Website : www.asthafoundation.in
Progressive Research : An International Journal
Vol 18 (1) : 36-40 (January-2023), Print ISSN : 0973-6417, Online ISSN : 2454-6003
Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) India

Effect of Biofertilizer Use on Crop Productivity in Kolhapur District

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Abstract

The present investigation was intended to access the impact of bio-fertilizer use in Kagal and Hatkanagale tehsils of Kolhapur districts in two significant crops *viz;* Paddy and Sugarcane. The study was conducted to examine and compare the resource use productivity of major inputs and production relations on the farms using biofertilizers with that of farms not using at all and the nature and extent of use of biofertilizers on farmers' fields just to visualize the gap and pattern of their use at the cultivators level. For this purpose, the primary data were collected from 60 selected paddy growers and sugarcane growers, spread over 4 villages i.e. two villages each from Kagal and Hatkanagale tahsils. The results indicated that the use of *Azotobacter* for production of paddy was 1.5 per cent and that of *Acetobacter* in Sugarcane was 2.88 per cent. The per hectare use of biofertilizer was less than the recommended level. The per hectare difference in productivity of Paddy crop was more by 6.91 quintals and that in Sugarcane was 22 tons on the farms of biofertilizer users than the non-users.. The use of biofertilizer leads to increase in crop productivity. The per hectare productivity has been increased by 19.89 and 18.03 per cent in case of Paddy and Sugarcane, respectively. The B:C ratio, by and large , is observed to be a bit more in biofertilizer used (1.19 and2.17)paddy and sugarcane than the non used (1.10 and 2.02). The regression analysis clearly indicated that use of biofertilizer has significant impact on the yield of Paddy and Sugarcane in the area under study.

Key words : *Biofertilizers, use-gap, productivity, B:C ratio,*

Introduction

One of the major effects of indiscriminate use of chemical fertilizers is gradual decrease in the number of useful microorganisms in agricultural soil. The problem is so intensive that, in many agricultural land of our country less than one crore of microorganism has been found in one gram of soil (1). Because of this reasons, not only the soil is polluted through environment destabilization but the yield of agricultural produce also fluctuating alarmingly. In such a situation the biofertilizers play a major role. The cultivators are being attracted towards the use of biofertilizers as they have realized the utility of biofertilizers in boosting crop productivity. To convince the farmers for the use of biofertilizers there is a need for scientific assessment of impact of use of biofertilizers on crop productivity and returns on farms. Therefore to examine and compare the resource use productivity of major inputs and production relations on the farms using biofertilizers with that of farms not using at all, the need was felt to know the nature and extent of use of biofertilizers on farmers' fields just to visualize the gap and pattern of their use at the cultivators level. It is in this context, the present study *viz*., impact assessment of biofertilizer use on crop productivity in Kolhapur district was executed in the year 2020-21 with the specific objectives to estimate the resource use level, costs and returns of biofertilizer used and non used crops.

Materials and Methods

For present study, Kagal and Hatkangle tahsil of Kolhapur district were selected purposively. From each tahsil two villages were selected randomly. Further, fifteen each biofertilizer users and non-users cultivating paddy and sugarcane were selected randomly from each selected village. Thus, the total sample for the study consisted of 120 farmers comprising 60 biofertilizer user and 60 non – biofertilizer users. The cost of cultivation of the major crops on biofertilizer user and non user farms was estimated by standard cost. Cobb- Douglas types of production function was used for estimating the resource use productivities of major important crops. The form of the production function used was

$$Y = a\ X1^{b1}\ X2^{b2}\ X3^{b3}\ X4^{b4}\ X5^{b5}\ X6^{b6}\ X7^{b7}\ .\ e^{u}$$

Where,

Y = Yield in quintal per hectare

X1 = Total human labour in man days per hectare

X2 = Use of manures in quintals per hectare

X3 = Use of nitrogen in kilograms per hectare

X4 = Use of phosphorus in kilograms per hectare

X5 = Use of potash in kilograms per hectare

X6 = Use of bio-fertilizers in grams/ha

Received : October-2022; Revised : October-2022; Accepted : November-2022

X7 = Other working capital in rupees per hectare a = Intercept

bis =Production elasticities

u = Error term

In order to know whether the biofertilizer users and non-users belong to different production relations, the Chow's test of equality had been applied (2).

Steps–I : Combine all N1 and N2 observations of two samples and run the single pooled regression. From regression, obtain the residual sum of squares (RSS) say S1 with df = N1 + N2 – K where K is the number of parameters estimated.

Steps–II : Run the two individual regression (1) and (2) and obtain their RSS, say S2 and S3 with df = N1 – K and N2 – K respectively. Add these two SS Say S4 = S2 +S3 with df = N1 + N2 – 2K.

Steps–III : Obtain S5 = S1 – S4

Steps–IV : **Apply F test as follows**

S5/K

F = S4 / (N1 + N2 - 2K) with df = (K,N1+N2-2K)

If computed "F" exceeds the critical "F" hypothesis that the two regression having the same production relations can be rejected.

Results and Discussion

Nature and extent of biofertilizer use on sample farms : The crop wise information on the per hectare actual use and recommended dose of biofertilizer and gap between recommended dose and actual use of biofertilizers in the year 2020-21 was presented in Table-1.

The biofertilizer like *Azotobacter* was observed to be used in powder form for paddy cultivation. The per hectare actual use of *Azotobacter* was 1.5 kg which was 25 per cent less than the recommended dose .The biofertilizer like *Acetobacter* was used for sugarcane in powder form . The use of this biofertilizer was 2.88 kg per hectare which was less than the recommended level by 28 per cent presented in Table-3.

Effect of biofertilizer use on the productivity of crops : The per hectare productivity of biofertilizer used and non – used crops have been worked out and compared with each other so as to assess the effects of biofertilizer use on productivity of paddy and presented in Table-2.

An average productivity of biofertilizer users and non users was 41.65 and 34.74 quintals of paddy per hectare respectively. The productivity differential was 6.91 quintals per hectare. The productivity has been increased by 19.89 per cent due to use of biofertilizers, *viz Azotobacter*, while the gross returns showed an increase by about 12.94 per cent. The average productivity of sugarcane on the farms of biofertilizer users and non-users was 144 and 122 tons per hectare respectively. The productivity differential was 22 tons per hectare i.e 18.03 per cent more due to use of biofertilizer like *Acetobacter.*

Per hectare recommended, actual use and gap in the use of manures and fertilizers in production of crops and gap in yields on biofertilizer user farms : The balanced use of all the resources up to the recommended levels is very important. In the light of a specific relationship between inputs and output of biofertilizer used crops, the data were analyzed further to work out the gaps in the actual use levels and recommended levels of inputs and output of biofertilizer used crops on per hectare basis. The results obtained from the analysis presented in Table-3.

The per hectare use of manure was less than recommended level in all the crops on the biofertilizer user farms. The gap in use of manure was maximum in sugarcane followed by paddy. The actual use of nitrogen, phosphorus and potash was less than recommended level for paddy and sugarcane. The per hectare yield obtained was less than the recommended level by 8.88 per cent in paddy and more than -6.67 per cent in sugarcane crop respectively. The per hectare yield of paddy was less than the recommended level, and the use of manures and fertilizers was less than the recommended levels, in case of biofertilizer user farms. The results were in simile with the results obtained by (3, 4, 5).

In case of biofertilizer non-user farms, the per hectare use of manures was observed to be less than the recommended levels for paddy and sugarcane crop in area under study. The actual yield received by biofertilizer non user farms was less than recommended level due to low use of fertilizers and manures.

Per hectare costs and returns on biofertilizer user and non-user farms : The per hectare cost of Paddy was Rs 43432.89, on the biofertilizer user farms while that for non users was Rs. 41536.66/-, respectively. The per hectare production cost for Paddy was higher on the biofertilizer user farms by 12.94 per cent as compared to the non –user farms. The yield of Paddy was higher on the user farms by 19.89 per cent.

The per hectare cost of cultivation of sugarcane was Rs. 172414.84/- respectively, on the biofertilizer user farms while that for non–user farm, was Rs. 162049.52/-, respectively. The per hectare production cost for sugarcane was higher on the biofertilizer user farms by

Table-1 : Nature and extent of biofertilizer use for important crops grown (2020-21).

Sr. No.	Name of crop	Name of biofertilizer	Form of use	No of users	Actual dose Kg ha^{-1}	Recommended dose Kg ha^{-1}	Actual gap in use (Kg)	Per cent Excess (+) or deficit (-)
1.	Paddy	*Azotobacter*	Powder	30	1.5	2	0.5	-25
2.	Sugarcane	*Acetobacter*	Powder	30	2.88	4	1.12	-28

Table-2 : Effect of biofertilizer use on the productivity of crops.

Sr. No.	Crop	Biofertilizer user		Biofertilizer non user		Difference in productivity	Percentage increase	
		Av. Productivity (q/ha) & (Tons)	Gross Returns (Rs)	Av. Productivity (q/ha) & (Tons)	Gross Returns (Rs)	(q/ha) & (Tons)	Av. Productivity	Gross Returns
1.	Paddy	41.65	51,865	34.74	45919	6.91	19.89	12.94
2.	Sugarcane	144	37,5180	122	327483	22	18.03	14.56

Table-3 : Per hectare recommended, actual use and gap in the use of manures and fertilizers in production of crops and gap in yields on biofertilizer user and non user farms.

Crop	Paddy		Sugar cane	
Biofertilizer	**User**	**Non User**	**User**	**Non user**
No. of cultivators	30	30	30	30
Manures				
Recommended	150		200	
Actual use	123	101	126	153
Gap	27	49	74	47
Chemical fertilizers				
N				
Recommended	100		400	
Actual use	83	221	388	435
Gap	17	121	12	35
P				
Recommended	50		170	
Actual use	24	39	92	118
Gap	26	11	78	52
K				
Recommended	50		170	
Actual use	42	72	59	92
Gap	08	22	111	78
Yield				
Recommended	45		135	
Actual use	41	34.74	144	122
Gap per cent	8.88	22.8	(-)6.67	10.40

14.56 per cent as compared to the non-user farms. The yield of sugarcane crop was higher on the user farms by 18.03 per cent.

Results of estimated Cobb-Douglas production functions for selected crops on the farms of biofertilizer users and non-users : The resource productivities in crop production have been estimated within the Cobb-Douglas type of production function frame work and is presented in Table-5.

In case of biofertilizer users in paddy, the value of coefficient of multiple determination (R2) was 0.98, indicating that 98 per cent of variation in the output However, in biofertilizer non users, the value of coefficient of multiple determination was 0.99.

The results have shown that nearly 92 per cent variation in sugarcane production is explained jointly by the seven variables under consideration. In case of non-users, the results indicated that nearly 95 per cent of variation in sugarcane production is explained by the six independent variables under consideration.

Statistical test for comparing production relations on biofertilizer used and non-used crops : The pooled analysis of the entire sample farms was carried out with a view to apply 'Chows test' of equality. In other words, the significance of difference between the crop production functions of biofertilizer used and non–used crops was tested by using 'Chows test'. It is observed from Table-6 that the F ratios were 53.55 and 4.3 in case of paddy and

Table-4 : Per hectare costs and returns of Paddy crops on biofertilizer user and non-use farms.

Sr. No.	Particulars	Paddy			Sugarcane		
		Biofertilizer		% change over non users	Biofertilizer		% change over non users
		Users	Non-users		Users	Non-users	
1.	Output (Qtls)	41.65	34.74	19.89	144.3	122	18.03
2.	Gross returns	51865	45919	12.94	375180	327483	14.56
3.	Cost A	22657	24235.56	-6.5	107149.3	105735.8	1.33
4.	Profit at cost A	29208	21683	34.70	268030	221748	20.87
5.	Cost B	40998.65	39153.43	4.71	130294.8	131366	-0.81
6.	Profit at cost B	10867	6766	60.61	244886	196117	24.86
7.	Cost C	43432.89	41536.66	4.56	172414.84	162049.52	6.39
8.	Profit at cost C	8433	4383	92.40	202766	165434	22.56
9.	B:C ratio	1.19	1.10		2.17	2.02	
10.	Per qtl. Cost	1068.01	1218.12		1166	1144	

Table-5 : Results of estimated Cobb-Douglas production functions for selected crops on the farms of biofertilizer users and non-user.

Particulars	Paddy		Sugarcane	
	User	Non-user	User	Non-user
Constant (a)	-1.41***	-0.113	-0.63**	-0.04
Human labour (Mandays) (X_1)	0.071*** (0.032)	0.505*** (0.109)	0.237*** (0.047)	0.27*** (0.071)
N (X_3) in kilograms	0.15*** (0.053)	0.25** (0.137)	0.31*** (0.080)	0.050 (0.097)
P (X_4) in Kilograms	-0.028 (0.036)	-0.056 (0.081)	0.0160 (0.091)	-0.032 (0.0076)
K(X_5) in kilograms	0.43*** (0.10)	0.0024 (0.049)	-0.11*** (0.041)	0.044*** (0.0093)
Biofertilizer (X_6) in gms	0.49*** (0.112)	-	0.027 (0.023)	-
Other working Capital (X_7) in Rs	0.008 (0.089)	0.030*** (0.012)	0.292*** (0.070)	0.21*** (0.040)
R^2	0.98	0.99	0.92	0.95
F value	1.93	1.34	1.2	1.17

*, ** and *** indicates 10, 5 and 1 per cent significant level.

Table-6 : Statistical test for comparing production relations on biofertilizer used and non-used crops.

Sr.No.	Crop	No of para meters -(K)	Degree of freedom (N1 + N2 -2 K)	S4 (S2 +S3)	S5 (S1 –S4)	F Value
1.	Paddy	30	46	31.43	256.18	53.55
2.	Sugarcane	30	46	142	94.88	4.3

sugarcane which were significant indicating that the two regression were not equal but differed significantly in their overall production relationships.

Conclusions

The use of *Azotobacter* for production of paddy was 1.5 per cent and that of *Acetobacter* in Sugarcane was 2.88 per cent. The per hectare use of biofertilizer was less than the recommended level. The per hectare difference in productivity of Paddy crop was more by 6.91 quintals and that in Sugarcane was 22 tons on the farms of biofertilizer users than the non-users. The use of biofertilizer leads to increase in crop productivity. The per hectare productivity has been increased by 19.89 and 18.03 per cent in case of Paddy and Sugarcane, respectively. The B:C ratio, by and large , is observed to be a bit more in biofertilizer used (1.19 and 2.17) paddy and sugarcane than the non used (1.10 and 2.02). On the basis of regression analysis it could be concluded that use of biofertilizer has significant impact on the yield of Paddy and Sugarcane in the area under study.

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