RESEARCH PAPER | International Journal of Agricultural Engineering | Volume 6 | Issue 1 | April, 2013 | 177–183

Effect of different soil and water conservation measures and sources of nutrients on growth and yield of cashew

B.M. ANANDA KUMAR, NARAYAN S. MAVARAKAR, PARASHURAM CHANDRAVANSHI AND H. BHOGI BASAVARAJAPPA

Received : 22.02.2013; **Revised :** 24.03.2013; **Accepted :** 20.04.2013

See end of the Paper for authors' affiliation

Correspondence to:

B.M. ANANDA KUMAR
Extension Education Unit, Agricultural Recearch Station, Kathalgere, DAVANAGERE (KARNATAKA) INDIA
Email : basavarajbhogi@rediffmail.com

ABSTRACT : The experiment plants were seven year old (during first year of study) cashew grafts of Ullal -1 variety with row and intra row space of 8x6 m. All soil and water conservation measures significantly increased the growth parameters as well as nut and total yield in treatment of trenches across the slope on four sides followed by preparation of basin around the tree and mulching basin around the tree when compared to control plot (without soil and water conservation measures). Among sub plot treatments, the application of organic and inorganic nutrient fertilizers along with soil and water conservation measures significantly helped in increasing the nut yield(kg/tree) and total yield (q/ha).

KEY WORDS : Water conservation efficiency, Soil conservation efficiency, Soil moisture content, Nut yield, Total yield

HOW TO CITE THIS PAPER : Ananda Kumar, B.M., Mavarakar, Narayan S., Chandravanshi, Parashuram and Basavarajappa, H. Bhogi (2013).Effect of different soil and water conservation measures and sources of nutrients on growth and yield of cashew. *Internat. J. Agric. Engg.*, **6**(1) : 177-183.

In India cashew is grown in an area of 9.23 lakh ha with 6.65 lakh tons production (Anonymous,2011). India is largest producer, processor and consumer and second largest exporter of cashew in the world. The share of India in raw nut production is about 20.7 per cent of the world production. Though there is a substantial increase in cashew area over the year, the production and productivity (710 kg/ ha) of the crop is remaining consistently low as compared to world average (838 kg/ha) (Hubballi, 2009). Similarly, Karnataka is one of the major cashew growing states in the country having an area of 1, 02,000 ha with an annual production of 60,000 tons (Hubballi, 2009). Dakshina Kannada, Uttara Kannada, Belgaum, Shimoga, Kolar and Udupi are the major cashew growing districts in Karnataka. Hence, the present study was conducted to know the effect of different soil and water conservation measures and sources of nutrients on growth and yield of cashew.

METHODOLOGY

The study was conducted in Ariyapu village which is situated in the coastal zone (Zone No-10) with an operational area of Taluk Puttur of Dakshina Kannada, District. The experiment was laid out in split plot design with three replications having 108 plants in interaction between soil and water conservation measures and nutrient levels were imposed in normal planting in 2009 and 2010. The experiment plants were seven year old (during first year of study) cashew grafts of Ullal-1 variety with row and intra row space of 8x6 m. During study period improved growth, yield parameters, nutrient losses soil loss and runoff losses observations were recorded and data were statistically analyzed by following Fisher method of analysis of variance.

Main plot : Soil and water conservation measures (M) :

M_1 = Individual tree terracing with crescent bund (Terrace of 2.0 m radius around the plant with crescent shaped bund of size 6.0 m length, 0.5 m height and 1.0 m width at base)

M_2= Trenches across the slope in between two rows (Trenches of size 2.0 m length, 0.45 m width and 0.45 m depth in between two rows)

M_3 = Trenches across the slope on four sides (Trenches of size 2.0 m length, 0.45 m width and 0.30 m depth at 2.0 m radius around the tree)

M_4 = Preparation of basin around the tree (Trenches of size 2.0 m radius around the plant with catch pit of size (0.45 m depth x 0.3 m width around the tree)

M_5 = Mulching of basin around the tree (Mulching of waste

green manure and cashew dry leaves were incorporated in 2.0 m radius around the plant)

M_6 = Control plot (Without any soil and water conservation practices)

Sub plot: Sources of nutrient (S) :

S_1= Recommended dose of inorganic fertilizer (1000g N: 600 g P_2O_5: 200 g K_2O)

S_2= Recommended dose of organic manure (FYM @ 80kg/ tree/ year)

S_3= Recommended dose of inorganic fertilizer and recommended organic manures (*i e.*, 1000g N: 600 g P_2O_5: 200 g K_2O + FYM @ 80kg/ tree/ year)

Growth and yield parameters of cashew :

Growth parameters of cashew crop such as height, girth, canopy height were recorded at an interval of 12 months up to 36 months. Cashew yield was recorded for the crop years 2009 and 2010. Average nut yield per tree (kg/tree) and total yield (q/ha) of cashew nut were recorded and analyzed.

Statistical analysis and interpretation :

The data collected on different characters during the course of investigation were subjected to Fisher's method of analysis of variance technique for interpretation of the data as given by Panse and Sukhatme (1967). The level of significance used in 'F and't' test was p=0.05.Critical Difference (C.D.) values were calculated for the p = 0.05 probability level wherever 'F' test was found significant.

RESULTS AND DISCUSSION

The growth parameters *viz.,* stem girth, tree height and canopy height under different treatments were recorded at an interval of twelve months for two years.

Adoption of different conservation measures and sources of nutrient applied significantly increased the stem of cashew during the period of study. Among different conservation measures, the main treatments having trenches across the slope along with four sides recorded significantly higher (62.22 and 62.97 cm) stem girth as compared to rest of the conservation measures.

The treatment, preparation of basin around the tree recorded a stem girth of 61.23 and 62.21cm, respectively during both the years which is comparable with M_3 (Table 1).

Application of different sources of nutrients significantly influenced the stem girth of cashew during the course of investigation. However, significant highest stem girth was observed in combined use of organic and recommended dose of nutrient supply (58.01 and 59.19 cm) during 2008-09 and 2009-10, respectively. Among different sub level treatments minimum stem girth (57.55 and 58.52 cm) was observed in treatment with application of RDF alone during both the years of the study.

Cashew is a nitrogen lover and N and K nutrition is of greatest significance along with organic sources of nutrients in enhancing the growth and development there by production and productivity (Abdul Salam, 2003). The minimum growth parameters were observed in control where no adoption of conservation measures, during both the years. The findings in this study concurred with the results supported by Nambiar (1983).

Interaction effects of different conservation methods and nutrient supply (main plot and sub treatments) with respect to the stem girth was found to be significant during 2008-09 and 2009-10.

Tree height increased significantly due to conservation measures and sources of nutrient applied during both the years of study. Among different conservation measures, the main treatments having trenches across the slope on four sides recorded highest tree height (4.68 and 4.71 m, respectively) as compared to rest of the conservation measures. The next best treatment that recorded highest tree height was preparation of basin around the tree (4.35 and 4.39 m) during 2008-09 and 2009-10, respectively (Table 2).

Application of different sources of nutrients significantly influenced the tree height of cashew during the course of investigation. However, significantly highest tree height was noticed in combined use of organic and recommended dose of nutrient supply (4.01 and 4.05 m) during 2008-09 and 2009-10, respectively. Among different sub plot treatments, minimum (3.81 and 3.88 m) tree height was observed in the treatment that received RDF alone during both the years of the study (Table 2).

Interaction effects of different conservation methods and nutrient supply (main plot and sub treatments, respectively) with respect to the tree height was not significant during 2008-09 and 2009-10.

Canopy spread significantly increased due to conservation measures and nutrients applied (Table 3). Among different conservation measures, the main treatments having trenches across the slope along with four sides recorded significantly higher (1.26 and 1.63 m) canopy spread as compared to rest of the treatments. Similarly preparation of basin around the tree recorded a canopy spread of 1.17 and 1.47, respectively during 2008-09 and 2009-10.

Application of different sources of nutrients significantly influenced the canopy spread of cashew during the course of investigation. However, significantly highest canopy spread was observed in combined use of organic and recommended dose of nutrient supply (1.06 and 1.30 m) during 2008-09 and 2009-10, respectively. Among different sub plot treatments, minimum (1.02 and 1.10m, respectively) canopy spread was observed in treatment with application of RDF alone during both the years of the study.

Interaction effects of different conservation methods and nutrient supply (main plot and sub treatments) with respect to the canopy spread was found to be significant during 2008-09 and 2009-10.

Table 1: Stem girth (cm) as influenced by different soil and water conservation measures and nutrient sources

Treatments	2008-09	2009-2010
Main (Soil and water conservation measures)		
M_1	59.22	60.21
M_2	58.21	58.92
M_3	62.22	62.97
M_4	61.23	60.30
M_5	57.71	59.18
M_6	48.34	49.52
F – Test	**	**
S.E. $\pm$	0.121	0.231
C.D. (0.05)	0.382	0.728
C.V. (%)	0.63	1.18
Sub (Nutrient levels)		
S_1	57.55	58.52
S_2	57.90	58.84
S_3	58.01	59.19
F – Test	**	**
S.E. $\pm$	0.058	0.111
C.D. (0.05)	0.170	0.325
C.V. (%)	0.43	0.80
Interactions (Main x Sub)		
$M_1 S_1$	60.03	61.44
$M_1 S_2$	61.47	62.13
$M_1 S_3$	62.19	63.05
$M_2 S_1$	58.23	58.63
$M_2 S_2$	58.20	58.70
$M_2 S_3$	58.19	59.43
$M_3 S_1$	61.88	62.85
$M_3 S_2$	62.47	62.99
$M_3 S_3$	62.32	63.07
$M_4 S_1$	59.05	60.23
$M_4 S_2$	59.23	60.22
$M_4 S_3$	59.37	60.44
$M_5 S_1$	57.50	58.54
$M_5 S_2$	57.89	58.62
$M_5 S_3$	57.74	60.38
$M_6 S_1$	48.64	49.39
$M_6 S_2$	48.14	50.39
$M_6 S_3$	48.26	48.77
F – Test	**	**
S.E. $\pm$	0.143	0.273
C.D. (0.05)	0.416	0.796

Table 2: Tree height (m) as influenced by different soil and water conservation measures and nutrient sources

Treatments	2008-09	2009-2010
Main (Soil and water conservation measures)		
M_1	4.35	4.39
M_2	3.73	3.86
M_3	4.68	4.71
M_4	4.35	4.39
M_5	3.68	3.71
M_6	3.28	3.34
F – Test	**	**
S.E. $\pm$	0.045	0.032
C.D. (0.05)	0.141	0.100
C.V. (%)	3.43	2.40
Sub (Nutrient levels)		
S_1	3.81	3.88
S_2	3.90	3.96
S_3	4.01	4.05
F – Test	**	**
S.E. $\pm$	0.022	0.018
C.D. (0.05)	0.065	0.053
C.V. (%)	2.40	1.91
Interactions (Main x Sub)		
$M_1 S_1$	4.30	4.31
$M_1 S_2$	4.30	4.33
$M_1 S_3$	4.52	4.53
$M_2 S_1$	3.63	3.79
$M_2 S_2$	3.69	3.86
$M_2 S_3$	3.88	3.93
$M_3 S_1$	4.63	4.66
$M_3 S_2$	4.66	4.69
$M_3 S_3$	4.74	4.78
$M_4 S_1$	3.68	3.72
$M_4 S_2$	3.73	3.76
$M_4 S_3$	3.74	3.79
$M_5 S_1$	3.53	3.58
$M_5 S_2$	3.70	3.72
$M_5 S_3$	3.80	3.82
$M_6 S_1$	3.13	3.21
$M_6 S_2$	3.29	3.39
$M_6 S_3$	3.40	3.42
F – Test	NS	NS
S.E. $\pm$	0.054	0.044
C.D. (0.05)	-	-

Table 3: Canopy spread (m) as influenced by different soil and water conservation measures and nutrient sources

Treatments	2008-09	2009-2010
Main (Soil and water conservation measures)		
M_1	0.94	1.47
M_2	1.10	1.28
M_3	1.26	1.63
M_4	1.17	1.47
M_5	1.17	1.23
M_6	0.59	0.65
F-test	**	**
S.E. $\pm$	0.023	0.018
C.D. (0.05)	0.074	0.058
C.V. (%)	6.80	4.53
Sub (Nutrient levels)		
S_1	1.02	1.10
S_2	1.04	1.23
S_3	1.06	1.30
F-test	**	**
S.E. $\pm$	0.009	0.011
C.D. (0.05)	0.031	0.031
C.V. (%)	3.82	3.52
Interactions (Main x Sub)		
$M_1 S_1$	1.11	1.39
$M_1 S_2$	1.17	1.45
$M_1 S_3$	1.23	1.57
$M_2 S_1$	1.08	1.18
$M_2 S_2$	1.10	1.31
$M_2 S_3$	1.12	1.34
$M_3 S_1$	1.26	1.27
$M_3 S_2$	1.28	1.75
$M_3 S_3$	1.25	1.88
$M_4 S_1$	0.90	0.92
$M_4 S_2$	0.90	0.95
$M_4 S_3$	1.03	1.13
$M_5 S_1$	1.15	1.19
$M_5 S_2$	1.17	1.26
$M_5 S_3$	1.19	1.24
$M_6 S_1$	0.60	0.67
$M_6 S_2$	0.62	0.65
$M_6 S_3$	0.55	0.62
F -test	**	**
S.E. $\pm$	0.026	0.025
C.D. (0.05)	0.075	0.075

The data pertaining to the nut yield (kg per tree) and total yield (q/ha) is presented in Table 4.

Significant increase nut yield was observed in treatments with the adoption of conservation measures compared to non adoption of soil and water conservation measures. Among different conservation measures, the main treatment, trenches across the slope along with four sides recorded significantly increased the nut yield (5.19 and 6.85 kg/tree) followed by treatments preparation of basin around the tree (4.81 and 4.99 kg/tree) and mulching of basin around the tree (4.26 and 4.44 kg/tree) (Table 4).

Application of different sources of nutrients significantly influenced the yield of cashew during the course of investigation. However, significantly higher nut yield was

Table 4 : Cashew yield as influenced by different soil and water conservation measures and nutrient sources

Treatments	2008-09		2009-10	
	Nut yield (kg/tree)	Total yield (q/ha)	Nut yield (kg/tree)	Total yield (q/ha)
Main (Soil and water conservation measures)				
M_1	4.14	8.61	4.24	9.81
M_2	4.62	9.61	4.90	10.15
M_3	5.19	10.79	6.85	11.48
M_4	4.81	10.23	4.99	11.07
M_5	4.26	8.86	4.44	9.80
M_6	3.13	6.51	3.15	7.33
F- test	**	**	**	**
S.E. $\pm$	0.076	0.179	0.143	0.244
C.D. (0.05)	0.240	0.563	0.452	0.770
C.V. (%)	5.23	5.89	9.04	7.37
Sub (Nutrient levels)				
S_1	4.00	8.32	4.40	9.20
S_2	4.38	9.10	4.57	9.92
S_3	4.70	9.88	5.32	10.70
F-test	**	**	**	**
S.E. $\pm$	0.042	0.103	0.068	0.098
C.D. (0.05)	0.123	0.301	0.198	0.308
C.V. (%)	4.14	4.80	6.07	4.17
Interactions (Main x Sub)				
$M_1 S_1$	4.05	8.42	4.13	9.04
$M_1 S_2$	4.11	8.54	4.16	9.54
$M_1 S_3$	4.26	8.86	4.43	10.86
$M_2 S_1$	4.05	8.42	4.16	8.96
$M_2 S_2$	4.51	9.38	4.88	9.85
$M_2 S_3$	5.30	11.02	5.65	11.64
$M_3 S_1$	4.16	8.65	5.92	9.89
$M_3 S_2$	4.68	9.73	6.95	10.63
$M_3 S_3$	5.59	12.31	7.69	12.68
$M_4 S_1$	4.68	9.73	4.16	10.84
$M_4 S_2$	5.69	11.83	4.88	12.64
$M_4 S_3$	5.20	10.81	5.92	10.95
$M_5 S_1$	4.05	8.42	4.16	9.45
$M_5 S_2$	4.16	8.65	4.47	9.60
$M_5 S_3$	4.57	9.50	4.68	10.35
$M_6 S_1$	3.01	6.26	3.84	7.00
$M_6 S_2$	3.12	6.48	2.08	7.24
$M_6 S_3$	3.26	6.78	3.53	7.74
F – Test	**	**	**	**
S.E. $\pm$	0.103	0.253	0.167	0.239
C.D. (0.05)	0.301	0.737	0.486	0.699

observed in treatment with combined use of organic and recommended dose of nutrient supply (4.70 and 5.32kg/tree) during 2008-09 and 2009-10, respectively. Among different sub plot treatments, minimum cashew yield (4.00 and 4.40 kg/tree, respectively) was observed in the application of RDF alone during both the years of the study.

Interaction effects of different conservation methods and nutrient supply (main plot and sub treatments) failed to show significant differences during 2008-09 and 2009-10.

Adoption of conservation measures recorded significantly increased yield as compared to non adoption of soil and water conservation measures (Table 4). Among different conservation measures, the main treatments having trenches across the slope along with four sides recorded significantly highest (10.79 and 11.48 q/ha) yield as compared to rest of the conservation measures. The yield in treatments preparation of basin around the tree (10.23 and 11.07 q/ha) and mulching of basin (8.86 and 9.80 q/ha) were at par during 2008-09 and 2009-10, respectively. The lowest yield was recorded in treatment with non adoption of conservation measures (6.00 q/ha and 5.80 q/ha, during 2008-09 and 2009-10, respectively).

Among different sub plot treatments, application of different sources of nutrients significantly influenced the yield of cashew nuts during the course of investigation. Significantly higher yield was observed in combined use of organic and recommended dose of nutrient supply (9.88 and 10.70 q/ha). Minimum cashew nut yield (8.32 and 9.20 q/ha) was noticed in treatment with application of RDF alone during both the years of the study, respectively (Table 4.).

Interaction effects of different conservation methods and nutrient supply (main plot and sub treatments) failed to exhibit significant difference during 2008-09 and 2009-10.

Adoption of conservation measures with nutrient sources resulted in better soil and water conservation measures in turn helped to reduce soil and nutrient losses and increased yield of crop under lateritic soil. It could be drawn from above observation that adoption of conservation measures with nutrient sources increased the vegetative barriers could increase the cashew nut yield (Manivannan and Korikhanthimath, 2007).

Many workers have reported significant increase in yield due to integration of organic and inorganic nutrients (Mavarkar, 2006; Nambiar, 1983 ; Abdul Salam, 2003). The reason for increased nut yield and total yields in case of combined use of organic and in organic nutrient sources could be attributed to the response of cashew to the major nutrients in the order of N, K and P. Cashew is a nitrogen lover and N and K nutrition are of greater significance along with organic sources of nutrients in enhancing the growth and development there by production and productivity (Abdul Salam, 2003). The minimum growth parameters were observed in control where no adoption of conservation measures was adopted, during both the years (4.21 m). The findings in this study concurred with the results supported by Nambiar (1983).

Conclusion :

All soil and water conservation measures significantly increased the growth parameters as well as nut and total yield in treatment of trenches across the slope on four sides followed by preparation of basin around the tree and mulching basin around the tree when compared to control plot (without soil and water conservation measures). Among sub plot treatments, the application of organic and inorganic nutrient fertilizers along with soil and water conservation measures significantly helped in increasing the nut yield(kg/tree) and total yield (q/ha).

Authors' affiliations:

NARAYAN S. MAVARAKAR, Department of Agronomy, College of Agriculture, Navile, SHIVAMOGA (KARNATAKA) INDIA

PARASHURAM CHANDRAVANSHI, Department of Soil Science and Agriculture Chemistry, Agricultural Research Station, Kathalagere, DAVANAGERE (KARNATAKA) INDIA

H. BHOGI BASAVARAJAPPA, Department of Agricultural Engineering, Agricultural Research Station, Kathalagere, DAVANAGERE (KARNATAKA) INDIA

■ REFERENCES

Abdul Salam, M. (2003). Strategies for improved productivity through soil and nutrient management. *Golden Jubilee Souvenir*, 2003, pp. 62-68.

Anonymous (2011). Annual Report. Directorate of Cashew nut and Cocoa Development, Kera Bhavan, Cochin, 5pp.

Hubbali (2009). Cashew development in India enhancement of production and productivity, Souvenier of 7th National Seminar on cashew development in India enhancement of production and productivity, GOA, INDIA. 47-54.

Manivannan, S. and V.S. Korikathimath (2007). Soil and water conservation measures for sustainable production of cashew. In: Research Bulletin 9: ICAR Res. Comp. GOA, INDIA.

Mavarkar Narayan (2006). Production potential of castor (*Ricinus communis* L.) based cropping system in Alfisols of Karnataka. Ph.D. Thesis, University of Agricultural Sciences, G.K.V.K., Bengaluru, KARNATAKA (INDIA).

Panse, V.G. and Sukhatme, P.V. (1967). *Statistical methods for agricultural worked*, ICAR Publications, NEW DELHI, INDIA