International Journal of Agriculture Sciences
ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 8, Issue 63, 2016, pp.-3552-3554.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

EFFICACY OF ORGANIC INPUTS ON SOIL HEALTH OF CASHEW (*Anacardium occidentale* L.) PLANTATION

MOHAPATRA AMRITA[1*], DASH D. K.[2], ROUT K.K.[3] AND TRIPATHY P.[4]

[1,2]Department of Fruit Science and Horticulture Technology, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha, 751 003, India
[3]Department of Soil Science & Agriculture Chemistry, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha, 751 003, India
[4]Department of Vegetable Science, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha, 751 003, India
*Corresponding Author: Email-amritaouat@gmail.com

Received: November 01, 2016; Revised: December 17, 2016; Accepted: December 18, 2016; Published: December 28, 2016

Abstract- Cashew (*Anacardium occidentale* L.) being emerged as one of the most important dollar earning plantation crops having very significant role to play in Indian economy, hence there is need for producing organic cashew for export purpose. In order to address the challenge, the present investigation of use of organic inputs in cashew was carried out at All India Coordinated Research Project on Cashew (ICAR) of OUAT, Bhubaneswar, Odisha, India. Eight treatments of different organic inputs including recommended dose of fertilizers and FYM as control were used by adopting RBD, replicated thrice having four plants per treatments in recommended cashew variety, BPP-8. The results recorded during 2013-14 and 2014-15 revealed significant variations among different treatments for various soil physicochemical and biological parameters of organic cashew plantation. The soil which received combined application of 25 per cent N as FYM + recycling of organic residue + *in situ* green manuring + Biofertilizers, remained more porous & the inorganic treatment recorded lowest biological activity measured in terms of microbial respiration and dehydrogenase activity. Among the sole application of organic inputs, application of 100% nitrogen either through vermicompost+ *Biofertilizers*@ 200g, or through FYM + *Biofertilizer* @ 200g or25% N each as FYM + Recycling of organic residue + *In situ* green manuring/green leaf manuring + *Biofertilizer* @ 200g were proved to be significantly better for various soil health, indicating the scope of organic cashew cultivation for improvement of soil quality for production . The present study revealed a scope for further elaborate study in these aspects in future.

Keywords- Cashew, Soil health, Bio-fertilizers, FYM, Organic inputs, Vermicompost

Citation: Mohapatra Amrita, et al., (2016) Efficacy of Organic Inputs on Soil Health of Cashew (*Anacardium occidentale* L.) Plantation. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 8, Issue 63, pp.-3552-3554.

Introduction

Cashew (*Anacardium occidentale* L.) treated as "Wonder nut of the world" is native to Brazil having about 75 genera and 700 species. Although cashew was introduced to India by Portuguese as a crop of afforest ration and soil conservation purpose, but later on, the crop was exploited commercially due to its versatile uses by India.

Cashew nut is now treated as a healthy friendly nut [3]. 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[8], thereby reduce the cholesterol and have good for heart health of human beings .The high dietry fiber and high monosaturated fatty acid lower the blood glucose and improve insulin resistance [9]. 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.

Besides the valuable kernel in cashew. Thus, the objective of the present study is to study the effect of various organic sources of nutrients on soil biological status of soil during different stages of crop growth.

Material and Method

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 $20^{0}45$"N, longitude $86^{0}10$" E and altitude 60m) during 2007 to 2013. 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 *Treatment details of Organic Management in Cashew*

Treatment	Treatment details
T_1	100 % N as FYM
T_2	100 % N as FYM + Bio-fertilizers (*Azatobacter*+ *Azospirillum*+ 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 % cow dung 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 + *In situ* green manuring /green leaf manuring + Bio-fertilizers (200g)
T_8	Recommended doses of fertilizer + 10 kg FYM (Control)

Soil samples, one in each direction of the cashew orchard were collected at the time of leaf sampling. Soils from depth (0-30 cm) were sampled from base of the plant at 1.5 m radius from 5 random locations from east, west, north and south directions of cashew orchard. The soil samples from each direction were bulked for each depth, thoroughly mixed and a composite sample taken for analysis. The soil samples were air dried and passed through 2 mm sieve. The bulk density of experimental soil was determined by core method as described by [1]. Available nitrogen Modified kjeldhal's method [4],Available Phosphorus Brays 1 method [2], Available Potassium Flame-Photometer using neutral normal ammonium acetate extracts (Jackson,1962),Organic CarbonWalkley and Black's rapid titration [6],Soil pH Blackmans pH meter [7] with 1:2.5 soil water ratio, Electrical Conductivity (EC) Conductivity Bridge Method .The recorded observations were calculated statistically by adopting standard procedure suggested by [11].

Results and Discussion

The data related to soil dehydrogenase activity and microbial respiration presented in table 4.16 showed significant effect of manorial treatments on both the biological characteristics. The difference was more distinct in soil dehydrogenase activity that varied from 14.24µg/g of soil/24hr observed with *insitu* green manuring treatment to maximum of 34.11 µg/g of soil/24hr observed in treatment that received combined use of all organic treatment FYM, organic residue ,green manure and biofertilizer, it was at par with T_2(32.99µg/g of soil/24hr) that received 100per cent N as FYM and biofertilizers, 100per cent N as FYM (28.33) and 100per centN as vermicompost along with biofertilizer (26.20µg/g of soil/24hr). The activity of this treatments were significantly higher than that found in the *insitu* green manure treatment (T_6). The data clearly showed that application of FYM or vermicompost in full dose recorded higher dehydrogenase activity .Smaller dose of FYM there is 10kg /plant along with RDF, 50 per centN as FYM +Biofertilizer or recycling of organic residue +Cowdung slurry or *in situ* green manuring alone held to maintained higher biological activity as measured in terms of dehydrogenase activity. In relation to soil microbial respiration significant differences were also observed among some of the treatments. Microbial respiration varied from a lowest (7.67mgCO_2/100gsoil/day) in *insitu* green manure treatment to highest (13.30mgCO_2/100gsoil/day) in treatment that received both vermicompost and biofertilizer, perusal of data revealed that treatments that received vermicompost or any organic inputs + biofertilizer recorded higher microbial respiration, correlation study between the two parameters showed positive but insignificant correlation(r=0.486)

Table-2 *Effect of organic inputs on soil dehydrogenase activity and soilmicrobialrespiration*

Treatment		Soil dehydrogenase activity (µg/g of soil/24 hr)	Soil Microbial Respiration(mg CO_2/100g soil/day)
T_1	100% N as FYM	28.33^{ab}	8.00^{c}
T_2	100% N as FYM + Biofertilizers (*Azotobacter* + *Azospirillum* + PSB) 200g	32.99^{a}	11.33^{ab}
T_3	50% N as FYM +Biofertilizers (200g)	18.12^{cd}	9.33^{bc}
T_4	100% N as Vermicompost + Biofertilizers (200g)	26.20^{abc}	13.00^{a}
T_5	Recycling of organic residue with the addition of 20% cowdung slurry	19.59^{bcd}	9.33^{bc}
T_6	*In situ* green manuring / green leaf manuring to meet100% N	14.24^{d}	7.67^{c}
T_7	25% N as FYM +recycling of organic residue + *in situ* green manuring/green leaf manuring + Biofertilizers (200g)	34.11^{a}	11.33^{ab}
T_8	Recommended doses of fertilizer + 10 kg FYM (Control)	19.00^{bcd}	9.75^{bc}
	SEm±	3.09	0.88
	CD(p=0.05)	9.38	2.68
	CV %	22.27	15.37
	F test	**	*

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

In the past scientists have expressed concerns on the danger of indiscriminate and continuous use of chemical fertilizers in soil as it eventually reduces the soil biological activity (Tennakoon,1990).The use of chemical fertilizers /agrochemicals kills the beneficial soil organisms and destroys there natural fertility. This is probably because of the adverse effects of high concentration of nutrients and salts in inorganic fertilizers [13]. Chemically grown foods have adversely affected soil and human health [5,10].

Table-3 *Effect of Organic inputs on pH, electrical conductivity and organic carbon content of soil*

Treatment		pH			EC (dS m^{-1})			OC (g kg^{-1})		
		2013-14 initial	2013-14 final (14-15 initial)	2014-15 final	2013-14 Initial	2013-14 final (14-15 initial)	2014-15 Final	2013-14 initial	2013-14 final (14-15 initial)	2014-15 Final
T_1	100% N as FYM	5.42	5.30	5.17	0.04	0.04	0.033	2.59e	4.55	4.11
T_2	100% N as FYM + Biofertilizers (*Azotobacter* + *Azospirillum* + PSB) 200g	5.67	5.24	5.14	0.04	0.04	0.029	3.50^{b}	4.17	4.39
T_3	50% N as FYM +Biofertilizers (200g)	5.57	5.00	5.35	0.03	0.07	0.031	2.41^{f}	3.59	4.95
T_4	100% N as Vermicompost + Biofertilizers (200g)	5.68	4.95	5.40	0.04	0.06	0.032	2.94^{c}	4.63	4.82
T_5	Recycling of organic residue with the addition of 20% cowdung slurry (20%-Weight of organic residue cowdung)	5.45	5.06	4.99	0.06	0.04	0.033	2.24^{g}	4.12	4.82
T_6	*In situ* green manuring / green leaf manuring to meet100% N .	5.15	5.02	4.95	0.04	0.04	0.019	2.14^{h}	4.42	4.64
T_7	25% N as FYM +recycling of organic residue + *in situ* green manuring/green leaf manuring +Biofertilizers (200g)	5.10	5.06	4.95	0.07	0.05	0.028	3.69^{a}	4.19	5.50
T_8	Recommended doses of fertilizer + 10 kg FYM (Control)	4.91	5.05	4.91	0.08	0.05	0.051	2.86^{d}	4.58	5.58
	SE(m)±	0.18	0.11	0.11	0.013	0.013	0.01	0.007	1.11	0.66
	CD (p = 0.05)	NS	NS	NS	NS	NS	NS	0.02	NS	NS
	CV %	5.6	3.77	3.91	5.66	46.93	55.54	0.44	45.23	23.86
	F test	NS	NS	NS	NS	NS	NS	**	NS	NS

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

The data clearly showed that application of FYM or vermicompost in full dose recorded higher dehydrogenase activity .Smaller dose of FYM there is 10kg /plant along with RDF, 50per cent N as FYM + Biofertilizer or recycling of organic residue + Cowdung slurry or *in situ* green manuring alone held to maintained higher biological activity as measured in terms of dehydrogenase activity dehydrogenase activity .In relation to soil microbial respiration the data revealed

that treatments that received vermicompost or any organic inputs + biofertilizer recorded higher microbial respiration, Correlation study between the two parameters showed positive but insignificant correlation(r=0.486)

Chemical properties of the soil

Data related to pH, EC and OC of soil measured at different periods during two years of investigation and revealed from [Table-3] that increase in the pH in all the treatments over the initial status of 5.10 was observed during vegetative growth of first year (2013-14). Subsequent measurement of pH showed lower values in respective of treatments, which were even smaller than the initial value. This indicates the variation in soil pH at different stages of crop growth within a stage the measured pH however did not differ among the treatments. This shows continuous application of various organic inputs didn't have significant effect on soil pH within 5 years. However the treatment that received RDF along with 10kg FYM (T_8) maintained a relatively low pH which was lower than the initial value

The data pertaining to the Electrical Conductivity (EC) of soil [Table-3] measured at different stages showed no significant effect of the manurial treatments. However continuous application of organic and inorganic inputs caused rise in EC values as compared to initial values of 0.02dS m^{-1}. The measured EC value ranged from 0.03-0.8dS m^{-1} at initial stage (2013-2014) among different treatments. In general the treatment that receives RDF + FYM maintains relatively high value of EC which be due to continuous application of salt through chemical fertilizers in 2014-15. The value showed a declining trend as compared to other stages of measurement .The data pertaining to organic carbon [Table-3] at three stages of measurement showed an increasing trend. During 2013-14 measurement made at that stage showed lower values of soil organic carbon that varied as 2.14 g/kg as compared to the initial value 3.9g/kg. However the treatments had significant effect. Treatment 100% N as FYM along with biofertilizer (T_2)and 25per cent N as FYM+organic residue+ *insitu* green manuring + biofertilizer (T_7) recorded higher content of organic carbon than other treatments. Among the treatments *insitu* green manuring alone maintained lowest value of 2.14g/kg but in subsequent stages the value increases 2.14g/kg to 3.69g/kg during 2013-14 initial, 3.59g/kg to 4.58g/kg during 2013-14 final and 4.11g/kg to 5.58g/kg during 2014-15 final. However, there is no significant difference among the treatments. The treatments that produced higher yield also maintained more organic carbon in soil.

The data clearly showed that application of FYM or vermicompost in full dose recorded higher dehydrogenase activity .Smaller dose of FYM there is 10kg /plant along with RDF, 50per cent N as FYM + Biofertilizer or recycling of organic residue + Cowdung slurry or *in situ* green manuring alone held to maintained higher biological activity as measured in terms of dehydrogenase activity dehydrogenase activity .In relation to soil microbial respiration the data revealed that treatments that received vermicompost or any organic inputs + biofertilizer recorded higher microbial respiration, Correlation study between the two parameters showed positive but insignificant correlation(r=0.486)

In the past scientists have expressed concerns on the danger of indiscriminate and continuous use of chemical fertilizers in soil as it eventually reduces the soil biological activity [12]. The use of chemical fertilizers /agrochemicals kills the beneficial soil organisms and destroys there natural fertility .This is probably because of the adverse effects of high concentration of nutrients and salts in inorganic fertilizers [13]. Chemically grown foods have adversely affected soil and human health [5,10]. The data pertaining to the Electrical Conductivity (EC) of soil measured as different stages showed no significant effect of the manurial treatments. However continuous application of organic and inorganic inputs caused rise in EC values as compared to initial value of 0.02. The measured EC value ranged between 0.63-0.8 at initial stage (2013-2014). In general, the treatment that received RDF maintained relatively high value of EC which might be due to continuous application of salt, through chemical fertilizers. The value showed a declining trend at other stages of measurement which might be due to more leaching of salt during rainy season due to heavy rainfall. The data pertaining to organic carbon showed an increasing trend with growth. During 2013-14 measurement made at stage showed lower values of soil organic carbon that varied from 2.1 to 2.86 g/kg as compared to the initial value 3.9g/kg. However, the treatments had significant effect. Treatment received 100% N as FYM along with *biofertilizer* and 25per cent N as FYM+ organic residue+ *in situ* green manuring + *biofertilizer* recorded higher content of organic carbon than other treatments. Among the treatments *in situ* green manuring alone maintained lowest value of 2.14g/kg but in subsequent years the value increased to 3.59g/kg to 4.58g/kg during 2013-14 and 4.11g/kg to 5.58g/kg during 2014-15 final. However in both these years there is no significant difference among the treatments. But the treatments that produced higher yield also maintained more organic carbon in soil.High organic carbon in the surface horizon could be due to leaf litter fall and applied manure.

Conclusion

For the present study, it is concluded that organic amendments in general have a positive impact on soil biological parameters of cashew plantation. Thus there is scope for cultivation of organic cashew for quality produce along with preventing both water and food pollution resulting from hazardous chemical fertilizers .

Acknowledgement

We greatly acknowledge the Orissa University of Agriculture & Technology, Odisha, India for the research facilities provided to the Director, Directorate of Cashew Research (ICAR), Puttur, Karnataka, India for providing the financial and other facilities to carry out the study under AICRP on Cashew.

Abbreviations:

RBD-Randomized block design
FYM-Farm Yard Manure
g-Gram
AICRP-All India Coordinated Research projects

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest: None declared

References

[1] Black C.A. (1965) *American Soc. Agron. Inc. Madison*, pp. 117-74.
[2] Bray R.H. and Kurti L.T. (1945) *Soil Sciences,* 39,*39-45.*
[3] Fernadez M. (2001) *The Cashew,* XV(4), 8-11.
[4] Jackson M.L. (1960) *Soil Chemical Analysis*. Prentice Hall Inc. Englewood Cliff, New Jersy, pp. 498.
[5] Jithya (2010) Effect of different fertilizers on the growth of coconut seedlings, availability of some nutrients and soil microbial activities .http// environmentlanka.Com/blog/2010
[6] Page A.L., Miller R.H. and Kenedy D.R. (1982) *Am. Soc. Agron. Inc. and Soil Sci. Soc. Am. Inc.*, Madison, Wi, USA.
[7] Piper C.S. (1966) Soil and Plant Analysis. Prentice Hall, USA.
[8] Rao S.I.K. and Venkataraman S. (1995) Nutritional qualities of cashew, cashew industry KJP Research Foundation, Trivendrum.
[9] Sacks Frank M. (1999) Harvested Nut Research Revealed to Japan nut Association. The cracker, No.3.International Tree nut council; Spain.
[10] Sujit A. (2002) *Agriculture Science,* 3(7), 905-917.
[11] Sukhatme P.V., Amble V.N. (1995) Randomized Blocks Designs. In: Statistical Methods for Agricultural Workers, Krishi AnusandhanBhavan, Pusa, New Delhi, India 145-156.
[12] Tennakoon N.A. (1990) *Cocos,* 15,*23-30*
[13] H*uat* O.K., Awang K., Hashim A. and Majid N.M. (2002) *Forest Ecology, Management,* 158(1-3), *51-58.*