

Comparative analysis of various organic amendments on tree growth and nut yield of cashew (*Anacardium occidentale* L.)

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Abstract

An experiment was carried out on "Comparative analysis of various organic amendments on tree growth and nut yield of Cashew (*Anacardium occidentale* L.)" var. BPP8 (H 2/16) at Cashew Research Station under AICRP on Cashew, Orissa University of Agriculture and Technology, Bhubaneswar during 2013-14 and 2014-15 adopting randomized block design (RBD) having eight treatments replicated thrice. The treatments were T1-100 per cent N as FYM, T2 -100 per cent N as FYM + Biofertilizers (*Azotobacter* + *Azospirillum* + PSB) 200 g, T3-50 per cent N as FYM + Biofertilizers (200g), T4-100 per cent N as Vermicompost + Biofertilizers (200g), T5-Recycling of organic residue with the addition of 20 per cent cow dung slurry, T6- *In situ* green manuring/ green leaf manuring + Biofertilizers (200g) and T8- RDF + 10 kg FYM (Control). Biometrical observations on vegetative characters, were recorded during 2013-14 and 2014-15. Application of RDF along with 10 kg FYM recorded maximum value in plant height (5.05 m), canopy spread (7.88 m), production of laterals (26.91) and flowering laterals (22.48) and nut yield (14.06 q/ha). The recommended dose of fertilizer and an addition of 10 kg FYM is most beneficial and economical, but 25 per cent N as FYM, recycling of organic residue, *in situ* green manuring/green leaf manuring and biofertilizers must be recommended from the view point of environmental sustainability and equity.

Highlights

- Application of RDF along with 10 kg FYM observed as suitable for vegetative parameters and nut yield of cashew.
- Organic inputs are the best way for environmental sustainability and equity.
- Organic amendments are most beneficial and economical in productivity of cashew.

Keywords: Cashew, organic, biofertilizer, vermicompost, FYM, nut yield

Cashew (*Anacardium occidentale* L.) treated as "Wonder nut of the world" having about 75 genera and 700 species. The wonder nut is indigenous to Brazil and is an evergreen nut-bearing tropical plant that grows in latitude 15° north and south of the equator. It is a multipurpose tree crop with great economic importance to third world countries including Benin Republic, Brazil, Coted'Ivoire,

Guinea Bissau, Ghana, India, Mozambique, Nigeria, Philippines, Sri Lanka, Tanzania and Vietnam. Morphologically, the architecture of cashew tree makes it a foremost tree crop for reclaiming land area to enhanced productivity, through the prevention of desertification and soil erosion. The drought resistant, evergreen cashew tree is economically grown for its nut, apple and wood.

Products derived from the nuts include the world's highly delighted roasted kernel snacks, kernel oil, cashew nut shell liquid, and from the apple: juice, jam and alcohol among others.

Although cashew was introduced into Nigeria more than 400 years ago, extensive cultivation started only in the early 1950's. From 1965 to 1990 cashew production was relatively static at 25,000 tonnes with estimated land area of 50,000 ha in 1990. Currently, cashew cultivation has spread to about 27 states of the country and in the past 12 years, production has increased almost thirty-fold from 30,000 MT in 1990 to 836,500 MT in 2012 from estimated land area of 366,000 ha (FAOSTAT, 2013)

Cashew nut is now treated as a healthy friendly nut (Fernandez, 2001). This is primarily due to presence of high fat i.e 47%, out of which 82 % are in unsaturated form and the proportion of the monosaturated fatty acid and polysaturated fatty acid in 4:1 (Rao and Venkataraman 1995), thereby reduce the cholesterol and have good for heart health of human beings .The high dietary fiber and high monosaturated fatty acid lower the blood glucose and improve insulin resistance (Sacks, 1999). As a whole, cashew nuts are becoming established as a food item that can protect human beings against major diseases including heart diseases, diabetics, cancer etc. with its rare combination of fats, carbohydrates and protein. Cashew kernel is a rich source of high energy and a snack of great taste. Hence, in order to compete with international market, India has to go for organic cultivation of cashew.

Materials and methods

The research experiment was carried out at Cashew Research Station, Ransinghpur, Bhubaneswar under All India Coordinated Research Project on Cashew of Orissa University of Agriculture and Technology, Odisha, India (latitude 20°45''N, longitude 86°10'' E and altitude 60m). Eight treatments were used in the study by adopting RBD, replicated thrice having four plants per treatments. The details of the treatment schedule are presented in Table 1. The grafted plants of recommended cashew varieties for Odisha, BPP-8 were transplanted during 2007 with a normal spacing of 7.0 m X 7.0 m by adopting the recommended package of practices uniformly to all the treatments except the nutrient management, which was followed as per the treatment schedule (Table 1).

Table 1: Treatment details of Organic Management in Cashew

Treatment	Treatment details
T ₁	100 % N as FYM
T ₂	100 % N as FYM + Bio-fertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB) 200 g
T ₃	50 % N as FYM + Bio-fertilizers (200 g)
T ₄	100 % N as Vermicompost + Bio-fertilizers (200 g)
T ₅	Recycling of organic residue with the addition of 20 % cowdung slurry (20.0 % weight of organic residue as cow dung)
T ₆	In situ green manuring / green leaf manuring to meet 100 % N
T ₇	25 % N as FYM + Recycling of organic residue + <i>In situ</i> green manuring /green leaf manuring + Bio-fertilizers (200 g)
T ₈	Recommended doses of fertilizer + 10 kg FYM (Control)

Results and discussion

Data relevant to plant height is indicated from Table 2 that the height of the plant due to various treatments was found significant. The data it was observed that maximum (5.05m) plant height was found in recommended doses of fertilizer + 10 kg FYM (T₈) followed by (4.38 m) 100per cent N as FYM(T₁) was found statistically superior and at par. Minimum (4.38m) was recorded in 100 per cent N as Vermicompost + Biofertilizers (T₄). All treatments except T₈ and T₁ treatments were found statistically at par with T₄. Data relevant to plant girth is indicated from Table 2 that the girth of the plant due to various treatments was found highly significant. Trunk girth was noticed under pooled analysis where 100per centN as FYM(T₁) and N as FYM + Biofertilizers, (T₂) noted for maximum (71.39cm and 71.25cm, respectively) trunk girth. 100per cent N as Vermicompost + Biofertilizers (T₄) showed minimum (63.33cm) girth followed by T₃ which was significantly different from others. Rest of the treatment (T₅, T₈, T₇ and T₃) was found statistically at par with T₁.

Canopy Spread in the East - West (E-W) direction among the treatments was found statistically non significant (Table2) From the pooled data it was observed that Recommended doses of fertilizer + 10 kg FYM (T₈) recorded highest (7.98m) plant

spread followed by 25 per cent N as FYM + recycling of organic residue + *in situ* green manuring / green leaf manuring + Biofertilizers, 100 per cent N as FYM + Biofertilizers and *in situ* green manuring / green leaf manuring to meet 100 per cent N.

It is seen from the Table 2 that the canopy spread in the North-South (N-S) direction was found statistically different among the treatments.

It is indicated from the pooled data, Recommended doses of fertilizer + 10 kg FYM (T₈) recorded maximum (7.88m) canopy spread and was found

statistically superior to all other treatments and minimum (6.92m) was recorded in 100 per cent N as Vermicompost + Biofertilizers (T₄)

The two years pooled data indicated that highest (26.91) number of laterals were recorded in recommended doses of fertilizer + 10 kg FYM (T₈) followed by 100 per cent N as FYM + Biofertilizers (25.57) and was found significantly superior to all other treatments and minimum (22.38) was recorded in 100 per cent N as FYM (T₁).

Table 2: Effect of organic inputs on tree height and trunk girth, canopy spread and Total no. of Laterals/m² of pooled (Pooled data for the year 2013-14 & 2014-15)

	Treatment	Tree height (m)	Trunk girth (cm)	Canopy spread (E-W)	Canopy Spread (N-S)	Total no. of Laterals/m ²
T ₁	100% N as FYM	4.89 ^{ab}	71.39 ^a	7.42 ^{ab}	7.62 ^b	22.38 ^d
T ₂	100% N as FYM + Biofertilizers (Azotobacter + Azospirillum + PSB) 200g	4.57 ^{bc}	71.25 ^a	7.51 ^{ab}	7.13 ^{bc}	25.57 ^{ab}
T ₃	50% N as FYM + Biofertilizers (200g)	4.59 ^{bc}	64.33 ^c	7.13 ^b	7.20 ^{bc}	22.78 ^d
T ₄	100% N as Vermicompost + Biofertilizers (200g)	4.38 ^c	56.1 ^d	7.25 ^{ab}	6.92 ^c	24.59 ^{bc}
T ₅	Recycling of organic residue with the addition of 20% cow dung slurry	4.68 ^{bc}	69.88 ^{ab}	7.32 ^{ab}	7.19 ^{bc}	22.47 ^d
T ₆	In situ green manuring / green leaf manuring to meet 100% N	4.56 ^{bc}	66.46 ^{ab}	7.11 ^b	7.27 ^{bc}	23.62 ^d
T ₇	25% N as FYM + recycling of organic residue + in situ green manuring / green leaf manuring + Biofertilizers (200g)	4.71 ^{bc}	68.70 ^{ab}	7.47 ^{ab}	7.18 ^{bc}	25.14 ^b
T ₈	Recommended doses of fertilizer + 10 kg FYM (Control)	5.05 ^a	69.60 ^{ab}	7.98 ^a	7.88 ^a	26.91 ^a
	SE(m)±	0.09	1.40	0.21	0.13	0.51
	CD (p=0.05)	0.29	4.24	NS	0.39	1.55
	CV %	3.59	3.60	5.11	3.07	3.67
	F test	**	**	NS	**	**

*significant at 5% level **significant at 1% level, The superscription like a,b.... within a row or a column do not differ statistically.

The vegetative parameters like plant height, girth, canopy spread and Number of laterals/m² are the indicator for the final output.

The tree height was significantly influenced by the various treatments. RDF along with 10kg FYM recorded the highest height and was found statistical par with 100 per cent N as FYM and

it was different from all other treatments and minimum height was recorded in 100 per cent N as vermicompost and biofertilizer consortium. The trunk girth which was an indicator for health of plant was found maximum in treatment amended with 100 per cent N as FYM + Biofertilizer was significantly superior to other treatments but at



par with 100 per cent N as FYM. Minimum was recorded in 100 per cent N as vermicompost and Biofertilizers. The application of 100 per cent N as FYM+ Biofertilizers and 100 per cent N as FYM increase the girth of the plant compare to other treatments. The minimum girth was recorded where 100per cent N as vermicompost and Biofertilizers was applied. In the plantation crop like cashew on rain fed situation the nutrient uptake might be less compare to other treatments. FYM being a bulky organic material releases soil compaction and improves soil aeration in addition to the supply of essential plant nutrients and organic matter thereby increasing the soils biological activities. FYM also provided room for better microbial establishment along with the accumulation of excess humus content. Naik *et al.* (2007) in Guava and Ghose *et al.* (2014) obtained a significant result in plant growth by application of organic manures.

The canopy spread both in (E-W) and (N-S) direction is the reflection of fruiting area to the plant and the number of laterals/meter² also varied according to various treatments, applications. The Canopy spread in the East -West and North- South direction was maximum in Recommended doses of fertilizer + 10 kg FYM followed by 100 per cent N as FYM and minimum was recorded in 100 per cent N as Vermicompost + Biofertilizers. The number of laterals also found highest in treatment applied with Recommended doses of fertilizer + 10 kg FYM followed by 25 per cent N as FYM + recycling of organic residue + *in situ* green manuring/green leaf manuring + Biofertilizers and 100per cent N as FYM + Biofertilizers. The minimum was recorded in 100 per cent N as FYM. It was found that the application of RDF i.e. 500g, 250g, 250g with 10 kg FYM was found superior with respect to plant height, Canopy spread and production of laterals per square meter so the plant is able to absorb more nutrients and induce more of vegetative growth. The present findings are agreement with earlier worker Ghosh *et al.* 2014 in orange, Jeeva *et al.* (1988) in banana, Gautam *et al.* (2012) in mango, Yadav *et al.* (2010) in strawberry. However, the organic treatments like 25 per cent N as FYM + recycling of organic residue + *in situ* green manuring/green leaf manuring + Biofertilizers and 100 per cent N as FYM + Biofertilizers showed the second highest result.

The pooled data was found significant. Treatment RDF+10 kg FYM (T₈) recorded highest (27.21 cm)

panicle length, found statistically at par with T₇ (26.30cm) supplied with 25 per cent N as FYM + recycling of organic residue + *in situ* green manuring/green leaf manuring + Biofertilizers, T₄ (25.61 cm) and minimum (26.62cm) was recorded in *In situ* green manuring / green leaf manuring (T₆). Treatment T₆, T₅, T₃, T₁ and T₂ was also found statistically at par. As indicated from pooled data maximum (19.62cm) panicle breadth was recorded in RDF+10 kg FYM (T₈) and was found statistically at par with 100per cent N as Vermicompost + Biofertilizers (T₄). Minimum panicle breadth (16.37) was recorded in Recycling of organic residue with the addition of 20per cent cow dung slurry (T₅) The pooled data indicated that maximum number (22.48) of flowering laterals was recorded in RDF+10 kg FYM (T₈) followed by T₂ (21.9) amended with 100per cent N as FYM + Biofertilizers (T₂). T₈, T₂, T₄ and T₇ were statistically at par but significantly superior to all other treatments and minimum (19.25) was recorded in treatment *in situ* green manuring / green leaf manuring to meet 100per cent N (T₆). Pooled data RDF with 10 kg of FYM (T₈) recorded highest (14.06 q/ha) nut yield and was found significantly superior to all other treatments and minimum (6.85 q/ha) was recorded by *in situ* green manuring / green leaf manuring (T₆). There was no significant variation among T₆, T₅, T₃ and T₁.

The highest nut yield 14.6 q/ha was in RDF +10kg FYM compare to all other treatments and lowest in *in situ* green manuring/green leaf manuring that is 6.85q /ha. The nut yield was influence by the vegetative growth, flowering behavior, nut weight. It is evident that as compare to T₆ the nut yield was more than 100 per cent in T₈ and it is also found that 25% N as FYM recycling of organic residue along with *in situ* green manuring and Biofertilizers recorded yield of 10.19q/ha and in case of 100 per cent as FYM and Biofertilizer increase the yield of 10.04q/ha. The increase in yield might be due to the solubilization effect of the nutrients as well as the chelating effect of bio fertilizer on metals thereby the availability of essential nutrients get increased. Srichandan *et al.* (2015) This finding is in accordance with Brahma *et al.* (2012) in Broccoli. It is found that the low yield is also attributed due to less number of flowering panicles, less number of nuts per m² and nut weight. This present findings are confirmed

with the findings of Mahendra *et al.* (1988), Hebbara *et al.* (2006) recorded good effect of organic inputs in grapes and sapota respectively, Chottopadhaya and Ghos (1986) and Reddy *et al.* (1972), The application of organic manure, biofertilizer was

found promising in the fruit crops as fated by the above worker. Richards (1993) recorded higher yields with higher dose of NPK and lower yield in any nitrogen application in cashew.

Table 3: Effect of organic inputs on Panicle length(cm), Breadth (cm) , Number of flowering laterals/m² Nut Yield (q/ha) pooled data for the year 2013-14 & 2014-15.

Treatment		Panicle length(cm)	Panicle Breadth (cm)	Number of flowering laterals/m ²	Nut Yield (q/ha)
T ₁	100% N as FYM	24.78 ^{bcd}	19.98 ^{bc}	88.00 ^{cd}	7.96 ^{cd}
T ₂	100% N as FYM + Biofertilizers (Azotobacter + Azospirillum + PSB) 200g	25.33 ^{bcd}	21.90 ^a	89.33 ^{bc}	10.04 ^b
T ₃	50% N as FYM +Biofertilizers (200g)	24.12 ^{cd}	19.75 ^c	87.33 ^d	7.96 ^{cd}
T ₄	100% N as Vermicompost + Biofertilizers (200g)	25.61 ^{abc}	21.40 ^{ab}	90.33 ^{ab}	8.98 ^{bc}
T ₅	Recycling of organic residue with the addition of 20% cow dung slurry	23.94 ^{cd}	19.81 ^c	88.33 ^{cd}	7.49 ^d
T ₆	In situ green manuring / green leaf manuring to meet 100% N	23.62 ^d	19.25 ^c	88.33 ^{cd}	6.85 ^d
T ₇	25% N as FYM +recycling of organic residue + in situ green manuring/green leaf manuring +Biofertilizers (200g)	26.30 ^{ab}	21.39 ^{ab}	89.67 ^{bc}	10.19 ^b
T ₈	Recommended doses of fertilizer + 10 kg FYM (Control)	27.21 ^a	22.48 ^a	91.33 ^a	14.06 ^a
	SE(m)±	0.44	0.53	0.47	0.38
	CD (p=0.05)	1.33	1.6	1.42	1.159
	CV %	3.03	5.16	3.92	7.2
	F test	**	**	**	**

*significant at 5% level ** significant at 1% level, The superscription like a,b,... within a row or a column do not differ statistically.

Conclusion

We have concluded that application of integrated nutrient of both inorganic (recommended fertilizers) and organic nutrients (FYM) not only increases the vegetative growth but also the nut yield in cashew as compared to other sole organic inputs. The study also showed the possibility of integrated use of different sources of organic inputs in equal proportion to supplement 100% N as 25% N as FYM + Recycling of organic residue + In situ green manuring / green leaf manuring + Biofertilizers @ 200g in order to provide better growth and yield in cashew by maintaining soil fertility, at least continuous application for a period of six to seven years and required further study.

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