). The different parameters *viz.* fruit length (cm), fruit width (cm), fruit weight (kg/fruit), pulp weight (kg/fruit) and shell weight were noted after harvesting of fruits. These characters were statistically analyzed with the theory of Panse and Sukhatme. The treatment T7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter*+ PSB) was found significantly superior for all the characters while the characters like specific gravity, number of seeds/fruit, number of cavities/fruit and shell thickness did not affected by the treatments and they found non-significant during both the years of experimentation (2014-2015 and 2015-2016).

Introduction

Bael (*Aegle marmelos* Correa) is one the most important fruit crop of India. It is belongs to the family Rutaceae. It has mythological significance and has known in India from prehistoric times. Its trifoliate leaves are offered to Lord Shiva for worship which has great importance in Hindu religions. The literatures like Ramayana, Yajurveda, Buddhist and Jain are fulfilled with it great importance and uses. Broadly it is known differentially name in different languages Bel, Beli, Belgiri (Hindi), Shivadruma, Shivapahala, Vilva (Sanskrit), Bael, (Assamese and Marathi), Bilvaphal (Gujrati), Marredy (Malayam), Belo (Oriya), Vilvom, Vilvamarum (Tamil) and Bilvapandu (Telgu). The bael plant has several important ingredients in their different parts like leaves, bark, seed, flower and root. Every part are used for different purposes like twigs and leaves are used as fodder, sweet scented water is distilled from the flower and leaf juice I applied to body before taking a bath to removal the bad smell while fruit of bael have curative properties due to this it is the most valuable part of plant. Bael plant is historical plant from prehistoric time of India and has essential in the ancient system of medicinal ayurvedya. Bael fruit is rich in different physico-chemical characters. It has a fare amount of vitamin-A, B, C and high content of carbohydrates. The ripe fruit have is a tonic as restorative, laxative and good for heart and brain problems. Only bael has a high content of riboflavin, marmelosin ($C_{14}H_{12}O_4$) is most probably the therapeutic activity principles. The plants which are propagated by budding or grafting means can bear fruits within 4-5 while the plants propagated by seed takes 7-8 or more years to come under bearing. It grows throughout the Indian peninsular as well as in Sri Lanka, Pakistan, Bangladesh, Burma, Thailand and most of the South East Asian countries, the tree are found in different states like Uttar Pradesh, Orissa, Bihar, West-Bengal, Madhya Pradesh etc. As according to present scenario the cultivation of bael is increasing day by day not only in one state also in other states. The maximum area is in Uttar Pradesh while in Uttar Pradesh Gonda, Basti, Deoria, Mirzapur and Etawah are the major district under which it is being cultivated. It is very hardy subtropical deciduous tree that can tolerate alkaline soil and hardy in nature, which can thrive well in salt affected soil up to 30 ESP and $9dSm^{-1}$.

As growers are using continuous huge amount of chemical fertilizers which hampers the fruit quality soil health and generate pollution. So to skip from such problems Integrated Nutrient Management becomes a great cause to retrieve the soil health. The plant nutrients are apply through different sources *viz.* organic manure, crop residues, bio-fertilizers and chemical fertilizers for better utilization of resources and to produce crop with less expenditure. So that Integrated Nutrient Management is the best approach for sustainable crop production. The soil health, soil structure can be improved with the help of organic manure it also provide conducive environment for the treatment of soil micro flora. Potentially of using organic manure along with balanced fertilizers are well established in increasing crop yield and sustainable crop production (Nambiar and Abrol, 1992). The Integrated Nutrient Management combination is the combination of different plant nutrients is now assured significantly in the field of fruit production. The conjugation uses of bio-fertilizers with nitrogenous fertilizers increase the efficiency of nitrogen, improve the soil health and control the soil pollution. It is therefore necessary to standardize the possible sources of nutrients to a specific soil and agro-climatic condition for better plant growth production and quality of fruits.

Materials and Methods

The present investigation entitled "Response of Integrated Nutrient Management on different physical characters of bael (*Aegle marmelos* Correa) *cv.* Narendra Bael-9" was carried out at Main Experiment Station and PG laboratory, Department of Horticulture, Horticulture, N. D. University of Agriculture and Technology, Kumarganj Faizabad (U.P.) 224 229 during the years 2014-2015 and 2015-2016. The Kumarganj area is located 42 km. away from Faizabad city on Faizabad - Raebareily Road. The geographically, university is situated at 26.47^0 N latitude, 82.12^0 E longitude and at altitude of 113.0

meter from sea level in the Indo-gangatic plain of Eastern Uttar Pradesh, India. The region falls under sub-humid and sub-tropical climate receiving a mean annual rainfall of about 1200 mm out of which about 85 per cent is precipitated from mid-June to end of September. The winter months are cold, dry and occasional frost occurs during the period, hot wind starts from the month of April and continue up to onset of monsoon. The bael cultivar Narendra Bael-9 was 16 years old and uniform in vigour were selected randomly. There were nine treatments and these treatments were replicated four times with Randomized Block Design. Each treatmenthas different doses of organic manure, inorganic fertilizers and bio-fertilizers. The different treatments like T1-100% NPK, T2-50 Kg FYM, T3-50 Kg FYM+ 100% NPK, T4-50 Kg FYM + 75% NPK, T5-50 Kg FYM + 50% NPK, T6-50 Kg FYM + 200g each (*Azotobacter*+ PSB),T7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter*+ PSB), T8-50 Kg FYM + 75% NPK + 200g each (*Azotobacter*+ PSB) and T9-50 Kg FYM + 50% NPK + 200g each (*Azotobacter*+ PSB) were conducted under sodic soil condition. The experiment was conducted to evaluate the effect of different sources and doses of organic manure, inorganic fertilizers and bio-fertilizers on different characters like fruit length (cm), fruit width (cm), fruit weight (kg/fruit), pulp weight (kg/fruit), number ofseeds/fruit, number of cavities/fruit, specific gravity, shell weight and shell thickness.

Results and Discussion

The results regarding response of Integrated Nutrient Management on different physical characters of bael which had a different effect with their different doses they are summarized as below:

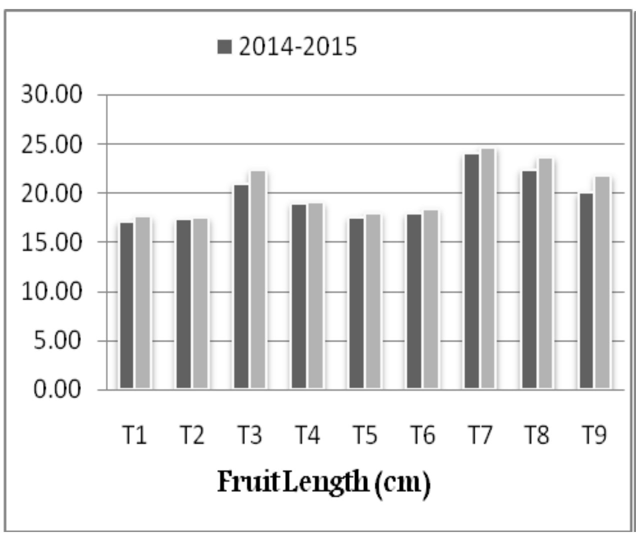
The data presented in Table 1 shows that the soil application of organic manure, inorganic fertilizers and bio-fertilizers recorded the superior results in all treatments during both the years of experimentation (2014-15 and 2015-16). The data regarding to fruit length were maximum (24.00cm and 24.62cm) with the soil application ofT_7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter*+ PSB) followed by the treatment T_8-50 Kg FYM + 75% NPK + 200g each (*Azotobacter*+ PSB), except these no other treatments have better response regarding fruit length. The treatment having 50 Kg FYM lonely was found lowest among all others during both the years of experimentation (2014-15 and 2015-16).

The data regarding fruit width was influenced significantly and the maximum (18.08cm and 19.32cm) fruit width was noted with the use T_7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter*+ PSB) followed byT_9-50 Kg FYM + 50% NPK + 200g each (*Azotobacter*+ PSB). The treatmentT_8-50 Kg FYM + 75% NPK + 200g each (*Azotobacter*+ PSB) was found at par with the treatment T_7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter*+ PSB) while the others have quiet effect on fruit width. The treatment T2-50 Kg FYM has lowest results than others during both the years of experimentation (2014-15 and 2015-16).

It seems from the data presented in Table 2 that the soil application of Integrated Nutrient Management on fruit weight of bael were significantly affected by the treatments T_7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter*+ PSB) the maximum (2.41kg/fruit and 2.45kg/fruit) fruit weight was recorded which was found at par with the use of T_8-50 Kg FYM + 75% NPK + 200g each (*Azotobacter*+ PSB) followed by the treatment T_9-50 Kg FYM + 50% NPK + 200g each (*Azotobacter*+ PSB) while the treatment T2-50 Kg FYM had lowest result during both the years of experimentation (2014-15 and 2015-16).

Table.1 Effect of Integrated Nutrient Management on fruit length and width of bael

Treatment	Fruit length (cm)		Fruit width (cm)	
	2014-15	**2014-15**	**2015-16**	**2015-16**
T_1 :100% NPK	17.10	15.93	16.00	17.58
T_2 :50 kg FYM	17.30	15.43	15.69	17.46
T_3 :50 kg FYM+ 100% NPK	20.95	17.43	17.97	22.34
T_4 :50 kg FYM+ 75% NPK	18.93	16.40	16.91	18.98
T_5 :50 kg FYM+ 50% NPK	17.53	16.23	16.32	17.97
T_6 :50 kg FYM+ 200g each (*Azotobacter*+ PSB)	17.85	16.85	16.61	18.35
T_7 :50 kg FYM+ 100% NPK+200g each (*Azotobacter*+ PSB)	24.00	18.08	19.32	24.62
T_8 :50 kg FYM+ 75% NPK+200g each (*Azotobacter*+PSB)	22.38	17.65	18.53	23.64
T_9 :50 kg FYM+ 50% NPK+200g each (*Azotobacter*+ PSB)	20.03	17.10	17.22	21.78
S. Em ±	**0.53**	**0.08**	**0.56**	**0.68**
CD at 5%	**1.55**	**0.23**	**1.65**	**1.99**



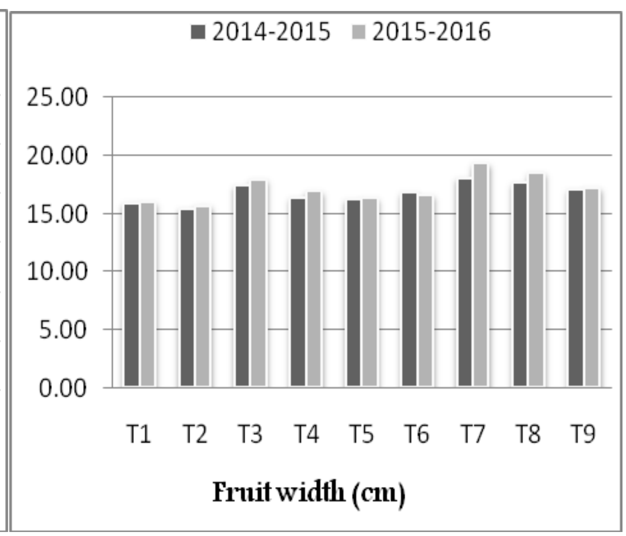
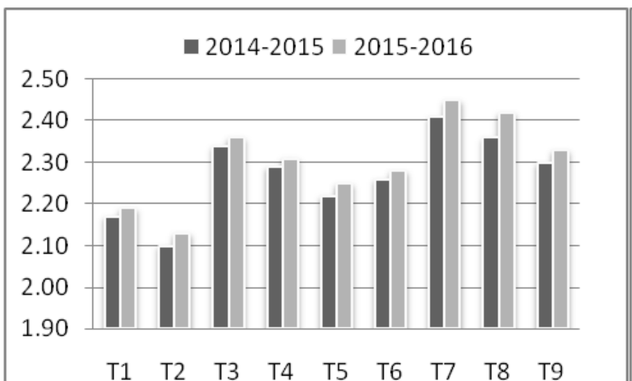
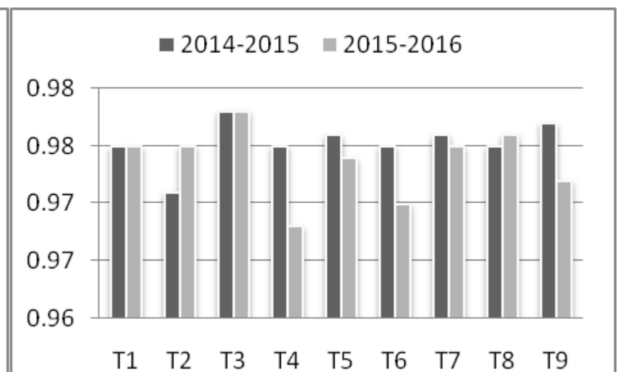


Table.2 Effect of Integrated Nutrient Management on fruit weight, pulp weight and Specific gravity of bael

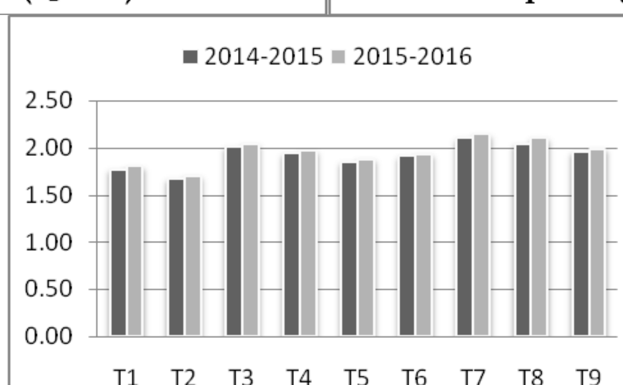
Treatment	Fruit weight (kg)		Pulp weight (kg)		Specific gravity	
	2014-15	**2014-15**	**2014-15**	**2014-15**	**2015-16**	**2015-16**
T_1 :100% NPK	2.17	1.77	89.00	0.975	0.975	2.19
T_2 :50 kg FYM	2.10	1.67	80.75	0.971	0.975	2.13
T_3 :50 kg FYM+ 100% NPK	2.34	2.01	100.50	0.978	0.978	2.36
T_4 :50 kg FYM+ 75% NPK	2.29	1.94	95.75	0.975	0.968	2.31
T_5 :50 kg FYM+ 50% NPK	2.22	1.85	90.00	0.976	0.974	2.25
T_6 :50 kg FYM+ 200g each (*Azotobacter*+ PSB)	2.26	1.91	91.50	0.975	0.970	2.28
T_7 :50 kg FYM+ 100% NPK+200g each (*Azotobacter*+ PSB)	2.41	2.10	100.00	0.976	0.975	2.45
T_8 :50 kg FYM+ 75% NPK+200g each (*Azotobacter*+ PSB)	2.36	2.04	111.00	0.975	0.976	2.42
T_9 :50 kg FYM+ 50% NPK+200g each (*Azotobacter*+ PSB)	2.30	1.96	105.75	0.977	0.972	2.33
S. Em ±	**0.02**	**0.03**	**4.78**	**0.002**	**0.002**	**0.03**
CD at 5%	**0.08**	**0.10**	**NS**	**NS**	**NS**	**0.11**



Fruit weight (kg/fruit)



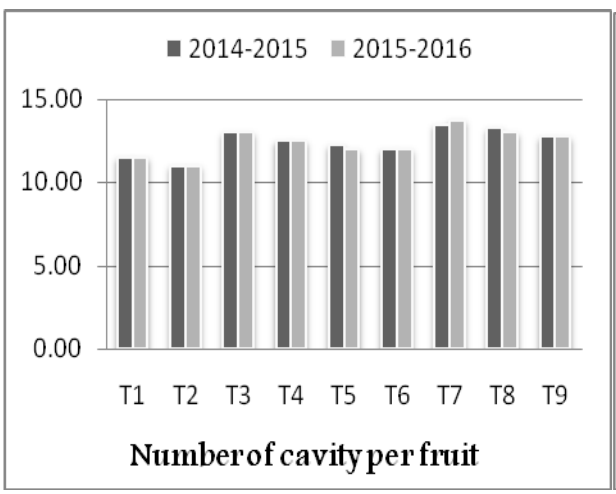
Specific gravity



Pulp weight (kg/fruit)

Table.3 Effect of Integrated Nutrient Management on number of cavityand number of Seed/fruit of bael

Treatment	Number of cavity/fruit		Number of seed/fruit	
	2014-15	**2014-15**	**2015-16**	**2015-16**
T_1 :100% NPK	11.50	394.44	94.75	1.80
T_2 :50 kg FYM	11.00	426.94	82.25	1.70
T_3 :50 kg FYM+ 100% NPK	13.00	322.44	110.75	2.04
T_4 :50 kg FYM+ 75% NPK	12.50	341.69	99.00	1.97
T_5 :50 kg FYM+ 50% NPK	12.25	366.94	95.75	1.88
T_6 :50 kg FYM+ 200g each (*Azotobacter*+ PSB)	12.00	345.94	97.25	1.93
T_7 :50 kg FYM+ 100% NPK+200g each (*Azotobacter*+ PSB)	13.50	303.44	110.25	2.14
T_8 :50 kg FYM+ 75% NPK+200g each (*Azotobacter*+PSB)	13.25	315.69	116.50	2.10
T_9 :50 kg FYM+ 50% NPK+200g each (*Azotobacter*+ PSB)	12.75	335.19	111.75	1.99
S. Em ±	**0.61**	**6.03**	**5.29**	**0.03**
CD at 5%	**NS**	**17.61**	**NS**	**0.11**



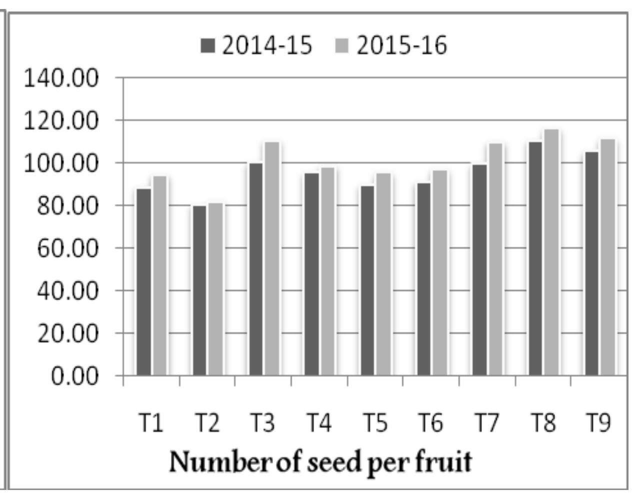
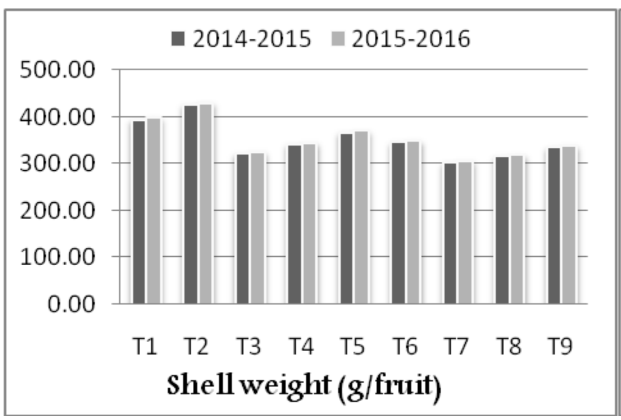
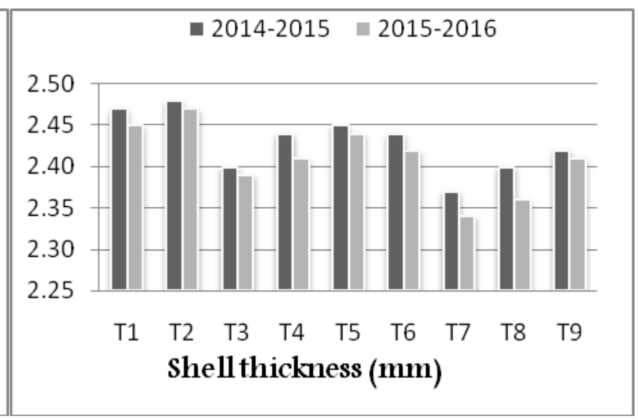


Table.4 Effect of Integrated Nutrient Management on shell thickness and shell weight of bael

Treatment	Shell thickness (mm)		Shell weight (g)	
	2014-15	**2015-16**	**2015-16**	**2015-16**
T_1 :100% NPK	2.47	2.45	397.75	11.50
T_2 :50 kg FYM	2.48	2.47	430.00	11.00
T_3 :50 kg FYM+ 100% NPK	2.40	2.39	325.50	13.00
T_4 :50 kg FYM+ 75% NPK	2.44	2.41	344.75	12.50
T_5 :50 kg FYM+ 50% NPK	2.45	2.44	370.00	12.00
T_6 :50 kg FYM+ 200g each (*Azotobacter*+ PSB)	2.44	2.42	349.00	12.00
T_7 :50 kg FYM+ 100% NPK+200g each (*Azotobacter*+ PSB)	2.37	2.34	306.50	13.75
T_8 :50 kg FYM+ 75% NPK+200g each (*Azotobacter*+ PSB)	2.40	2.36	318.75	13.00
T_9 :50 kg FYM+ 50% NPK+200g each (*Azotobacter*+ PSB)	2.42	2.41	338.25	12.75
S. Em ±	**0.02**	**0.02**	**18.09**	**0.60**
CD at 5%	**NS**	**NS**	**52.81**	**NS**





The data recorded for specific gravity shown in Table 2 shows that the soil application of Integrated Nutrient Management had no significant effect on specific gravity. The maximum specific gravity was noted with T_7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter*+ PSB) while lowest was noted with T2-50 Kg FYM during both the years of experimentation (2014-15 and 2015-16).

The increase in fruit size (length and width) and fruit weight are due to the optimum supply of plant nutrients in right amount during entire crop period caused more plant height and ultimately more photosynthesis that resulted to more length and breadth of fruit (Govindan and Purushothamam, 1984 and Atiyeh, 2002). Mani *et al.*, (2013) reported maximum increase in length and diameter of phalsa fruits with the application of *Azotobacter* inoculated treatment with 75% N substitution by phosphate solubilizing bacteria and remaining 25%through inorganic fertilizer in two equal splits at establishment and before flowering stage. Singh *et al.*, (2013) recorded maximum fruit size with treatment when phosphorus was applied 50% through bone meal+ 50% P through FYM and remaining N and K through urea and muriate of potash followed by others treatments.

The data regarding pulp weight of bael fruit is presented in Table 2 shows that all the treatments were influenced significantly on pulp weight. The maximum (2.10kg/fruit and 2.14kg/fruit) pulp weight was recorded with the use of T_7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter*+ PSB) and it was at par with T_8-50 Kg FYM + 75% NPK + 200g each (*Azotobacter*+ PSB) followed by T_9-50 Kg FYM + 50% NPK + 200g each (*Azotobacter*+ PSB). The only treatment T2-50 Kg FYM showed lowest result in comparison to others during both the years of experimentation (2014-15 and 2015-16). The data regarding number of seed per fruit and number of cavity per fruit were not significantly influenced with the use of Integrated Nutrient Management. All the data were found non-significant. The maximum number of seeds and number of cavities per fruit were recorded with the use of T7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter* + PSB) while the lowest were recorded with T2-50 Kg FYM during both the years of experimentation (2014-15 and 2015-16).

It is clear from the Table 4 that the soil application of organic manure, inorganic fertilizer and Bio-fertilizers affected the shell thickness of fruit significantly. The minimum thickness was noted with the use of T_7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter*+ PSB) which was closely at par with the treatment T_8-50 Kg FYM + 75% NPK + 200g each (*Azotobacter*+ PSB) followed by T_9-50 Kg FYM + 50% NPK + 200g each (*Azotobacter*+ PSB)while the treatmenT2-50 Kg FYM recorded lowest results than others during both the years of experimentation (2014-15 and 2015-16).

The data regarding the shell weight shown in Table 4 that the soil application of organic manure, inorganic fertilizer and bio-fertilizers were significantly affected the shell weight. The minimum shell weight was recorded with use of T_7-50 Kg FYM + 100% NPK + 200g each (*Azotobacter*+ PSB) while the treatment T_8-50 Kg FYM + 75% NPK + 200g each (*Azotobacter*+ PSB) found at par with treatments T_7 followed by T_9-50 Kg FYM + 50% NPK + 200g each (*Azotobacter*+ PSB). The treatment T2-50 Kg FYM was recorded as maximum shell weight during both the years of experimentation (2014-15 and 2015-16).

The increase in pulp weight, number of seed/fruit and Shell weight might be due to the fact that *Azotobacter* enhances the rate of cell division and multiplication to better over all food and nutrient status of plants under this treatment. The combination of PSB in this treatment increased the availability of phosphorus and subsequent uptake by the plants due to phosphate solubilizers might also have improved vigour of berries since phosphorus is known to improve the quality of fruits. The results are close conformity with the finding of Aariff (2004) in the acid lime by the soil application of iron pyrites [pyrites] (IPat 100, 200 and 300 g/plant), press mud (PM at 4 and 8kg/plant), farmyard manure (FYM at 25 and 50 kg/plant)and VAM (150 g/plant), either individually or in combination, in both years. Kumar *et al.*, (2012), Ghosh *etal.* (2012), Manjunath *et al.*, (2006) and Bendegumbal *et al.*, (2008) were also found same results by the application of organic and inorganic manures on different fruit crops.

Acknowledgement

The author is grateful to the Advisor, Head, and all the members of advisory committee, Department of Horticulture, N.D. University of Agriculture & Technology, Kumarganj, Faizabad, for providing necessary facilities.

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How to cite this article:

Govind Vishwakarma, Bhanu Pratap, Dinesh Yadav and Satya Pal Singh. 2019. Response of Integrated Nutrient Management on Different Physical Characters of Bael (*Aegle marmelos* Correa) cv. Narendra Bael-9. *Int.J.Curr.Microbiol.App.Sci.* 8(02): 3341-3349.
doi: https://doi.org/10.20546/ijcmas.2019.802.389