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Bio-Intensive Nutrient Management in High Density Pear (*Pyrus communis* L.) cv. Carmen

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ABSTRACT

*The present experiment entitled **"Bio-intensive nutrient management in high density pear (Pyrus communis L.) cv. Carmen"** was carried out during 2014-2016 in experimental field of SKUAST-K on three-year-old pear plants cv. Carmen grafted on Quince C planted at a distance of 3 x 3 m. The experiment was laid out in Randomised Complete Block design (RCBD) with three replications and fourteen treatments. All cultural practices were practised as per SKUAST-K package of practices. Significant differences were observed with application of different treatments. Parameters like fruit length, fruit breadth, fruit weight, fruit volume, yield, incremental extension growth, incremental plant spread, volume and height and titratable acidity showed highest values with T_1:(N + P + K) as recommended while T_4: (N75% + P75%+ Azotobacter + PSB + VAM + VC 7kg/tree) excelled in, TSS, Total sugars, organoleptic rating. On the other side fruit firmness, initial bloom and final bloom was highest in T_{14}: (Azotobacter + PSB + VAM + VC 7kg/tree).*

Key words: *Pear, Carmen, Azotobacter, PSB, VAM and Vermicompost.*

INTRODUCTION

Pear is truly wondrous hardy fruit, widely grown in temperate regions of the world with varied size, shape, texture and flavours. Among temperate fruits, pear is next only to apple in importance, acreage and production with high degree of adaptability under varied climatic conditions. In India pear is predominantly grown in Kashmir valley and cooler areas in the hills of Himachal Pradesh and Uttrakhand[3]. In Jammu and Kashmir, pear occupies an area of about 14532 hectares with an annual production of 88329 MT with productivity of 6.08 MT/hectare. While alone Kashmir occupies an area of about 6932 hectares with an annual production of 58072 MT with productivity of 8.38 MT/hectare[2].

Integrated Nutrient management comprises organic, inorganic and microorganisms are highly beneficial for sustainable food and fruit production as it ameliorates soil environment, maintain adequate level of nutrients and provide favorable conditions for higher yield with divine quality[9,13].

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Among various factors which affect the productivity and cost of production, nutrition is the most important, which shares 30% of total cost of production. In view of the above fact, it becomes imperative to make fruit production a more cost effective enterprise by switching on to the non-conventional sources of nutrients to meet the nutrient need of plants while at the same time helping to lower the cost of production and maintaining healthy edaphic environment. Most of the inorganic fertilizers which are applied to boost the production are lost through denitrification, leaching and fixation in soil. Fifty per cent of the nitrogenous fertilizer applied to crops is lost, loss of Fertilizer-N into the environment disturbs the balance[22], thus making ground water unsafe for drinking[11,28]. In case of phosphatic fertilizers applied to plants only a small fraction (10-15%) are taken up by the plant in the years[3].

Biofertilizers can be important components of integrated nutrients management. A biofertilizer is a substance which contains living micro-organisms which when applied to seed, plant surface or soil, colonizes the rhizosphere or the anterior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant[8], counteracting negative impact of chemical fertilisers and also protect the plant root from harmful effect of some soil borne pathogens. With using the biological and organic fertilizers, a low input system can be carried out and it can help in achieving sustainability of farms[12].

A small dose of biofertilizer is sufficient to produce desirable results because each gram of carrier of biofertilizers contains at least 10 million viable cells of a specific strain[1]. Application of biofertilizers like azotobacter, vesicular arbuscular mycorrhizia (VAM) and phosphate solubilizing bacteria (PSB) were studied in low chill pear cv. Gola. It was revealed that incorporation of azotobater @ 30 g was effective for enhancing vegetative growth of tree. Physical and chemical qualities of fruits were significantly improved by treatment of 90 g VAM more effectively[16]. Use of excessive inorganic fertilizers has not only resulted in soil and water pollution but also increased the incidences of disease, insect and pest attacks reducing productivity and quality of fruit crops. Under these circumstances, integrated use of organic manures, inorganic fertilizers have assumed great importance for sustainable production and maintaining soil health[20]. Thus, the present investigation aimed to evaluate the response of Bio-intensive nutrient management in high density pear (*Pyrus communis* L.) cv. Carmen" under J&K agro-climatic condition and to establish a guideline to improve the quality and productivity in pear through integrated nutrient management.

MATERIALS AND METHODS

The present investigation was carried out at Division of Fruit Science, SKUAST-K, Shalimar Orchard on three-year-old Carmen pear plants grafted on Quince C planted at a distance of 3 × 3 m during 2014-2016.

Methodology adopted

The experiment was laid out in Randomised complete Block design (RCBD) with three replications and fourteen treatments *viz.* All horticultural and agronomic practices were practised as per SKUAST-K package of practices. T1 Control N% + P% + K% as recommended, T2 [$N_{75\%}$ + $P_{75\%}$ + azotobacter + PSB + VAM + VC (3 kg/tree)], T_3 [$N_{75\%}$ + $P_{75\%}$ + azotobacter + PSB + VAM + VC (5 kg/tree)], T_4 [$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)], T_5 [$N_{75\%}$ + $P_{50\%}$ + azotobacter + PSB + VAM + VC (3 kg/tree)], T_6 [$N_{75\%}$ + $P_{50\%}$ + azotobacter + PSB + VAM + VC (5 kg/tree)], T_7 [$N_{75\%}$ + $P_{50\%}$ + azotobacter + PSB + VAM + VC (7 kg/tree)], T_8 [$N_{50\%}$ + $P_{75\%}$ + azotobacter + PSB + VAM + VC (3 kg/tree)], T_9 [$N_{50\%}$ + $P_{75\%}$ + azotobacter + PSB + VAM + VC (5 kg/tree)], T_{10} [$N_{50\%}$ + $P_{75\%}$ + azotobacter + PSB + VAM + VC (7 kg/tree)], T_{11} [$N_{50\%}$ + $P_{50\%}$ + azotobacter + PSB + VAM + VC (3 kg/tree)], T_{12} [$N_{50\%}$ + $P_{50\%}$ + azotobacter + PSB + VAM + VC (5 kg/tree)] T_{13} [$N_{50\%}$ + $P_{50\%}$ +azotobacter + PSB + VAM + VC (7 kg/tree)] and T_{14} [azotobacter + PSB + VAM + VC (7kg/tree)]. (Potassium kept uniform for all treatments)

For biofertilizers top layer of soil was removed to a depth of 5-10 cm, exposing the newly formed feeder roots. When root system was active and new roots were formed (a fortnight before flowering) without damaging the root system, later covered with soil. One liter azotobacter formulation having population upto 10^7 cfu was mixed with 6 kg of vermicompost, out of this carrier based formulation 100 g was applied around the root zone of the tree. Similarly, 1 liter of PSB formulation having population upto 10^5 cfu was mixed with 6 kg of vermicompost and out of this 100 g shall be applied to root zone of each tree. 200 g of specific mycorrhizal culture with effective propagule population was also be applied in the root zone of tree. All the biological inputs were applied in the middle of March. The inorganic fertilizers were applied after 10 days of application of biological inputs.

The plant growth was measured as annual extension of current season shoots, whereas, yield attributes were observed in terms of initial bloom and full bloom along with the yield per tree at final harvest. The quality of fruits was estimated by physical fruit (weight, volume, length, breadth, firmness, field and organoleptic raring) and chemical (TSS, acidity and total sugars), attributes taking a random sample of 05 fruits from each treatment at the time of harvest.

RESULT AND DISCUSSION

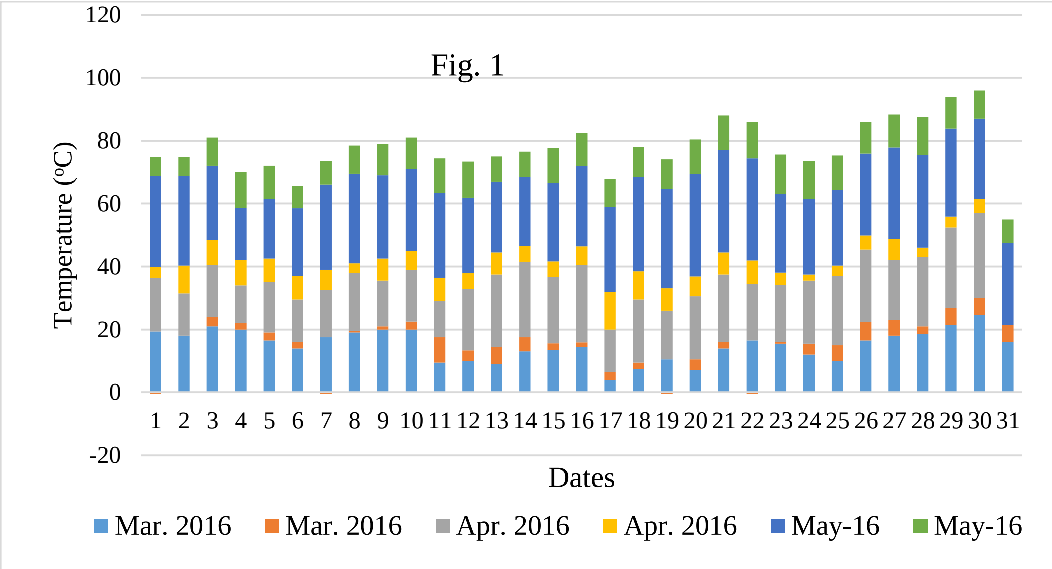
Incremental extension growth (16.91 cm), Incremental plant height (24.4 cm), Incremental plant spread (48.0 cm), and Incremental plant volume (0.78 m^3) (Table 1 & 2) were noticed maximum with T_1 (control N, P and K 150, 75 and 240 g/tree as recommended respectively). Minimum value was observed in T_{14} (azotobacter + PSB + VAM + VC (7 kg/tree). Probably this may be due to balanced rate of photosynthates production and N-assimilation[17]. Increased rate of nitrogen dose induced lush green foliage[29]. Also improvement in root proliferation resulted in improved nutrient absorption[19]. Besides growth factors lead to improved cell elongation and cell division.

Initial bloom (34.6 %) and Final bloom (44.2 %) (Table 2) were recorded maximum with T_{14} (azotobacter + PSB + VAM + VC (7 kg/tree). On the other hand, minimum (27.8 % and 37.7 %) noticed under T_1 (control N, P and K 150, 75 and 240 g/tree as recommended respectively).as fertilizers are readily available in T_1 in this case flowers take lesser time to bloom while organic fertilizers are slow releasing and are not available during critical vegetative and reproductive stages in optimum dose so flowers take comparatively more time to bloom in comparison with trees treated with inorganic fertilizers. Days to flowering decreased with the increasing urea fertilization as reported by Chuansong[5]. In addition[30], observed that nitrogen fertilization can promote vegetative growth of soybean, and plants can be flowered around 33 days after sowing.

Yield attributes of fruit *viz*, fruit length, fruit breadth, fruit volume, fruit weight (Table 3 & 4) were recorded maximum in control treatment where recommended dose of N, P and K was applied. The higher uptake and accumulation of nutrients in the tissues and fruits with recommended dose of N, P and K might have occurred due to stimulation of the rates of various physiological and metabolic processes resulting in better size, weight and fruit yield[25]. These were supported by findings of Treder[27]. Application of inorganic fertilizers with and without biofertilizers inoculation showed highest response in respect of fruit attributes as compared to the application of organic manures with and without integration of biofertilizers. This may be due to fact that organic manures released macro and micro nutrients at very slow rate and in small quantities which could not sustain optimum supply of nutrients to the trees during vegetative and reproductive growth period. Fruits produced under organic orchard management has lower fruit weight due to the smaller cells and less intercellular spaces[6].

Maximum fruit firmness (14.20 kg cm^{-2}) was recorded in T_{14} (azotobacter + PSB + VAM + VC (7 kg/tree). while lowest firmness (12.78 cm^{-2}) was observed in T_1 (control N, P and K 150, 75 and 240 g/tree as recommended) (Table 4). Large fruit tend to be softer than small fruits. This influence of size on firmness is generally thought to be a consequence of differences in cell expansion. Large fruits tend to have large cell size thus large cell vacuole so exhibit less cell to cell contact and more air spaces. Both larger cells and air spaces provide more stress to cell walls resulting in less firm fruits[7,20] support the findings that firmness is less in large fruits because of loss of cell to cell adhesion.

Yield obtained during 2015 was more as compared to 2016 (Table 5) because night temperature dropped to less than 3.3 degrees (Fig.1).



So spring frost affected the yield. Temperature was recorded for the months of March, April and May by Division of Agronomy SKUAST-Kashmir Shalimar.

Maximum organoleptic rating (Table 5) was recorded in fruits harvested from trees under T_4 (N 75% + P75% + azotobacter + PSB + VAM + VC (7 kg/tree). significantly minimum organoleptic rating recorded in fruits harvested from trees under T_1 (control N, P and K 150, 75 and 240 g/tree as recommended respectively). As fruits harvested from trees treated with T_4 were enriched in more sugars that resulted in tastier fruits.

Fruit chemical properties *viz.* TSS, titratable acidity and total sugar presented in (Table 6) showed that maximum TSS (17.39 ^{o}Brix) was recorded in T_4 (N 75% + P75% + azotobacter + PSB + VAM + VC 7 kg/tree) followed by (16.58 ^{o}Brix) of fruits obtained from trees under T_3 (N 75% + P 75% + azotobacter + PSB + VAM + VC (5 kg/tree). The improvement in fruit TSS is because of hormonal secretion by bio inoculants and due to balanced and enhanced supply of macro and micro nutrients. Increased TSS could be due to beneficial effect on total leaf area of the plant which reflected in more carbohydrates production through photosynthesis process. Considering physiological view point biofertilizers being constituent of pyridines which in turn are constituents of chlorophyll and cytochromes help in increasing photosynthesis so beneficial for TSS[10,15]. These results were supported by Rathi and Bist[24].

Maximum titratable acidity (0.60%)was recorded in fruits harvested from trees under T_1 (control N, P and K 150, 75 and 240 g/tree as recommended respectively) and T_{14} (azotobacter + PSB + VAM + VC (7 kg/tree)). While T_4 (N 75% + P75% + azotobacter + PSB + VAM + VC (7 kg/tree) recorded lowest titrable acidity of (0.42%). This might be due to low nitrogen content in fruits treated with organic and vermicompost compared to fruits treated with inorganic fertilizers which results in low N:Ca ratio. This has positive correlation with ethylene production, and it induces water core incidence along with loss of cell to cell adhesion, hence increased sweetness and firmness of apple fruit[7,20]. Application of inorganic fertilizers with or without integration of biofertilizers enhanced acidity in comparison to application of organic manures. These results corroborate the findings of Macit *et al*[14]., and Prabakaran and Pichal[21]. explained Titrable acidity of fruit increased due to more availability of N.

Maximum total sugars (15.09 %) were recorded in T_4 (N 75% + P75% + azotobacter + PSB + VAM + VC (7 kg/tree). while minimum total sugars (9.68) recorded in fruits harvested from trees under T_{14} (azotobacter + PSB + VAM + VC (7 kg/tree) and it was found statistically at par with T_1 (control N, P and K 150, 75 and 240 g/tree as recommended respectively) with total sugars observed as 10.01 %. Increased total sugars content may be due to increased rate of absorption by bio inoculants thus making macro and micro nutrients available in balanced dose and also growth regulators produced by bio inoculants help in increasing total sugars in fruits.

Increased total sugars might have resulted due to absorption of macro and micro nutrients and growth regulator produced by biofertilizers which may have exerted regulatory role as an important constituent of endogenous factors in affecting the quality of fruits in which carbohydrate is important and during ripening of fruits the carbohydrates reserves of root and stems are drawn upon heavily by fruits which resulted in sugar content in fruits[18].

Sugar content of fruit was recorded fairly high in plants inoculated with azotobacter[26] supported by Rana and Chandel[23], which revealed that Azotobacter inoculated plants resulted in higher fruit sugars in strawberry as compared to un –inoculated.

Table 1: Effect of bio-intensive nutrient management on incremental extension growth incremental plant height and incremental plant spread of pear cv. Carmen

	Treatments	Annual extension growth (cm)			Incremental plant height (cm)			Incremental plant spread (cm)		
		2015	**2016**	**Pooled**	**2015**	**2016**	**Pooled**	**2015**	**2016**	**Pooled**
T_1	Control N% + P% + K% as recommended	16.85	16.98	16.91	24.3	24.6	24.4	32.2	34.4	33.3
T_2	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	14.89	14.96	14.92	20.8	21.5	21.1	42.6	45.2	43.9
T_3	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	15.56	15.86	15.71	22.9	23.7	23.3	44.1	47.3	45.7
T_4	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	16.00	16.38	16.19	23.7	24.6	24.1	47.0	49.0	48.0
T_5	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	14.41	14.67	14.54	19.9	20.5	20.2	37.4	40.4	38.9
T_6	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	14.74	14.86	14.8	21.6	22.8	22.2	40.0	43.6	41.8
T_7	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	15.03	15.21	15.12	22.0	22.7	22.3	45.2	47.1	46.15
T_8	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	13.78	13.90	13.84	15.3	16.2	15.7	38.5	40.0	39.25
T_9	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	13.91	14.03	13.97	18.1	18.7	18.4	39.6	41.5	40.55
T_{10}	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	14.02	14.23	14.12	18.9	19.5	19.2	41.3	43.4	42.35
T_{11}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	13.06	13.25	13.15	15.1	15.7	15.4	31.8	33.8	32.8
T_{12}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	13.15	13.42	13.28	16.4	16.9	16.65	33.7	36.9	34.3
T_{13}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	13.21	13.47	13.34	17.5	18.1	17.8	40.1	42.7	41.4
T_{14}	Azotobacter + PSB + VAM + VC (7 kg/tree)	12.95	13.06	13.00	14.8	15.6	15.2	28.5	30.6	29.55
	CD (p≤ 0.05)	**0.75**	**0.70**	**0.67**	**0.007**	**0.008**	**0.005**	**1.52**	**1.60**	**1.64**

Table 2: Effect of bio-intensive nutrient management on incremental plant volume, initial bloom and final bloom of pear cv. Carmen

	Treatments	Incremental plant volume (m^3)			Initial bloom (10% flowering)			Final bloom (80% flowering)		
		2015	**2016**	**Pooled**	**2015**	**2015**	**Pooled**	**2015**	**2016**	**Pooled**
T_1	Control N% + P% + K% as recommended	0.75	0.81	0.78	27.50	28.1	27.8	37.26	38.32	37.7
T_2	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	0.68	0.73	0.70	31.51	33.7	32.6	42.09	44.26	43.1
T_3	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	0.69	0.75	0.72	31.60	33.9	32.7	42.96	44.85	43.9
T_4	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	0.73	0.79	0.76	32.00	33.8	32.9	42.63	45.24	43.9
T_5	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	0.62	0.67	0.64	30.21	32.1	31.1	40.92	43.16	42.0
T_6	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	0.65	0.71	0.68	30.92	32..9	31.9	41.18	43.84	42.5
T_7	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	0.67	0.72	0.69	31.25	33.1	32.2	41.92	44.09	43.0
T_8	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	0.51	0.54	0.52	30.71	31.4	31.1	40.52	43.45	41.9
T_9	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	0.56	0.59	0.57	30.77	31.7	31.3	40.74	43.61	42.2
T_{10}	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	0.58	0.61	0.59	30.80	32.1	31.5	41.24	43.96	42.6
T_{11}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	0.42	0.46	0.44	28.90	29.7	29.3	39.29	41.06	40.2
T_{12}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	0.45	0.50	0.47	29.11	29.5	29.3	39.43	41.52	40.5
T_{13}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	0.49	0.55	0.52	29.61	30.2	29.9	39.55	41.89	40.7
T_{14}	Azotobacter + PSB + VAM + VC (7 kg/tree)	0.37	0.43	0.40	33.68	35.4	34.6	43.75	44.65	44.2
	CD ($p\leq 0.05$)	**0.017**	**0.019**	**0.015**	**0.23**	**0.41**	**0.35**	**0.53**	**0.62**	**0.59**

Table 3: Effect of bio-intensive nutrient management on yield attributes of pear cv. Carmen

	Treatments	Fruit length (cm)			Fruit breadth (cm)			Fruit volume (cm^3)		
		2015	**2016**	**Pooled**	**2015**	**2016**	**Pooled**	**2015**	**2016**	**Pooled**
T_1	Control N% + P% + K% as recommended	9.23	9.39	9.31	7.94	8.04	7.99	164.7	167.01	165.9
T_2	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	8.30	8.40	8.35	7.12	7.18	7.15	162.3	164.25	163.3
T_3	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	8.70	8.90	8.80	7.42	7.50	7.46	162.6	164.56	163.6
T_4	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	8.90	9.20	9.05	7.63	7.72	7.67	164.2	166.50	165.3
T_5	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	7.69	7.75	7.72	7.05	7.10	7.07	158.9	160.96	159.9
T_6	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	8.50	8.62	8.56	7.17	7.22	7.19	160.3	162.32	161.3
T_7	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	8.56	8.73	8.64	7.26	6.31	6.78	161.1	163.25	162.2
T_8	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	7.23	7.41	7.32	6.83	6.90	6.86	156.1	163.15	159.6
T_9	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	7.70	7.92	7.81	6.92	6.98	6.95	156.5	158.75	157.6
T_{10}	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	7.93	8.23	8.08	6.96	7.05	7.00	157.2	158.28	154.7
T_{11}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	6.23	6.42	6.32	6.77	6.85	6.81	153.9	159.75	156.7
T_{12}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	6.70	6.85	6.77	6.83	6.92	6.87	154.4	155.54	154.9
T_{13}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	7.03	7.15	7.09	6.87	6.95	6.91	154.5	156.65	155.6
T_{14}	Azotobacter + PSB + VAM + VC (7 kg/tree)	6.10	6.20	6.15	5.44	5.48	5.46	151.5	153.66	152.6
	CD ($p\leq 0.05$)	**0.38**	**0.25**	**0.30**	**0.05**	**0.07**	**0.04**	**0.20**	**0.26**	**0.23**

Table 4: Effect of bio-intensive nutrient management on yield attributes of pear cv. Carmen.

Treatments		Fruit weight (g)			Fruit firmness (kg cm^{-2})		
		2015	2016	Pooled	2015	2016	Pooled
T_1	Control N% + P% + K% as recommended	201.20	203.12	202.08	12.62	12.95	12.78
T_2	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	192.12	194.23	193.17	13.59	13.72	13.65
T_3	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	195.08	197.02	196.05	13.29	13.34	13.31
T_4	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	196.20	198.06	197.13	12.82	13.00	12.91
T_5	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	182.32	185.23	183.77	13.63	13.81	13.72
T_6	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	186.65	189.60	188.12	13.33	13.45	13.39
T_7	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	191.63	194.62	193.12	12.96	13.19	13.07
T_8	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	172.62	175.71	174.16	13.82	14.02	13.92
T_9	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	177.31	180.30	178.80	13.42	13.61	13.51
T_{10}	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	180.32	183.35	181.83	13.12	13.19	13.15
T_{11}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	162.02	165.52	163.77	14.00	14.24	14.12
T_{12}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	165.07	168.12	166.59	13.55	13.69	13.62
T_{13}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	165.21	171.21	168.21	13.22	13.27	13.24
T_{14}	Azotobacter + PSB + VAM + VC (7 kg/tree)	160.32	163.25	161.78	14.02	14.39	14.20
	CD ($p \leq 0.05$)	**3.41**	**3.65**	**3.54**	**0.28**	**0.32**	**0.38**

Table 5: Effect of bio-intensive nutrient management on yield and organoleptic rating of pear cv. Carmen

Treatments		Yield (kg tree^{-1})			Organoleptic rating (Hedonic scale)		
		2015	2016	Pooled	2015	2016	Pooled
T_1	Control N% + P% + K% as recommended	9.00	6.20	7.60	2.60	2.62	2.61
T_2	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	7.96	6.00	6.98	3.31	3.33	3.32
T_3	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	8.56	6.11	7.33	3.36	3.38	3.37
T_4	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	8.76	6.11	7.43	3.43	3.45	3.44
T_5	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	7.21	5.75	6.48	3.17	3.19	3.18
T_6	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	7.50	5.96	6.73	3.21	3.23	3.22
T_7	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	8.27	6.09	7.18	3.22	3.26	3.24
T_8	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	7.09	5.57	6.33	3.08	3.10	3.09
T_9	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	7.31	5.86	6.58	3.10	3.12	3.11
T_{10}	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	7.72	5.98	6.85	3.19	3.21	3.20
T_{11}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	7.01	5.54	6.27	3.06	3.09	3.07
T_{12}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	7.14	5.65	6.39	3.08	3.11	3.09
T_{13}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	7.27	5.80	6.53	3.10	3.14	3.12
T_{14}	Azotobacter + PSB + VAM + VC (7 kg/tree)	6.50	5.52	6.01	3.01	3.04	3.02
	CD ($p \leq 0.05$)	**0.50**	**0.63**	**0.57**	**0.03**	**0.02**	**0.04**

Table 6: Effect of bio-intensive nutrient management on fruit chemical properties of pear cv. Carmen

	Treatments	Total soluble solids (°Brix)			Titratable acidity (%)			Total sugars (%)		
		2015	2016	pooled	2015	2016	pooled	2015	2016	pooled
T_1	Control N% + P% + K% as recommended	11.16	11.25	11.20	0.61	0.60	0.60	9.95	10.07	10.01
T_2	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	16.20	16.27	16.23	0.46	0.45	0.45	14.45	14.53	14.49
T_3	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	16.56	16.60	16.58	0.45	0.43	0.44	14.70	14.77	14.73
T_4	$N_{75\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	17.36	17.42	17.39	0.43	0.41	0.42	15.06	15.12	15.09
T_5	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	13.66	13.70	13.68	0.52	0.50	0.51	13.55	13.63	13.59
T_6	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	13.86	13.92	13.89	0.50	0.48	0.49	13.80	13.88	13.84
T_7	$N_{75\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	14.40	14.47	14.43	0.48	0.46	0.47	14.15	14.23	14.19
T_8	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	12.60	12.67	12.63	0.56	0.53	0.54	11.47	11.55	11.51
T_9	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	13.20	13.25	13.22	0.55	0.52	0.53	11.72	11.78	11.75
T_{10}	$N_{50\%}$ + $P_{75\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	13.70	13.78	13.74	0.54	0.51	0.52	12.05	12.17	12.11
T_{11}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (3 kg/tree)	11.70	11.85	11.77	0.59	0.56	0.57	10.90	11.04	10.97
T_{12}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (5 kg/tree)	12.46	12.53	12.49	0.58	0.55	0.56	10.55	10.60	10.56
T_{13}	$N_{50\%}$ + $P_{50\%}$ + Azotobacter + PSB + VAM + VC (7 kg/tree)	12.90	12.96	12.93	0.56	0.52	0.54	10.65	10.73	10.69
T_{14}	Azotobacter + PSB + VAM + VC (7 kg/tree)	11.66	11.70	11.68	0.61	0.60	0.60	9.65	9.72	9.68
	CD ($p \leq 0.05$)	**0.35**	**0.38**	**0.43**	**0.46**	**0.45**	**0.45**	**0.25**	**0.20**	**0.34**

CONCLUSION

Present investigation led to conclusion that conjoint application 75% RDF with biofertilizers and vermicompost (7kg/tree) was best for improving fruit quality. Recommended dose of fertilizer achieved highest fruit yield and improved fertility status but was inferior in fruit quality.

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