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Influence of Biozyme on growth and yield performance of rice in rice-rice cropping sequence

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ABSTRACT

Field experiments were conducted to study the effect of Biozyme on growth, total chlorophyll content and the grain yield of rice in rice-rice cropping sequence. Experimental results revealed that the different growth attributes and total leaf chlorophyll content of rice increased with the application of biozyme in combination with chemical fertilizers. When ¼ of the recommended dose of chemical fertilizer was substituted by 20 kg Biozyme ha^{-1}, dry matter yield outweighed the treatment of recommended dose of chemical fertilizer alone. The highest grain yield was obtained from the treatment receiving 60 kg ha^{-1} of biozyme in two equal splits at 5-7 days after transplanting and at active tillering stage along with the recommended dose of chemical fertilizer. Sole application of biozyme without chemical fertilizer did not bring about better performance.

Key words: *biozyme, chlorophyll content, growth attributes, rice, yield*

Exhaustive cropping systems like rice-wheat, rice-rice, etc. are known to hasten the pace of soil health deterioration due to excessive mining of native fertility and leaving no residue that lead to depletion of organic matter content, optimum level of which is important for balanced availability and supply of many micronutrients. Under most cases, the plant does not utilize its full potential while absorbing nutrients from the soil and major portion of the applied nutrients goes waste. Application of Biozyme enhances the capacity of the plant to increase its' uptake capacity to a substantial level (Mandal *et al.*, 2006). It is based on the seaweed extract that is imported from Norway. These weeds contain the highest concentrations of various constituents in unadulterated form which is the backbone of the product's efficacy under diverse climatic condition.

The effect of seaweed extract in the increase of agro-output has baffled many and at the same time, has confidence to the user for using an eco-friendly product. In West Bengal, rice-rice copping sequence is the most predominant system, while the profit from this system is meager. Furthermore, this system requires high amount of chemical fertilizers. There is scope to integrate some organic materials like biozyme for enhancing and sustaining the productivity. Keeping this in view, the present study was undertaken to partially substitute chemicals fertilizers with biozyme in rice-rice cropping sequence.

MATERIALS AND METHODS

A field experiment was conducted at Kalyani, West Bengal in lowland irrigated and well drained alluvial soil (Entisol) having pH 6.8, organic carbon 0.651%, total N 0.061%, available P 16.97 kg ha^{-1} and available K 126.32 kg ha^{-1} to evaluate the growth and productivity of transplanted rice in various combinations of chemical fertilizers and biozyme with 20 treatments in a randomized complete block design replicated thrice. The treatments included recommended dose of chemical fertilizer, ¾ of the recommended dose of chemical fertilizer, recommended dose of chemical fertilizer+ Biozyme G @ 20 kg ha^{-1} at 5-7 days after transplanting(DAT), recommended dose of chemical fertilizer + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT, recommended dose of chemical fertilizer + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage, recommended dose of chemical fertilizer +

Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage, recommended dose of chemical fertilizer + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage, recommended dose of chemical fertilizer + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage, ¾ of the recommended dose of chemical fertilizer + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT, ¾ of the recommended dose of chemical fertilizer + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT, ¾ of the recommended dose of chemical fertilizer + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage, ¾ of the recommended dose of chemical fertilizer + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage, ¾ of the recommended dose of chemical fertilizer + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage, ¾ of the recommended dose of chemical fertilizer + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage, recommended dose of chemical fertilizer + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage, ¾ of the recommended dose of chemical fertilizer + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage, Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage – No fertilizer, Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage – No fertilizer, Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage – No fertilizer and Control (No Biozyme, no fertilizer).

Rice variety Shatabdi (IET 4786) was grown at a spacing of 20 cm x 10 cm with a fertilizer dose of 60, 13.1 and 25 and 120, 26.2 and 50 kg ha^{-1} of N, P and K, during wet and dry seasons, respectively. Full dose of phosphate and potash and one-fourth of nitrogen were applied as basal at time of final land preparation; half of the nitrogen was top-dressed at active tillering stage and rest one-fourth at panicle initiation stage.
Periodical biometrical observations on various growth attributes, i.e. leaf area index (LAI), dry matter (DM) accumulation, crop growth rate (CGR) and total leaf chlorophyll content were taken and while grain and straw yields at harvest were recorded accordingly. The chlorophyll content of leaf was estimated by using the formula given by Arnon (1949). The data were subjected to analysis of variance (Gomez and Gomez, 1984) and using MSTAT-C computer software.

RESULTS AND DISCUSSION

Experimental results revealed that the leaf area index increased with the advancement of crop age reaching the peak value at 2 weeks after panicle initiation (WAPI) during both the seasons of growing rice under the trial (Table 1& 2). Biozyme in combination with chemical fertilizer increased LAI compared to chemical fertilizer alone. Swain and Sen (1996) also made similar observations. The highest LAI was recorded within the treatments receiving biozyme along with recommended chemical fertilizers. It was also found that LAI of rice was recorded to be higher during the dry season compared to the wet season and the values differed significantly with application of different levels of biozyme and chemical fertilizer (Table 2). LAI increased significantly when chemical fertilizer was coupled with biozyme over application of chemical fertilizer alone and with the increasing level of biozyme upto 30 kg ha^{-1} during both the years of experimentation. Better soil physico-chemical properties leading to better soil environment with application of biozyme could be the reason for increased crop growth and thereby reflecting the higher LAI. The dry matter (DM) accumulation went on increasing with the advancement of crop age reaching at the peak value at 6 WAPI during the wet as well as dry seasons under the study. DM yield progressively increased with each additional increment of biozyme along with the recommended dose of chemical fertilizer. When ¼ of the recommended dose of chemical fertilizer was substituted by 20 kg biozyme ha^{-1}, DM accumulation outweighed the plot which received recommended dose of chemical fertilizer only during both the years. The highest amount of DM yield was recorded with the treatment in which biozyme granule was applied twice @ 30 kg ha^{-1}, once at 5-7 DAT and another at active tillering stage along with the recommended chemical fertilizers. Stephenson (1966) obtained higher DM content when the crop was treated with seaweed extracts.

Crop growth rate (CGR) was recorded more between PI to 2 WAPI and thereafter declined with the advancement of age of the crop during wet season. Application of biozyme along with chemical fertilizer brought about significant increase in the value of CGR compared with the sole application of chemical fertilizer. The highest value of CGR was recorded with the treatment in which biozyme granule was applied twice

Table 1. Effect of various treatments on Leaf area index, dry matter accumulation, crop growth rate and Chlorophyll content of rice during wet season (pooled over two years)

Treatments	LAI	DM accumulation (g m^{-2})				CGR (g m^{-2} d^{-1})			Chlorophyll content (mg g^{-1})		
		PI	2 WAPI	4 WAPI	6 WAPI	Between PI & 2 WAPI	Between 2 WAPI & 4 WAPI	Between 4 WAPI & 6 WAPI	PI	2 WAPI	6 WAPI
RDF	4.18	280.45	505.95	613.85	696.40	16.03	7.92	5.68	1.77	2.06	1.68
¾ of the RDF	3.67	233.60	451.70	558.55	634.05	15.58	7.63	5.39	1.71	1.83	1.62
RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT	4.60	337.00	565.45	678.75	756.80	16.32	8.10	5.58	1.83	2.06	1.73
RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT	4.74	383.60	613.65	728.90	813.85	16.43	8.24	6.04	1.91	2.04	1.82
RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage	4.80	406.05	637.25	755.45	843.20	16.52	8.45	6.27	1.85	1.96	1.80
RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage	4.88	418.80	652.35	773.35	865.80	16.68	8.65	6.61	1.94	2.12	1.86
RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage	4.76	392.90	624.80	742.40	821.10	16.57	8.40	5.62	1.86	2.01	1.77
RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage	4.84	412.05	644.60	762.80	837.10	16.61	8.44	5.31	1.92	2.05	1.81
¾ RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT	4.33	308.40	535.00	646.15	723.65	16.19	7.94	5.54	1.81	2.03	1.72
¾ RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT	4.45	316.60	544.00	656.60	735.35	16.25	8.04	5.63	1.87	2.05	1.78
¾ RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage	4.59	334.55	564.25	680.20	765.10	16.41	8.29	6.07	1.83	2.03	1.75
¾ RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage	4.69	368.50	600.65	719.60	808.85	16.59	8.48	6.39	1.88	2.08	1.81
¾ RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage	4.57	316.15	546.10	661.45	742.15	16.43	8.24	5.75	1.83	1.92	1.71
¾ RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage	4.70	369.70	600.35	716.95	794.25	16.48	8.33	5.53	1.89	2.00	1.80
RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage	4.85	413.65	647.10	767.35	855.45	16.68	8.59	6.29	1.93	2.13	1.85
¾ RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage	4.65	353.30	583.90	708.60	787.65	16.48	8.27	6.29	1.88	2.05	1.74
Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage – No fertilizer	2.26	210.70	348.25	412.20	463.30	9.83	4.57	3.65	1.68	1.82	1.60
Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage – No fertilizer	2.31	216.75	355.90	421.80	474.75	9.94	4.71	3.78	1.63	1.81	1.58
Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage – No fertilizer	2.18	204.30	339.00	399.50	447.25	9.62	4.32	3.41	1.58	1.76	1.53
Control	2.11	171.25	300.40	357.00	399.95	9.18	4.05	3.07	1.52	1.69	1.51
C.D. at 5%	0.30	12.67	21.30	21.55	29.74	0.22	0.16	0.10	0.14	0.17	0.13

LAI - Leaf area index, DM - dry matter, CGR - crop growth rate, PI - panicle initiation, WAPI - Weeks after panicle initiation

Table 2. Effect of various treatments on Leaf area index, dry matter accumulation, crop growth rate and Chlorophyll content of rice during dry season (pooled over two years)

Treatments	LAI	DM accumulation (g m^{-2})				CGR (g m^{-2} d^{-1})			Chlorophyll content (mg g^{-1})		
		PI	2 WAPI	4 WAPI	6 WAPI	Between PI & 2 WAPI	Between 2 WAPI & 4 WAPI	Between 4 WAPI & 6 WAPI	PI	2 WAPI	6 WAPI
RDF	4.65	313.85	569.45	762.45	876.35	18.26	13.79	8.14	1.78	1.80	1.75
¾ of the RDF	4.35	283.10	481.55	626.80	727.20	14.18	10.38	7.17	1.68	1.74	1.62
RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT	4.72	345.65	607.35	803.90	920.45	18.70	14.03	8.33	1.92	1.96	1.84
RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT	4.80	368.10	631.60	824.80	942.85	18.82	13.80	8.43	2.03	2.05	1.90
RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage	4.85	382.65	649.10	854.05	974.75	19.03	14.64	8.66	1.98	2.10	1.94
RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage	4.83	386.30	649.75	855.30	976.35	18.82	14.68	8.63	2.04	2.08	1.90
RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage	4.75	361.65	616.20	810.80	924.25	18.19	13.90	8.12	1.95	2.00	1.88
RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage	4.85	371.60	629.35	830.25	948.00	18.41	14.35	8.40	1.98	2.04	1.94
¾ RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT	4.67	327.05	578.35	777.40	891.10	17.95	14.22	8.12	1.85	1.90	1.80
¾ RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT	4.73	348.25	597.20	798.95	914.55	17.79	14.41	8.26	1.90	1.90	1.87
¾ RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage	4.79	365.15	619.85	824.65	943.95	18.20	14.63	8.52	1.95	1.99	1.90
¾ RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage	4.81	366.80	621.85	825.75	944.60	18.22	14.56	8.49	1.95	2.01	1.90
¾ RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage	4.66	338.00	587.00	785.30	899.60	17.79	14.17	8.17	1.87	1.93	1.86
¾ RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage	4.76	352.60	603.45	804.80	921.60	17.93	14.38	8.34	1.93	1.95	1.89
RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage	4.83	382.65	648.30	852.35	971.45	18.97	14.58	8.52	2.02	2.07	1.96
¾ RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage	4.77	365.85	618.55	822.25	941.40	18.05	14.55	8.51	1.91	2.00	1.87
Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage – No fertilizer	2.90	239.35	375.05	476.70	547.25	9.69	7.26	5.04	1.63	1.63	1.51
Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage – No fertilizer	2.91	236.20	371.75	470.35	540.80	9.60	7.13	5.04	1.64	1.63	1.56
Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage – No fertilizer	2.78	232.90	365.90	463.60	529.90	9.50	6.99	4.74	1.56	1.63	1.51
Control	2.71	205.50	333.10	427.55	489.95	9.12	6.75	4.46	1.50	1.52	1.42
C.D. at 5%	0.26	15.11	20.80	21.40	28.55	0.26	0.22	0.13	0.11	0.08	0.10

LAI - Leaf area index, DM - dry matter, CGR - crop growth rate, PI - panicle initiation, WAPI - Weeks after panicle initiation

at higher rates (30 kg ha^{-1}) in combination with the recommended chemical fertilizers.This was in conformity with the findings of Mandal *et al*.,(2006). Combinations of chemical fertilizer along with biozyme tried on rice crop brought about significant changes in CGR during the dry seasons also (Table 2). CGR value significantly declined when 25% of the recommended dose of chemical fertilizer was substituted by the application of biozyme. Addition of inorganic fertilizer with biozyme could improve the soil physico-chemical properties and thus help in better soil environment suitable for increased crop growth and yield. Increased CGR along with higher uptake with increased level of biozyme coupled with recommended doses of chemical fertilizer in rice was earlier reported by Mitra and Mandal(2010).Total chlorophyll content of rice leaf was recorded to be maximum (2.13 and 2.10 µg g^{-1} during wet and dry season respectively) at 2 WAPI stage which declined gradually with the ageing of the leaves irrespective of treatments. By and large, the total chlorophyll content of rice leaf during both wet and dry seasons increased with the addition of biozyme but significant increment was seen when 25% of the recommended dose of chemical fertilizer was replaced by biozyme in different doses.

Grain yield of rice ranged between 2.06 to 4.58 and 2.84 to 6.25 t ha^{-1} during wet and dry seasons, respectively (Table 3). The highest grain yield was recorded with the treatment comprising application of biozyme granule twice @ 30 kg ha^{-1} along with the

Table 3. Effect of various treatments on grain yield and straw yield of rice during wet and dry season (pooled)

Treatments	Grain yield (t ha^{-1})		Straw yield (t ha^{-1})	
	Wet season	Dry season	Wet season	Dry season
Recommended dose of chemical fertilizer	3.63	5.41	4.43	6.51
¾ of the recommended dose of chemical fertilizer	3.21	4.74	4.14	6.22
RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 days after transplanting(DAT)	4.01	5.75	4.7	6.52
RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT	4.12	5.89	5.13	6.65
RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage	4.42	5.82	5.55	6.96
RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage	4.58	6.25	5.71	7.69
RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage	4.3	5.97	5.13	6.77
RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage	4.36	5.97	5.01	7.06
¾ RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT	3.82	5.69	4.56	6.36
¾ RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT	3.94	5.73	4.58	6.48
¾ RDF+ Biozyme G@20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage	4.11	5.86	4.64	6.7
¾ RDF+ Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage	4.2	5.87	5.06	6.74
¾ RDF + Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop@ 450 ml ha^{-1} at active tillering stage	4.11	5.79	4.55	6.57
¾ RDF + Biozyme G @ 30 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage	4.08	5.87	4.83	6.39
RDF + Biozyme G@20 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage	4.49	6.14	5.68	7.55
¾ RDF+Biozyme G@ 20 kg ha^{-1} at 5-7 DAT+30 kg ha^{-1} at active tillering stage	4.2	5.84	4.86	6.77
Biozyme G@20 kg ha^{-1} at 5-7 DAT + 20 kg ha^{-1} at active tillering stage – No fertilizer	2.38	3.32	3.08	4.31
Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + 30 kg ha^{-1} at active tillering stage – No fertilizer	2.43	3.63	3.11	4.54
Biozyme G @ 20 kg ha^{-1} at 5-7 DAT + Biozyme Crop^{+} @ 450 ml ha^{-1} at active tillering stage – No fertilizer	2.47	3.22	2.95	3.96
Control	2.06	2.84	2.63	3.79
C.D. at 5%	0.13	0.28	0.19	0.33

LAI - Leaf area index, DM - dry matter, CGR - crop growth rate, PI - panicle initiation, WAPI - Weeks after panicle initiation

recommended chemical fertilizers. Furthermore, grain yield of rice increased significantly with the application of biozyme upto 50 kg ha^{-1} in combination with full dose of chemical fertilizer. Sen and Santosh (1996) also reported significant increase in grain yield of rice upto 40 kg biozyme ha^{-1} + 100% of chemical fertilizer. It was found from the experiment that application of increased level of biozyme along with chemical fertilizer caused a substantial yield increase upto 26.17% over the recommended dose of chemical fertilizer during the wet season. Though the yield increase was less in dry season, results indicated that addition of biozyme either in granular or granular + liquid formulations in conjunction with chemical fertilizer increased grain yield as compared to the sole of application of chemical fertilizer (Table 3). Swain and Sen (1996) obtained the highest yield with 45 kg biozyme and 120, 26.2, 50 kg ha^{-1} of N, P and K, respectively. When 25% of the recommended dose of chemical fertilizer was replaced by 20 kg ha^{-1} of biozyme, the grain yield significantly increased. The straw yield also exhibited a similar trend with its highest value under application of biozyme granule in higher rates in combination with recommended chemical fertilizers.

The promotive effects of biozyme applied with 75% of recommended dose of NPK might be due to biozyme regulated plant bio-physiological activities which in turn resulted in higher chlorophyll content in leaves that's help in maintaining higher photosynthetic activity even during later stages of growth *viz.* grain-filling stage which collectively increased the yield performances. Mitra and Mandal (2010) reported the higher uptake of nutrients with increased level of biozyme granule application. The highest grain yield was obtained from the treatment receiving 60 kg ha^{-1} of biozyme in two equal splits at 5-7 days after transplanting and at active tillering stage along with the recommended dose of chemical fertilizer.

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