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An Analysis on Benefit-Cost Returns of Hybrid Rice under the Influence of Fertilizer and Weed Management Practices

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ABSTRACT

A field experiment entitled *"An Analysis on Benefit-Cost Returns of Hybrid Rice under the Influence of Fertilizer and Weed Management Practices"* was conducted during the *kharif* season of 2017 at the Research Farm, TCA, Dholi, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (BIHAR). The experiment was laid out in a split-plot design with twelve treatments. The results showed that among fertilizer levels, under F_3, grain (55.73 q/ha) and straw yield (78.36 q/ha) recorded was significantly superior over F_1 level but was found statistically at par with F_2 (53.21 q/ha) and (75.19 q/ha), respectively. Maximum net returns were found under F_3 (64,512 ₹/ha) as compared to F_2 (61,120 ₹/ha) and F_1 (49,136 ₹/ha). Still, it was statistically at par with F_2 and the B: C ratio was recorded as highest with F_3 (1.54), but it was found statistically at par with F_2 (1.51), and both the fertilizer levels (F_2& F_3) showed significantly higher value of B: C ratio than F_1 (1.26). In case of different weed management practices, Grain yield (62.35 q/ha) and straw yield (88.00 q/ha)) were significantly higher under W_3 than W_1 and W_4, but it was found at par with W_2 (60.23 q/ha), (85.03 q/ha), respectively. Net returns were recorded highest with W_2 (76,292 ₹/ha) which was significantly superior over W_3 (70,087 ₹/ha), W_1 (58,591 ₹/ha) and weedy check (28,054 ₹/ha) and the highest B: C ratio was found with W_2 (1.98) and it was superior over W_1 (1.56), W_3 (1.44) & W_4 (0.77).

Keywords: Weed Management, Fertilizer Levels, Hybrid Rice, Yield, Net Returns and B: C Ratio

Rice production and productivity have increased substantially with the development of dwarf and input responsive varieties. Recently, there has been a deceleration in the production growth rate of this crop. Hybrid technology, which has done wonders in rice production in China, may also give similar dividends in India if an adequate quantity of quality hybrid rice seed is made available at a reasonable price at the right time to the farmers. Since the yield of high-yielding varieties (HYVs) of rice is plateauing, it is rather challenging to achieve this target with the present day inbred varieties (Jaggarao *et al.* 2019 and Vijaykumar *et al.* 2019). Therefore, to sustain the self-sufficiency in rice, additional production of 1.5 MT is needed every year. Among the limited options, hybrid technology is the most proven technology currently available for stepping up rice production significantly. Therefore, introducing hybrids and

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popularizing their production technology techniques are feasible and readily adaptable to achieve targeted production (Lingaraju *et al.* (1997).

In hybrid rice, fertilizer has universally been recognized most important for growth and development. Nutrient management must be sound for sustainably achieving the production target. Using chemical fertilizer is the fastest way to counteracts the pace of nutrient mining. It promotes the growth and development of rice crops and is responsible for over 50 percent of the crop yield increment. Bali *et al.* (2006) and Bhowmick, and Nayak (2000).

Weeds compete with the crop for light, nutrients, water, and space, and other growth factors in the absence of effective control measures, removing a considerable quantity of applied nutrients results in significant yield losses. Weeds cause substantial losses in yield through the production of growth-inhibiting compounds, a phenomenon referred to as allelopathy. So, control of weeds is most important that can be accomplished by cultural, mechanical, and chemical methods (Banerjee *et al.* 2005). Considering these problems, the application of several herbicides in combination or in sequence can be utilized in controlling complex and diverse weed flora. These components highly impact crop yield. The crop is considered an economic enterprise by the growers. The cost-benefit ratio acts as a deciding factor in selecting the crop variety as it mainly influences the economic returns of the farmer. Hence, the present investigation was carried out to assess "*An Analysis on Benefit-Cost Returns of Hybrid Rice under the Influence of Fertilizer and Weed Management Practices*".

MATERIALS AND METHODS

A field experiment was conducted during *kharif* season of 2017 at the Research Farm of Tirhut College of Agriculture, RPCAU, Dholi, Samastipur (Bihar). The soil of the experimental site was sandy loam in texture (sand 56.72 %, silt 28.45 %, and clay 14.83 %) with a bulk density of 1.38 Mg m^{-3} having pH 8.2. The experiment was laid out in a split-plot design with three replications of weed management in main-plot and fertilizer levels in the sub-plot. The main plot comprised four different weed management practices *i.e.* W_1 (Bispyribac-sodium @ 25 g/ha at 20 DAT), W_2 (Bispyribac-sodium @ 25 g/ha + Pyrazosulfuron @ 25 g/ha at 20 DAT), W_3 (Hand weeding twice at 20 and 40 DAT) and W_4 (Weedy check), and under the sub-plot, there were three fertilizer levels i.e. F_1 (100 % RDF), F_2 (125 % RDF) and F_3 (150 % RDF), which were replicated thrice. Rice hybrid "*ARIZE-6444*" was taken as the test variety. The soil of the experimental plot was sandy loam in texture with pH 8.2, EC 0.56 dsm^{-1}, low in organic carbon (0.39 %), available nitrogen (207.3 kg/ha), phosphorus (16.5 kg/ha) and potassium (132.8 kg/ha).

RESULTS AND DISCUSSION

Grain Yield

Grain yield of a crop is the manifestation and impact of all the growth and development characteristics that had been studied during this investigation and very well reflected in the ultimate yield of grain under different weed management practices and fertilizer levels.

Weed management practices significantly influenced the grain yield. Hand weeding and herbicidal weed control recorded significantly higher grain yield than weedy check. Among weed management practices, hand weeding twice recorded maximum grain yield, similar to Bispyribac-sodium @ 25 g/ha + Pyrazosulfuron @ 25 g/ha, and both significantly surpassed Bispyribac-sodium @ 25 g /ha, and weedy check. This might be due to lesser crop-weed competition, which led to higher growth, better yield characters, lesser weed density, and dry weight, and thus more economic yield than other treatments. The minimum grain yield recorded in the weedy check might be due to severe weed infestation in the crop field. The weeds growing in weedy check attained higher vigor to compete with the crop plants for growth factors throughout the growing season. They thus suppressed the crop plant, which could not express the fullest yield potential, as was also corroborated by Yadav *et al.* (2008).

The calculated mean data revealed that a higher grain yield was recorded with 150 % RDF, which was statistically at par with 125 % RDF and significantly superior over 100 % RDF. Higher grain yield with a higher level of fertilizer might be due to better availability and uptake of nutrients and

photosynthetic efficiency, leading to higher plant dry matter production and ultimately increasing grain yield. Plant under 150 % RDF might not have realized nutrient deficits caused by weed infestation during peak vegetative and developmental phases and had favorable soil moisture conditions for optimum physiological functions. They grew freely to receive enough sunshine for carbohydrates synthesis resulting in better growth of the plant, longer panicle, more effective tillers, more number of grains per panicle, and higher test weight. These ultimately resulted in increased grain yield. Similar results were obtained by Kochroo and Bazaya (2011).

Straw Yield

A perusal of data regarding straw yield was significantly influenced by weed control treatments and fertilizer levels. The treatment recorded higher grain yield and also recorded higher yield straw. The maximum straw yield was recorded in hand weeding twice but was found at par with Bispyribac-sodium @ 25 g/ha + Pyrazosulfuron @ 25 g/ha, and both these treatments significantly surpassed over Bispyribac-sodium @ 25 g/ha and weedy check. This might be due to weed infestation because of the reduced growth and development and dry matter production by plants growing under more intense competition with weeds for plant nutrients, moisture, and sunlight, resulting in lower photosynthetic efficiency of the crop. Similar results were recorded by Rao *et al.* (2008).

Among fertilizer levels, the maximum straw yield was recorded with 150 % RDF but was found at par with 125 % RDF and significantly scored over 100 % RDF. These differences might be due to differential production of tillers per unit area, plant height, and dry matter production with increasing nutrient levels. The results are following those of Kumar, K. *et al*. (2005).

Economics

Cost of cultivation was worked out by taking the prevailing market prices of various inputs and outputs. Gross return is the any crop's total biological (grain + straw) yield. Data recorded under different components revealed that gross returns were increased with increased biological yield of crop obtained under different treatments.

The comparative economics has been presented in Table 1. This indicated that the maximum gross return was recorded under hand weeding twice but was significantly superior to Bispyribac-sodium @ 25 g/ha + Pyrazosulfuron @ 25 g/ha, Bispyribac-sodium @ 25 g/ha, and weedy check. Based on the performance regarding growth, development, and cost of cultivation, the treatmencomprised of the combination of Bispyribac-sodium @ 25 g/ha + Pyrazosulfuron @ 25 g/ha outclassed the other treatments concerning net return and B: C ratio. The above-mentioned treatment earned a net return (Rs. 76,292/ha) with a B: C ratio of (1.98) as against hand

Table 1: Grain yield (q/ha), Straw yield (q/ha), Gross Returns, Net Returns and B'C ratio as affected by different treatments

Treatment	Grain yield (q/ha)	Straw yield (q/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C Ratio (%)
Weed Management					
W_1	50.43	71.44	96,029	58,591	1.56
W_2	60.23	85.03	114,620	76,292	1.98
W_3	62.35	88.00	118,652	70,087	1.44
W_4	33.75	47.94	64,299	28,054	0.77
S. Em.±	0.87	1.24	1,667	1,667	0.042
CD (P=0.05)	3.09	4.38	5,882	5,884	0.148
Nutrients levels					
F_1	46.14	65.76	87,950	49,136	1.26
F_2	53.21	75.19	101,266	61,120	1.51
F_3	55.73	78.36	105,984	64,512	1.54
S. Em.±	1.64	2.29	3,109	3,109	0.078
CD (P=0.05)	4.95	6.94	9,401	9,401	0.236

weeding twice and Bispyribac-sodium @ 25 g/ha that fetched a net return of (₹ 70,087/ha) and (₹ 58,591/ha) and B: C ratio of (1.44) and (1.56), respectively. These three treatments were significantly superior to weedy check having a net return of ₹ 28,054/ha and B: C ratio of 0.77. This might be due to less cost involved in chemical treatment per unit of yield obtained. These findings agreed with Kaur and Singh (2015) and Khare, Arti, and Jain, H.C. (1995).

In the case of fertilizer levels, the maximum gross return was recorded with 150 % RDF and was adjudged comparable to the treatment with 125 % RDF, but it was significantly superior to 100 % RDF. The highest net return (₹ 64,512/ha) and B: C ratio (1.54) were recorded in 150% RDF but were found at par with 125% RDF. The treatment with 150% RDF, however, was adjudged comparable to the treatment with 125% RDF with a net return (₹ 61,120/ha) and B: C ratio (1.51) but was significantly superior to 100% RDF with regards to net returns (₹ 49,136/ha) and B: C ratio (1.26).

Regarding B: C ratio, hand weeding twice was far behind in comparison to herbicidal treatments (combination of Bispyribac-sodium @ 25 g/ha + Pyrazosulfuron @ 25 g/ha and Bispyribac-sodium @ 25 g/ha alone). Manual weeding (hand weeding twice) is still the most effective way to manage weeds in most crops. However, the ever-increasing efficacy of newly evolved herbicides and still -increasing labor cost make manual weeding a less desirable option. Based on numerous experimental results, one or two hand weeding still found a top position regarding growth, development, and yield, as was also evidenced in this investigation. Gross return is primarily a function of economic yield, but economics is an interplay of the cost involved in different treatments. The results obtained in terms of economics also find support with the works of Singh *et al.* (2010), Sanjay *et al.* (2008), and Natrajan, S. and Kuppusammy, G. (2001).

CONCLUSION

Net return and B: C ratio realized by Bispyribac-sodium @ 25 g/ha + Pyrazosulfuron @ 25 g/ha was significantly superior to all other treatments. The significant lowest value of net return and B: C ratio was recorded under the weedy check. Among fertilizer levels, the highest net return and B: C ratio was recorded by 150 % RDF, which was found statistically at par with 125 % RDF. Both these levels were significantly superior to 100 % RDF.

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