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Research Article

Effect of Castor De-Oiled Cake and Inorganic Fertilizers on Growth, Yield and Economics of Rice (*Oryza Sativa* L)

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Abstract

An experiment was carried out during 2013 and 2014 in deep black soil to study the effect of castor de-oiled cake and inorganic fertil-izers on growth, yield and economics of rice (Oryza sativa L) at ARS, Dhadesugoor, University of Agricultural Sciences, Raichur, Karnataka. Pooled data revealed that, application of 100 percent recommended dose of NPK and Zn + 1000 kg castor de-oiled cake per hectare recorded significantly higher filled grains per panicle, grain and straw yield (182, 5.89 and 7.54 t/ha, respectively) and it was on par with the application of 100 percent recommended dose of NPK and Zn + 750 kg castor de-oiled cake per hectare (177.9, 5.75 and 7.35 t/ha, respectively), and application of 100 percent recommended dose of NPK and Zn + 500 kg castor de-oiled cake per hect-are (176.9, 5.72 and 7.22 t/ha, respectively). Whereas, application of only 100 percent recommended dose of NPK and Zn per hectare recorded significantly lower number of filled grains per panicle, grain and straw yield (157.3, 4.56 and 5.78 t/ha, respectively).

Keywords: Rice; Castor de-oiled cake; Growth; Yield; Economics

Introduction

India is one of the world's largest producers of rice, accounting for 20% of all world rice production. Rice is India's prominent crop, and is the staple food of the people of the Eastern and Southern parts of the country. The country's rice production declined to 89.13 million tonnes in 2009-10 from 99.18 million tonnes in the previous year due to severe drought that affected almost half of the country. India could achieve a record rice production of 100 million tonnes in 2010-11 on the back of better monsoon this year. The India's rice production reached to a record high of 104.32 million tonnes in 2011-2012 (Anon., 2012).

Rice is one of the chief grains of India. Moreover, this country has the biggest area under rice cultivation, as it is one of the principal food crops. It is in fact the dominant crop of the country. India is one of the leading producers of this crop. Rice is the basic food crop and being a tropical plant, it flourishes comfortably in hot and humid climate.

Rice is produced by using organic manures are gaining importance because of less chemical residues and better yield. Considering the adverse effects on soil health and environment, besides the residual effect, luxurious usage of inorganic fertilizers is not advisable. Several scientists are advocating the integrated nutrient management with organic and inorganic fertilizers to conserve the soil health and to get good quality produce. Therefore, judicious and proper use of organic manures and fertilizers is very essential not only for obtaining higher yield and quality produce but also to maintain soil health and sustainability for longer period.

Among the oil cakes, castor de-oiled cakes is quick acting though insoluble in water and they provide slow and steady nourishment and protection from nematodes and improve yield and quality of produce (Gaur., *et al*. 1992). Keeping the importance of organic manures in view, the present experiment was undertaken to study the effect of castor de-oiled cake in combination with inorganic fertilizers on yield and quality of rice.

Material and Methods

A field experiment was carried out at ARS, Dhadesugoor, University of Agricultural Sciences, Raichur, Karnataka during summer 2013 and Kharif 2014 in deep black soil of uniform topography and texture

with slightly alkaline pH (8.1), low in organic carbon (0.21%) and nitrogen (160 kg/ha), medium in available phosphorus (26 kg/ha) and high in available potassium (486 kg/ha).

The field experiment was laid out in a randomized block design with seven treatments replicated thrice. The treatments consisted of castor de-oiled cake in combination with the recommended dose of NPK and Zn. T1: 100% Recommended dose of NPK and Zn (150:75:75:20 kg/ha), T2: 125% Recommended dose of NPK and Zn (187.5:93.75:93.75:25 kg/ha), T3: 150% Recommended dose of NPK and Zn (225:112.5:112.5:30 kg/ha), T4: 100 % Recommended dose of NPK and Zn + 500 kg of castor de-oiled cake/ha, T5: 100% Recommended dose of NPK and Zn + 750 kg of castor de-oiled cake/ha, T6: 100% Recommended dose of NPK and Zn + 1000 kg of castor de-oiled cake/ha and T7: 100% Recommended dose of NPK and Zn + 1250 kg of castor de-oiled cake/ha. The gross plot size for each treatment was 9 m x 6 m. Rice seedlings were transplanted at a spacing of 20 cm x 15 cm. castor de-oiled cake was incorporated in the soil before three days transplanting. Castor de-oiled cake contains 4.5% of nitrogen, 1.0% of P2O5 and 1.0% of K2O. Inorganic nitrogen (urea), P2O5 (DAP) and K2O (MOP) were applied as per treatment in three split doses. The data on the growth and yield parameters were recorded from a sample of five plants taken at randomly at harvest. The cost of inputs that were prevailing at the time of their use was considered for working out the economics of various treatments. Net return per hectare was calculated by deducting the cost of cultivation from gross returns per hectare, gross returns was calculated by using the total income obtained from grain and straw yields and the benefit cost ratio was worked out as follows. Benefit cost ratio = Net returns/Cost of cultivation. All the data were analyzed statistically.

Results and Discussion

Growth parameters of paddy as influenced by the application of castor de-oiled cake

The pooled data on growth parameters of paddy as influenced by the application of castor de-oiled cake is presented in Table 1. Plant height and number of tillers per hill were did not differ significantly. Application of 100 percent recommended dose of NPK and Zn + 1000 kg castor de-oiled cake per hectare recorded significantly taller plants (78.8 cm) and more tillers (28.3). This may be due to higher available nutrients from fertilizer and castor de-oiled cake. Whereas, application of 100 percent recommended dose of NPK and Zn (150:75:75:20 kg) per hectare recorded significantly shorter plants (67.8 cm, respectively) and least number of tillers (18.8).

Treatments	Plant height (cm)			Number of productive tillers/hill		
	2013	2014	Pooled	2013	2014	Pooled
T1	62.1	73.4	67.8	18.0	19.6	18.8
T_2	64.8	75.7	70.3	19.6	20.5	20.1
$^{T}3$	65.5	76.9	71.2	21.0	22.6	21.8
T_4	70.1	81.8	76.0	26.3	27.2	26.8
$^{T}5$	71.8	82.9	77.4	26.6	27.4	27.0
T_6	73.0	84.6	78.8	27.6	28.9	28.3
$^{T}7$	70.2	81.5	75.9	23.0	24.8	23.9
SEm ±	2.23	2.42	2.38	1.74	2.04	2.11
C.D. @ 5%	6.86	7.26	7.15	5.37	6.12	6.35

Table 1: Application of castor de-oiled cake on growth parameters of paddy.

T1: 100% Recommended dose of NPK & Zn (150:75:75:20 kg/ha)
T2: 125% Recommended dose of NPK & Zn (187.5:93.75:93.75:25 kg/ha)
T3: 150% Recommended dose of NPK & Zn (225:112.5:112.5:30 kg/ha)
T4: 100% Recommended dose of NPK & Zn + 500 kg of castor de-oiled cake/ha
T5: 100% Recommended dose of NPK & Zn +750 kg of castor de-oiled cake/ha
T6: 100% Recommended dose of NPK & Zn +1000 kg of castor de-oiled cake/ha
T7: 100% Recommended dose of NPK & Zn + 1250 kg of castor de-oiled cake/ha

Yield parameters of paddy as influenced by the application of castor de-oiled cake

The pooled data on yield parameters of paddy as influenced by the application of castor de-oiled cake is presented in Table 2. Panicle length did not differ significantly with the application of castor de-oiled cake with inorganic fertilizers. Application of 100 percent recommended dose of NPK and Zn + 1000 kg castor de-oiled cake per hectare recorded significantly more number of filled grains per panicle (182) and it was on par with the application of 100 percent recommended dose of NPK and Zn + 750 kg castor de-oiled cake per hectare (177.9), application of 100 percent recommended dose of NPK and Zn + 1250 kg castor de-oiled cake per hectare (168.4) and

application of 100 percent recommended dose of NPK and Zn + 500 kg castor de-oiled cake per hectare (176.6). This may be due to bet-ter growth of the plants. Whereas, application of only 100 percent recommended dose of NPK and Zn per hectare recorded significantly less number of filled grains per panicle (157.3). This may be due to poor growth of the plants.

recommended dose of NPK and Zn + 750 kg castor de-oiled cake per hectare (5.75 and 7.35 t/ha, respectively) and application of 100 percent recommended dose of NPK and Zn + 500 kg castor de-oiled cake per hectare (5.72 and 7.22 t/ha, respectively). Maximum grain yield was observed with castor cake (1000 kg/ha) in combination with the recommended dose of NPK and Zn, which was on par with T4 and T5.

Treatments	Panicle length (cm)			No. of filled grains per panicle			Grain yield (t/ha)			Straw yield (t/ha)		
	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled	2013	2014	Pooled
T_1	24.7	25.2	25.0	152.3	162.3	157.3	4.00	5.12	4.56	5.44	6.11	5.78
T_2	25.4	26.0	25.7	159.7	167.3	163.5	4.14	5.32	4.73	5.46	6.12	5.79
T_3	26.0	26.5	26.3	162.3	170.5	166.4	4.40	5.42	4.91	5.74	6.72	6.23
T_4	26.2	26.8	26.5	172.3	181.5	176.9	5.33	6.11	5.72	6.92	7.52	7.22
T_5	26.4	27.1	26.8	173.3	182.4	177.9	5.38	6.12	5.75	7.01	7.68	7.35
T_6	26.8	27.7	27.3	178.3	185.6	182.0	5.55	6.23	5.89	7.15	7.92	7.54
T_7	26.6	27.5	27.1	164.3	172.5	168.4	4.44	5.47	4.95	5.84	6.15	5.99
SEm +	1.13	2.25	2.71	4.43	4.26	4.03	0.36	0.24	0.29	0.40	0.50	0.51
C.D. @ 5%	NS	NS	NS	13.6	12.8	12.1	1.10	0.72	0.88	1.24	1.52	1.54

Table 2: Application of castor de-oiled cake on yield and yield parameters of paddy.

T1: 100% Recommended dose of NPK & Zn (150:75:75:20 kg/ha)

T2: 125% Recommended dose of NPK & Zn

T3: 150% Recommended dose of NPK & Zn

T4: 100% Recommended dose of NPK & Zn + 500 kg of castor de-oiled cake/ha

T5: 100% Recommended dose of NPK & Zn +750 kg of castor de-oiled cake/ha

T6: 100% Recommended dose of NPK & Zn +1000 kg of castor de-oiled cake/ha

T7: 100% Recommended dose of NPK & Zn + 1250 kg of castor de-oiled cake/ha

Grain and straw yield of paddy as influenced by the application of castor de-oiled cake

The pooled data on yield parameters of paddy as influenced by the application of castor de-oiled cake is presented in Table 2. Grain and straw yield of paddy differed significantly with respect to application of castor de-oiled cake along with inorganic fertilizer. Applica-tion of 100 percent recommended dose of NPK and Zn + 1000 kg castor de-oiled cake per hectare recorded significantly higher grain and straw yield (5.89 and 7.54 t/ha, respectively) and it was on par with the application of 100 percent

This could be due to the positive effect of all the yield components viz., panicle length, number of grains per panicle and test weight. Sandhya Rani (1998) also reported that application of higher dose of castor cake (6 t/ha) gave higher yield and uptake of nutrients in radish. Similar observations were made by Praveen Kumar (2000) who opined that the increased fresh weight of carrot with increased dose of castor cake. This might be due to increased and readily available nutrients, which might have contributed to, increased growth and yield parameters, there by increased grain yield. Whereas, application of only 100 percent recommended dose of NPK and Zn per hectare recorded signifi-cantly lower grain and straw yield (4.56 and 5.78 t/ha, respectively) and which was on par with the treatment T2, T3 and T7. The results corroborate with the findings of Mangal (1985) in onion.

Economics of paddy as influenced by the application of castor de-oiled cake

The data on economics of paddy as influenced by the application of castor de-oiled cake is presented in Table 3. The cost of production was higher when, the application of 100 percent recommended dose of NPK and Zn + 1250 kg of castor de-oiled cake per hectare (Rs. 38,708/ha). It was due to higher dose of fertilizer and castor de-oiled cake application. Whereas, application of only 100 percent recom-

mended dose of NPK and Zn per hectare recorded lower cost of cultivation (Rs. 32,458/ha). Net returns was significantly higher in the treatment applied with 100 percent recommended dose of NPK and Zn + 1000 kg castor de-oiled cake per hectare (Rs. 58427/ha) and it was on par with the treatment T4 and T5. This might be due to higher grain and straw yield. Similar results were also observed by Sunanda Rani and Mallareddy, 2007. Whereas, application of only 100 percent recommended dose of NPK and Zn per hectare recorded significantly lower net returns (Rs. 41717/ha) and which was on par with the treatment T2, T3 and T7. Application of 100 percent recom-mended dose of NPK and Zn + 500 kg castor de-oiled cake per hectare recorded significantly higher B: C ratio (2.66) and it was on par with the treatment T5 and T6. Whereas, application of 100 percent recommended dose of NPK and Zn + 1250 kg of castor de-oiled cake per hectare recorded significantly lower B: C ratio (2.11) and which was on par with the treatment T1, T2 and T3. This might be due to lower grain and straw yield.

Treatments	Cost of cultivation (Rs/ha)	Gross Returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
T1	32458	74175	41717	2.29
T_2	34323	76740	42417	2.24
T_3	36188	79880	43692	2.21
$^{T}4$	34958	93020	58062	2.66
T_5	36208	93595	57387	2.58
T_6	37458	95885	58427	2.56
T_7	38708	81795	43087	2.11
SEm +	-	-	122.0	0.10
C.D. @ 5%	-	-	366.2	0.32

Materials	Urea	DAP	MOP	Zn	Castor de –oiled cake	Grain	Straw
Prices (Rs/kg)	5.62	22.0	16.0	20.0	5.0	15	1.0

Table 3: Economics of paddy as influenced by castor de-oiled cake application.

T1: 100% Recommended dose of NPK & Zn (150:75:75:20 kg/ha)

T2: 125% Recommended dose of NPK & Zn (187.5:93.75:93.75:25 kg/ha)

T3: 150% Recommended dose of NPK & Zn (225:112.5:112.5:30 kg/ha)

T4: 100% Recommended dose of NPK & Zn + 500 kg of castor de-oiled cake/ha

T5: 100% Recommended dose of NPK & Zn +750 kg of castor de-oiled cake/ha

T6: 100% Recommended dose of NPK & Zn +1000 kg of castor de-oiled cake/ha

T7: 100% Recommended dose of NPK & Zn + 1250 kg of castor de-oiled cake/ha

Conclusion

Application of 100 percent recommended dose of NPK and Zn + 500 kg of castor de-oiled cake per hectare was recorded signifi-cantly higher benefit cost ratio (2.66) and which was on par with the application of 100 percent recommended dose of NPK and Zn + 750 kg of castor de-oiled cake per hectare (2.58) and application of 100 percent recommended dose of NPK and Zn + 1000 kg of castor de-oiled cake per hectare (2.56) as compared to 100, 125 and 150 percent recommended dose of NPK and Zn per hectare (2.29, 2.24 and 2.21, respectively) and application of 100 percent recommended dose of NPK and Zn + 1250 kg castor de-oiled cake per hectare (2.11). Therefore, further concluded that, it can be recommended to apply only 500 kg of castor de-oiled cake along with 100 percent recommended dose of NPK and Zn per hectare is enough to get higher income with reduced cost of cultivation.

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