Biological Forum – An International Journal **13(2): 254-259(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Predominant Sedges & Broad-Leaved Weed Management by Herbicides and its Impact on Yield Parameters, Harvest Index and Grain Yield, Straw Yield of Kharif Direct Seeded Rice

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(Received 02 April 2021, Accepted 09 June, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Direct Seeded Rice has been commercialized as an alternative technique for rice cultivation over puddled transplanted rice for sustainability reflections (able to save scarce resources like water, labor, energy) besides DSR reduces GHG emissions, enhances soil physical properties and yield as well. Higher weed pressure observed in DSR with contribution of grasses, sedges and broad-leaved weeds. Raj *et al.*, (2013) found that 72% of grain yield reduction occurs in DSR due to the infestation of sedges and BLWs (weed-crop competition demolish crop yield by suppressing yield attributes) together called as non-grassy weeds. Use of herbicides, an alternative over manual weeding (Rao *et al.*, 2007) hence, usage increased in South Asia by the spread of DSR (Azmi *et al.*, 2005). In the present autopsy, the yield attributes increased significantly by adopting various weed control treatments as compared to weed check. Though, their efficacy varied with respect to yield attributing characters depending on the spectrum of their weed control. The yield attributes increased significantly by adopting Carfentrazone Ethyl 40 DF @ 25 g ha^{-1} with highest number of effective tillers (263.18 tillers m^{-2}), grains per panicle (127.37), higher test weight (22.65 g), harvest index (47.53) which directly influenced grain yield (50.16 q ha^{-1}) and also acquired higher net returns (69860/-₹ha^{-1}) & higher BC ratio (0.27) exceeding all other treatments and was on par with weed free treatment. The better expression of yield attributes might be due to poor resurgence frequency and growth of weeds as evident from weed dry matter studies in these plots.

Keywords: Sedges, BLWs, effective tiller, test weight, harvest index & Grain yield.

INTRODUCTION

The success of direct seeded rice hinge on effective weed management. Weeds are the number one biological restraint and major menace to production and adoption of direct seeded rice systems. Higher weed pressure observed in direct seeded rice with contribution of grasses, sedges and broad-leaved weeds. Uncontrolled weeds reduce yield up to 96% in direct seeded rice and 61% in wet direct seeded rice (Maiti and Mukherji, 2008). There is a shift in weed flora from grassy weeds to sedges and broad-leaved weeds and from annuals to perennials thanks to the continual use of herbicides for the control of annual grassy weeds (Rajkhowa *et al.* 2006). Raj *et al.*, (2013) found that 72% of grain yield reduction occurs in direct seeded rice due to the infestation of sedges and broad-leaved weeds together called as non-grassy weeds. The yield decrease in direct-seeded rice confounds with an increase in weed competition period during the initial period (30 to 40 days), it holds an attraction; in that magnets attention for when weeding should occur. Weed-crop competition may demolish crop yield by suppressing yield attributes. In the present inquest, the yield attributes increased significantly by adopting various weed control treatments as compared to weed check. Though, their efficacy varied with respect to yield attributing characters depending on the spectrum of their weed control. The better expression of yield attributes might be due to poor resurgence frequency and growth of weeds as evident from weed dry matter studies in these plots. Usually, the herbicides which are normally used for weed control in DSR may be efficient to control all genera of grassy weeds and were not found to be effective for sedges and broad-leaved weeds, likewise it’s the same with manual and mechanical methods. Hence, it's imperative to spot alternative herbicides for effective control of sedges and broad-leaved weeds. Use of herbicides with variation in mode of action must be followed to avoid undesirable weed shift & herbicide resistance in weeds. Therefore, the present study was undertaken to evaluate different new & low dose, pre and post emergent herbicides for effective management of predominant sedges and BLWs and their influence yield parameters, harvest index, grain & straw yield of direct seeded rice.

MATERIALS AND METHODS

The field experiment conducted during kharif season from June 2019 to October 2019 at Field Research Station, Mandouri, Bidhan Chandra Krishi Vishwavidyalaya, West Bengal, located at 89°E longitudes, 23° N latitude & 10 m above the sea level. The experiment site was medium land with pH 7.70 (Neutral), organic carbon 0.56% and available N, P_2O_5, K_2O (210, 63, 186 kg ha^{-1}) respectively, it has irrigation facilities from deep tube well. The total rainfall during the season was 831.40 mm (June to October, 2019). The experiment was laid out in Randomized block design replicated thrice seven integrated weed management treatments. The cultivar *'Shatabdi (IET 4786)'* has taken up for investigation. On a well-prepared land, seeds were sown after subjecting it to seed incubation with salt water (160 g salt lit^{-1}), followed by seed treatment with *Trichoderma viride* @ 4 g and Azotobacter @ 250 g kg^{-1} and kept it overnight before sowing. Seeds were sown on 06.06.2019 with seed rate of 80 kg ha^{-1}, the spacing of 25 cm × 5 cm,in north-south direction. Full dose of Neem cake and P_2O_5 and 25% K_2O in the form of SSP and MOP were applied as basal on 5th June, 2019. 1st top dressing on 17th June, 2019 with 25% N in the form of Urea at 10 DAS and second topdressing on 5th July, 2019 with 25 % N in the form of urea and 25 % K_2O in the form of MOP. All the agronomic other package of practices were adopted as recommended by Bidhan Chandra Krishi Viswavidyalaya, West Bengal.

OBSERVATIONS & DATA ANALYSIS

Population count of the crops after establishment was done in all the crops. An area of 2 m × l m was kept reserved for destructive sampling and the rest of the plot was used for yield estimation. For assessing the relationship between yield and yield attributes, the following parameters were record at the time of harvest. 10 panicles from each plot were randomly collected length of panicle (cm) was measured using measuring scale and filled grains were counted and average was recorded for determining the number of filled grains $panicle^{-1}$. The harvested above ground plant parts (grain and straw) from net plot area were carefully bundled, tagged and taken to the threshing floor separately. The individual bundle was weighed after complete drying in the sun before threshing and weighed and the biological yield per plot was then converted in to kg ha^{-1}. The yield recorded in kg $plot^{-1}$ was standardized to 12-14 per cent moisture and then weight was converted in to kg ha^{-1}. Straw yield was calculated by subtracting the grain yield from the total biological yield of the crop. Finally, straw yield per plot was converted in to kg ha^{-1}. The data collected on different characters during the course of investigation were subjected to Fisher's method of analysis of variance and interpretation of data was made as per the procedure described by Gomez and Gomez (1984). The level of significance used in 'F' and 't' test was p=0.05, critical difference values were calculated whenever the 'F' test was significant.

RESULTS AND DISCUSSION

Different weed management practices significantly influenced various stages of *kharif* direct seeded rice and obtained results with various herbicide treatments interfered with crop yield parameters of direct seeded rice. In the present enquiry, results and discussion of impact of herbicidal treatments on yield parameters were elucidated here.

A. Yield Attributes of Direct Seeded Rice

1. Effective/productive tillers m^2. Tillering in rice is an important agronomic trait for grain production. Maximum production of tillers generally attained 30-40 DAS. Effective tillers m^{-2} differed significantly due to different weed management practices tried during the present investigation (Fig. 1). The highest number of productive tillers m^{-2} observed with Carfentrazone Ethyl 40 DF @ 25 g ha^{-1}, it has recorded significantly (263.18 tillers m^{-2}) with significant disparity among the herbicides. This might be due to upkeep of weed free environment led to increased availability of growth resources, resulted in a greater number of total tillers m^{-2} and then converted into higher number of productive tillers m^{-2} because of maintenance of better source sink relationship in these treatments. Obtained results in harmony with findings of Neeshu Joshi *et al.* (2015) and Sai Ramesh *et al.* (2015).

Results noticed with Carfentrazone Ethyl are co-equalled with Penoxulam 24 SC @ 25 g ha^{-1} and Pendimethalin 30 EC @ 750 ml ha^{-1} both stayed at par with each other (4.65%) in decreasing trend (graphically represented in Fig. 1). Pyrazosulfuron Ethyl 10 WP @ 80 g ha^{-1} has significantly obtained (246.83 tillers m^{-2}) which is similar to that of Das (2008), he found that the application of Pyrazosulfuron in general increase vigor of rice plants in terms of a greater number of tillers and better grain filling ensuing in higher yield.

The better control of dominant sedges and BLWs without any phytotoxicity on rice crop provide better environment for production of a greater number of effective tillers. Effective weed management, higher plant height, high leaf area and high accumulation of dry biomass resulted in obtaining higher effective tillers. Discoursed results are in conformism with those of Yoga Lakshmi (2001) and Rajbir Sharma (2007).

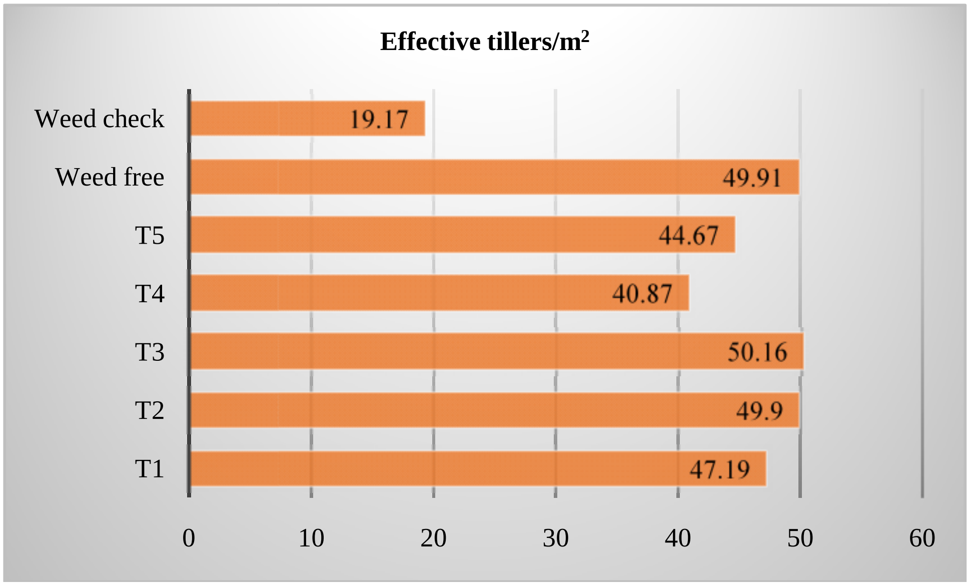

Fig. 1. Impact of herbicides on effective tiller production in DSR.

2. Number of total grains per panicle. Grains per panicle is chief agronomic trait for determination of yield, which is an important component for cultivation of rice. Herbicides has exerted significant influence on number of total grains panicle^{-1} (Fig. 2). The highest total number of grains panicle^{-1} recorded with Carfentrazone Ethyl 40 DF @ 25 g ha^{-1}; ithas recorded significantly higher grains per panicle (127.37 No. panicle^{-1}) than any other treatments. Next Penoxulam 24 SC @ 25 g ha^{-1} (117.7 No. panicle^{-1}) and Pyrazosulfuron Ethyl 10 WP @ 80 g ha^{-1}(112.56 No. panicle^{-1}) both were at par with each other. All these three treatments were superior in producing higher number of grains panicle^{-1} due to favorable conditions on behalf of increased production and translocation of photosynthates from source to grains, owing to adequate availability of growth resources as a result of less competition offered by weeds. Conferred results are in conformism with those of Narolia *et al.* (2014). The lowest number of total grains panicle^{-1} recorded with weed check (71.45 No. panicle^{-1}), due to heavy weed infestation led to reduced production & translocation of assimilates from source to developing grains.

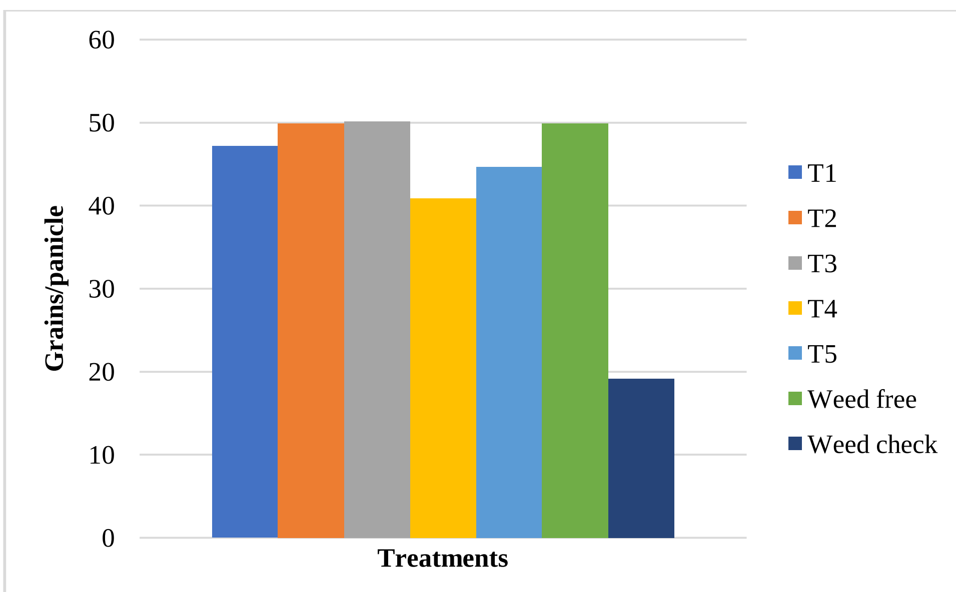

Fig. 2. Number of total grains per panicle among different treatments applied in DSR.

3. Test weight of Direct Seeded Rice. The heaviest grains recorded with Carfentrazone Ethyl 40 DF @ 25 g ha^{-1}, it has recorded significantly higher test weight (22.65 g) than any other treatments with significant disparity among the herbicides (Fig. 3). Due to better translocation of photosynthates from source to developing sink (grains), owing to increased availability of growth resources. Spoken results are in conformity with those of Yadav *et al.* (2018) and Hossain and Malik (2017).

The lowest thousand grain weight of rice was obtained with Pendimethalin 30 EC @ 750 ml ha^{-1} (21.39 g) and Bispyribac-sodium10 EC @ 25 g ha^{-1} (21.18 g). The lowest test weight of grains was recorded with weed check (20.21 g), On the other hand, relatively poor yield attributes and yield recorded under inferior treatments might be attributed to the poor crop growth due to insufficient weed control that could not reduce the weed-crop competition to the tune as achieved under above mentioned superior treatments. Results obtained in present investigation are strongly supported by Singh and Singh (2005), Pisal and Sagarka (2013) and Singh *et al.* (2013a).

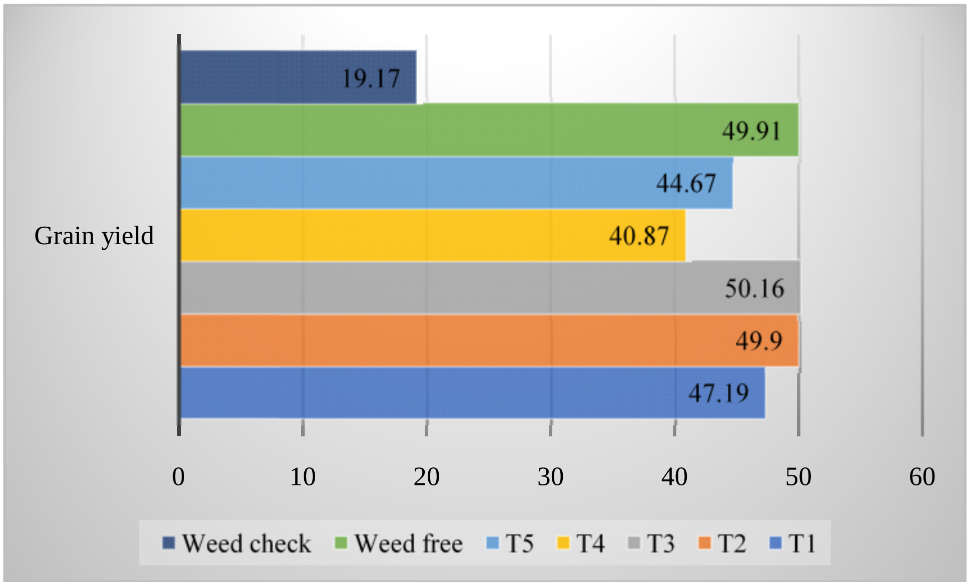

Fig. 3. Test weight of DSR treated with different herbicides.

The obtained results are in close agreement with those of Nadeem *et al.*, (2007), he recorded the maximum number of productive tillers m^{-2}, total number of grains panicle^{-1}, 1000-grain weight, yield obtained from Carfentrazone Ethyl, the increase in yield attributes *viz.*, effective tillers, total grains panicle^{-1} and test weight (g) mainly due to increased growth parameters at various growth stages, better nutrient uptake and least crop weed competition and genetic nature of direct seeded rice responsible for intercepting the sunlight to restrict the growth of weeds which resulted in lower weed density and weed dry matter that is responsible for higher yield parameters of rice. Thus, it clearly indicates that increased weed population adversely affect the yield parameters in direct seeded rice. These results discoursed on yield parameters are in orthodoxy with Prasad *et al.* (2001), Suresh and Singh (2003) and Dave Sahu (2006).

4. Harvest Index. Significantly highest harvest index was recorded with Carfentrazone-ethyl 40 DF @ 25 g ha^{-1} (47.53) which was coequal with weed free treatment (47.53) and these treatments were notably superior to rest of the herbicides, due to increased growth and yield attributes as a result of weed free environment during crop growth period (Fig. 4). Insights obtained from this investigation are supported by Mishra (2016). The next best treatment was Penoxulam 24 SC @ 25 g ha^{-1} has been recorded harvest index of 47.02. The lowest harvest index resulted in weed check due to severe weed infestation causes decreased stature of growth and yield parameters. This clearly indicate that sequential application of herbicides upheld weed free environment throughout the crop period and facilitate efficient use of growth resources by the crop and better translocation of photosynthates from source to sinkled to increased seed yield, which in turn increased the harvest index. Furnished results are in accord with those of Singh (2016).

Influence of Treatments on Yield of Direct Seeded Rice

Yield is the ultimate outcome of the crop and influenced by various management practices. Proper management of production factors under given set of environments gave high dividend in the form of yield increase. Enhancement in yield of economic part is usually depending on the dry matter production among different parts of the plant attributes. The variations in yield due to treatments could be attributed to the variations in the yield attributing parameters.

Grain Yield (kg ha^{-1}). Among different treatments shadowed for weed management, fascinated results acquired with Carfentrazone Ethyl 40 DF @ 25 g ha^{-1}, it has recorded grain yield (50.16 q ha^{-1}) significantly higher over all the treatments (visibly displayed in Fig. 5).

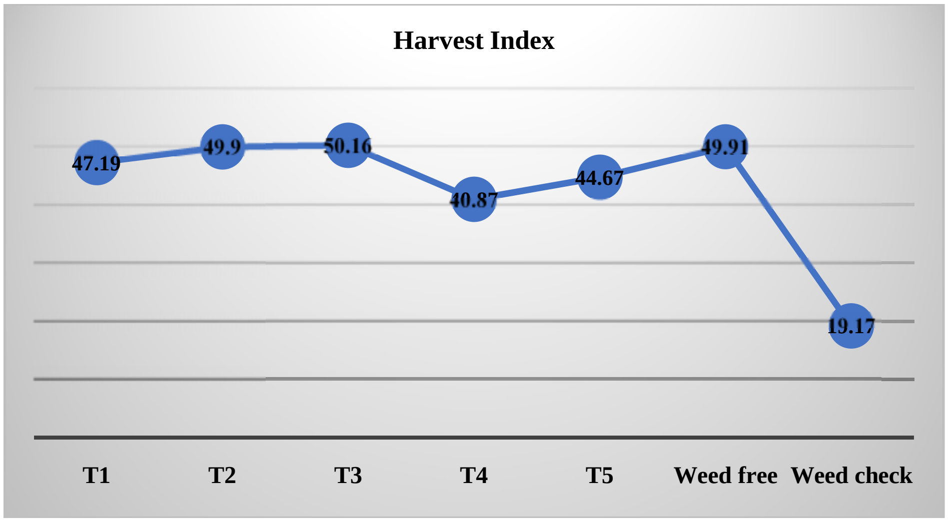

Fig. 4. Harvest index obtained from different treatments.

Results obtained and discoursed in present investigation are strongly braced with the finding of Singh and Singh (2005), Pisal & Sagarka (2013) and Singh *et al*., (2013a). The next best treatments obtained higher grain yield were Penoxulam 24 SC @ 25 g ha^{-1} (49.90 q ha^{-1}) and Pyrazosulfuron Ethyl 10 WP @ 80 g ha^{-1} (47.19 q ha^{-1}). Furnished results are in reinforced by findings of Yadav *et al*., (2010) from Karnal, he reported that Penoxulam @ 25 g ha^{-1} or 22.5 g ha^{-1} has provided satisfactory control of all types of weeds and resulted in grain yield of rice parallel to weed free plot. The enhanced yields were because of elimination of weeds which helped to enhance the availability of nutrients, space, sunlight, and water resulted in better growth and development of crop plants. Supplied results of yield parameters are in assured with the findings of Mukherjee and Singh (2005), Patra *et al.* (2011) and Sah *et al.* (2012).

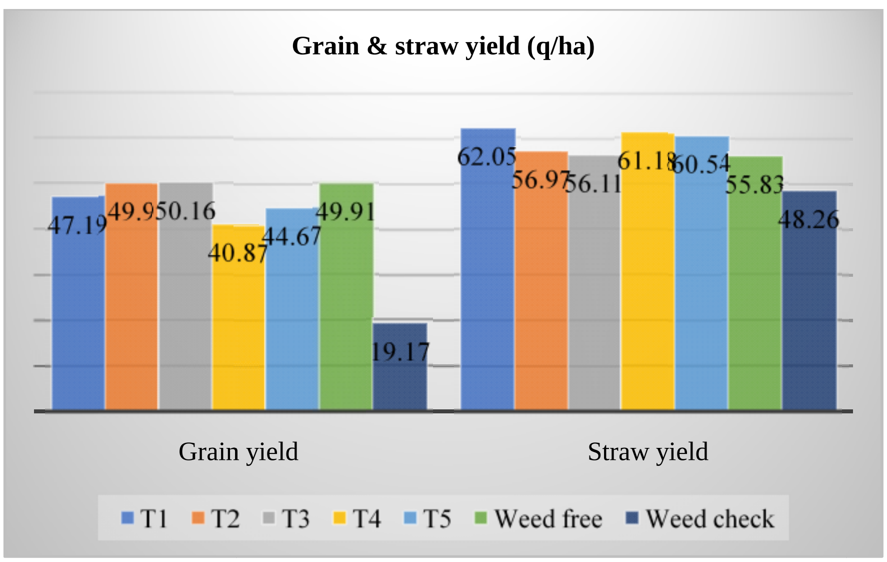

Fig. 5. Effect of treatments on Grain & Straw yield (q ha^{-1}).

Straw Yield (kg ha^{-1}). Significantly higher straw yield was recorded with application of Pyrazosulfuron Ethyl 10 WP @ 80 g ha^{-1} (62.05 g ha^{-1}) which was comparable with Bispyribac-sodium 10 EC @ 25 gha^{-1} as picturized in Fig. 5 (61.18 qha^{-1}) and these treatments were superior due to increased growth and yield attributes as a result of weed free environment during crop growth period. The lowest straw yield logged with weed check than rest of the treatments due to severe weed infestation during entire crop growth period led to decreased stature of growth and yield parameters. Chatted above results are in conformity with the findings of Kumar *et al.* (2011).

CONCLUSION

Among the different weed control treatments, the maximum mean value of the most significant yield parameters *viz*. number of effective tillers plant^{-1} (263.18), total number of grains panicle^{-1} (127.37) and test weight of grains (22.65 g) were respectively observed with Carfentrazone Ethyl 40 DF @ 25 g ha^{-1}. While in case of weed management practices, the lowest value of all these yield parameters were observed under weedy check plot. Significantly highest harvest index was recorded with Carfentrazone-ethyl 40 DF @ 25 g ha^{-1} (47.53) which was coequal with weed free treatment (47.53). Captivated grain yield acquired with Carfentrazone Ethyl 40 DF @ 25 g ha^{-1}; it has recorded grain yield (50.16 q ha^{-1}) significantly higher over all the treatments. While significantly higher straw yield recorded with Pyrazosulfuron Ethyl 10 WP @ 80 g ha^{-1} (62.05 g ha^{-1}).

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How to cite this article: Vijaya Rani, D., Pinto, B., Kanu, M. and Srijani, M. (2021). Predominant Sedges & Broad-Leaved Weed Management by Herbicides and its Impact on Yield Parameters, Harvest Index and Grain Yield, Straw Yield of Kharif Direct Seeded Rice. *Biological Forum – An International Journal*, *13*(2): 254-259.