Comparison of Hand Weeding Techniques and Different Herbicide Types on Direct Wet Seeded Rice Yield

Siva Krishna K[1], Prathiba R[2*]

[1]Research Scholar, Saveetha School of Engineering, Saveetha Institution of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India, Pincode: 602105

[2]*Project Guide, Corresponding Author, Saveetha School of Engineering, Saveetha Institution of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India, Pincode: 602105

ABSTRACT

Aim: The aim of the study is to compare different selective herbicides along with hand weeding for the yield of direct wet seeded rice. **Materials and Methods:** The experimental land was 2023 square meter. Selective Herbicides such as novel oxadiazon and bispyribac sodium were used for the study. The sample size is 20 for each herbicide and a total of 40 samples. G-power with 80 %, threshold 0.05 and confidence interval 95 % were done using online sample size test calculators. **Results:** The combination of different herbicides such as bispyribac sodium and novel oxadiazon resulted in control and elimination of weeds and increased yield. The statistical significance was 0.005 which is less than ($P < 0.05$) for yield and herbicides and are statistically significant. The herbicide application of oxadiazon has produced good yield for direct wet seeded rice. **Conclusion:** From the results, novel oxadiazon along with hand weeding increased the crop yield, when compared to the application of bispyribac sodium.

Keywords: Direct Wet Seeded Rice, Novel Oxadiazon, Selective Herbicides, Weed management, Bispyribac sodium, Yield Analysis.

Introduction:

Rice is one of the important cereals and staple food for the people of India. 25 % of world rice production is developed from India. By 2040, 96 million tons of rice should be produced for the rice demand (Dong et al. 2017) . The major challenge with meeting the rice demand is to use less water and labor sensitivity. This challenge can be overcomed with Direct Wet Seeded Rice (DWSR) (Farooq et al. 2011) . Wet seeded rice is a method, where the rice production consumes less water. It also increases rice production and effective use of all the resources (Ala et al. 2003). The application of herbicides is to control weeds. Weeds also grow simultaneously with the crop, thereby the major crop production is reduced by 50-90 %. Integrated weed management should be practiced for rice production with effective herbicides (Xu et al. 2019).

There are 108 research articles published in Google Scholar and 130 articles published in Science Direct for direct wet seeded rice. A comparison study was done between a wet seeded rice ratoon

rice system with a transplanted rice ratoon rice system. In which, wet seeded rice ratoon ratoon rice system produced a grain yield analysis of 12.4 -15.7 t/ha. Their studies concluded that wet seeded rice was comparable to that of transplanted rice (Hayashi et al. 2007). The weeds infestation in the yield analysis of rice plants can be effectively increased by chemical herbicides (Nachimuthu et al. 2007). Combination of different selective herbicides can effectively control and destroy the weed structures. There are pre emergence herbicides such as oxadiazon, butachlor, pendimethalin which provide effective control of weeds (Moody 1992). Many research articles showed that pre-emergence and postemergence selective herbicides are very efficient to control the mass of weeds (Farooq et al. 2011). Productivity of wet seeded rice was 13.4 % compared to dry seeded rice of only 11.6 % and also wet direct seeded rice produced more grain yield analysis (Bhuiyan et al. 2017). This study "Nitrogen Application in Direct Wet-Seeded Rice under Alternate Wetting and Drying Irrigation Condition: Effects on Grain Yield, Dry Matter Production, Nitrogen Uptake and Nitrogen Use Efficiencies" (Bhuiyan et al. 2017)is the best study from the above studies.

Our team has extensive knowledge and research experience that has translate into high quality publications(Bhavikatti et al. 2021; Karobari et al. 2021; Shanmugam et al. 2021; Sawant et al. 2021; Muthukrishnan 2021; Preethi et al. 2021; Karthigadevi et al. 2021; Bhanu Teja et al. 2021; Veerasimman et al. 2021; Baskar et al. 2021) Based on the above literature studies, the use of different herbicides to control weeds and maximum crop yield can be achieved by proper weed management practices. Weeds can be controlled and maximum yield of rice is achieved. Hence, the aim of this study is to compare different herbicides along with hand weeding to improve rice crop yield by applying herbicides subsequently.

Materials and methods

The experiment was done at Saveetha farm house, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha School of Engineering, Chennai. The control group is oxadiazon and the experimental group is bispyribac sodium. The sample size was 20 for novel oxadiazon herbicide and 20 samples for bispyribac sodium. The pretest analysis was done using a sample size test calculator with G-Power 80 %, threshold 0.05 and confidence interval 95 % (D. Wang and Barabási 2021).

Herbicides such as novel oxadiazon and bispyribac-sodium were purchased from online platforms. The experimental land was 2,023 square meter. The experiment was done with split plot arrangement, with a main plot for experiments and sub plot for cultivation.

For direct wet seeded rice (DWSR), initial land preparation was done by using a tractor attached with a cultivator and the field was layered with water. Seeds were soaked for 1 day in fiber sacks to germinate. They are sown in fields for germination of seedlings. The duration of seedlings takes 25 days on black soil. Seedlings plotted in the selected field. Fig 1 shows the yield of direct set seeded rice.

Weed control was done using novel oxadiazon and bispyribac-

sodium.Oxadiazon and bispyribac herbicide applied at the rate of 1 lit/acre, adding 200 lit of water using a knapsack sprayer to eliminate weeds which were observed after 25 days of cropping. Selective Herbicides along with manual hand weeding were used as weed control methods (Sheehy and Mitchell 2015).

Statistical Analysis

The statistical analysis was done using SPSS v.26. The statistical analysis was used to calculate the mean, standard deviation, standard error and significant difference. 20 samples were analyzed in each group. 95% confidence level with p = 0.05. Herbicides along with hand weed were the independent variables and crop yield was the dependent variable. Independent sample t-test was used to analyze the output of this experiment (D. Wang and Barabási 2021).

RESULTS

Table 1 shows the different herbicides of novel oxadiazon and bispyribac sodium, the yield is 80 g/plant for novel oxadiazon. Table 2 shows the group statistics of growth by use of herbicides with a mean of 80 for novel oxadiazon and 70 for bispyribac-sodium. Table 3 shows the independent sample test with significance value 0.005 which is less than 0.05 and are statistically significant. Fig 2 shows the comparison of herbicides with that of yield with 95 % confidence interval and +/- 1 standard deviation.

DISCUSSION

From the results, it shows that yield is 80 g/plant higher by the use of novel oxadiazon herbicides. Whereas, bispyribac sodium recorded 70 g/plant. This difference can be due to the better control of weeds and nutrient absorption provided by oxadiazon herbicide.

From the bar chart Fig 2, it shows that the mean value for oxadiazon is 79.6 and for bispyribac sodium is 69.3. Independent sample t-test for yield gives statistical significant difference is p = 0.005 and less than probability level of 0.05. Bispyribac-sodium and Oxadiazon are the chemicals used for increasing the yield. In use of herbicides with novel oxadiazon and bispyribac sodium, oxadiazon is shown to be a better yield (Goodman 1980). The highest grain yield obtained from the weed management might be attributed to the highest values of total and effective tillers, fertile grains and the lowest values of non-effective tillers and sterile grain. The above two studies have similar findings with this study (Chen et al. 2021). The above two studies are similar to our study. Herbicides are the most cost-effective weed management control method in wet-seeded rice but there is a need to reduce the almost total reliance on them for weed management control. A crop establishment method plays an important role in weed management emergence (Devkota et al. 2022). Weed management infestation is the major threat to rice. Weeds with their high adaptability and faster growth dominate the plant growth and reduce the yield of the crop. These weeds could be controlled through various methods. Manual methods are very common but cost intensive (Z. Wang et al. 2018). Herbicides when applied alone are economical. Therefore, presently there is a need to use high efficacy herbicides like novel oxadiazon to increase the yield. The above two studies did not correlate with our study.

The limitations of this is use of pre and post emergence herbicides to control weeds and increase yield. The scope of this study is to control the weeds and improve the soil nutrient absorption. Seed coating, seed priming are advanced techniques in which the seeds can be adapted to any climatic conditions.

CONCLUSION

This present study was experimentally done to compare the different types of herbicides along with hand weeding in rice crop yield. The results revealed that the application of herbicides along with hand weeding controlled the weeds and improved the crop yield of direct wet seeded rice. The statistical significance was 0.005 which is less than ($P < 0.05$) for yield and herbicides and are statistically significant. Thus this study can be concluded in such a way that oxadiazon along with hand weeding is efficient over bispyribac sodium to control weeds and to improve soil nutrients which plays a crucial role in development of crop yield.

Declaration:

Conflict of Interests

The authors of this paper declare no conflict of interests in this manuscript.

Author Contribution

Author (SKK) is involved in data collection, data analysis, and manuscript writing. Author (PR) was involved in the conceptualization, guidance, and critical review of the manuscript.

Acknowledgment

The authors would like to express their gratitude towards Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences (Formerly known as Saveetha University) for providing the necessary infrastructure to carry out this work successfully.

Funding: We would like to show our gratitude towards ours financial sponsors for their financial support that enabled us to complete this experimental research work

1. Agro industries
2. Saveetha school of Engineering
3. Saveetha University
4. Saveetha institute of medical and technical sciences.

REFERENCE

1. Bhuiyan, M. K. A., S. U. Bhuiya, M. A. Saleque, and A. Khatun. 2017. “Nitrogen Application in Direct Wet-Seeded Rice under Alternate Wetting and Drying Irrigation Condition: Effects on Grain Yield, Dry Matter Production, Nitrogen Uptake and Nitrogen Use Efficiencies.” *Journal of Plant Nutrition*. https://doi.org/10.1080/01904167.2017.1380826.
2. Chen, Liming, Yanhong Yi, Wenxia Wang, Yongjun Zeng, Xueming Tan, Ziming Wu, Xiongfei Chen, Xiaohua Pan, Qinghua Shi, and Yanhua Zeng. 2021. “Innovative Furrow Ridging Fertilization under a Mechanical Direct Seeding System Improves the Grain Yield and Lodging Resistance of Early Indica Rice in South China.” *Field Crops Research*. https://doi.org/10.1016/j.fcr.2021.108184.
3. Devkota, Krishna Prasad, Koichi Futakuchi, Valère Cesse Mel, and E. Humphreys. 2022. “Does Wet Seeding Combined with Sub1 Varieties Increase Yield in Submergence Prone Lowlands of West Africa?” *Field*

Crops Research. https://doi.org/10.1016/j.fcr.2021.108375.

4. Dong, Huanglin, Qian Chen, Weiqin Wang, Shaobing Peng, Jianliang Huang, Kehui Cui, and Lixiao Nie. 2017. "The Growth and Yield of a Wet-Seeded Rice-Ratoon Rice System in Central China." *Field Crops Research*. https://doi.org/10.1016/j.fcr.2017.04.003.
5. Farooq, M., Kadambot H. M. Siddique, H. Rehman, T. Aziz, Dong-Jin Lee, and A. Wahid. 2011. "Rice Direct Seeding: Experiences, Challenges and Opportunities." *Soil and Tillage Research*. https://doi.org/10.1016/j.still.2010.10.008.
6. Goodman, Daniel. 1980. "The Maximum Yield Problem: Distortion in the Yield Curve due to Age Structure." *Theoretical Population Biology*. https://doi.org/10.1016/0040-5809(80)90047-7.
7. Hayashi, Satoshi, Akihiko Kamoshita, Junko Yamagishi, Anuchart Kotchasatit, and Boonrat Jongdee. 2007. "Genotypic Differences in Grain Yield of Transplanted and Direct-Seeded Rainfed Lowland Rice (Oryza Sativa L.) in Northeastern Thailand." *Field Crops Research*. https://doi.org/10.1016/j.fcr.2007.01.001.
8. Moody, Keith. 1992. *Weed Management in Wet-Seeded Rice in Tropical Asia*.
9. . M. Y. Sarker, M. Y. Sarker ., M. Mosaddeque Hossai ., M. K. Hasan ., M. A. Khan ., M. R. Amin ., and F. Begum . 2002. "Weed Infestation in Direct Seeded and Transplanted Aus Rice as Affected by Method of Planting and Weeding Regime." *Journal of Biological Sciences*. https://doi.org/10.3923/jbs.2002.652.655.
10. Nachimuthu, Gunasekhar, V. Velu, P. Malarvizhi, S. Ramasamy, and L. Gurusamy. 2007. "Standardisation of Leaf Colour Chart Based Nitrogen Management in Direct Wet Seeded Rice (Oryza Sativa L.)." *Journal of Agronomy*. https://doi.org/10.3923/ja.2007.338.343.
11. Sheehy, John E., and P. L. Mitchell. 2015. "Calculating Maximum Theoretical Yield in Rice." *Field Crops Research*. https://doi.org/10.1016/j.fcr.2015.05.013.
12. Wang, Dashun, and Albert-László Barabási. 2021. *The Science of Science*. Cambridge University Press.
13. Wang, Zhiqin, Daojian Gu, Sarah S. Beebout, Hao Zhang, Lijun Liu, Jianchang Yang, and Jianhua Zhang. 2018. "Effect of Irrigation Regime on Grain Yield, Water Productivity, and Methane Emissions in Dry Direct-Seeded Rice Grown in Raised Beds with Wheat Straw Incorporation." *The Crop Journal*. https://doi.org/10.1016/j.cj.2018.05.004.
14. Xu, Le, Xiaoxiao Li, Xinyu Wang, Dongliang Xiong, and Fei Wang. 2019. "Comparing the Grain Yields of Direct-Seeded and Transplanted Rice: A Meta-Analysis." *Agronomy*. https://doi.org/10.3390/agronomy9110767.
15. Ala, M. Robiul, M. Robiul Ala, M. S. H. Molla, M. Shahjahan, M. O. Hoque, M. Akhtar Hos, and F. Islam. 2003.

"Study on Growth and Control of Weeds as Affected by Weeding Methods in Upland Direct Seeded Aus Rice." *Pakistan Journal of Biological Sciences*. https://doi.org/10.3923/pjbs.2003.1067.1069.

Tables and Figures

Table 1. The herbicides application such as oxadiazon and bispyribac sodium along with hand weeding to improve the yield and control of weeds. The crop yield was recorded as 80 g/plant for novel oxadiazon followed by bispyribac sodium 70 g/plant.

Trial number	Yield (g/plant)	
	Oxadiazon	Bispyribac sodium
1	80	70
2	81	68
3	78	71
4	79	69
5	82	71
6	77	71
7	79	70
8	80	68
9	82	67
10	78	68
11	80	70
12	81	68
13	78	71
14	79	69
15	82	71
16	77	71
17	79	70
18	80	68

19	82	67
20	78	68

Table 2. Group statistics of crop yield and treatment methods shown in the below tabulation. The mean value for yield was 79.6 for oxadiazon and 69.3 for bispyribac sodium. Standard deviation is 51.10 for novel oxadiazon and 25.46 for bispyribac sodium.

Herbicides	Treatment	N	Mean	Std.deviation	Std.error mean
Oxadiazon	T1	20	79.6	51.10	11.42
Bispyribac (Na)	T2	20	69.3	25.46	5.69

Table 3. Independent sample test for crop yield in which, the statistical significance was 0.005 which is less than (P < 0.05) for yield and herbicides and are statistically significant.

	Hypothesis	**F**	**Sig**	**t**	**Std.Error difference**	**Confidence interval of the difference**	
						Lower	Upper
Yield	Equal variances assumed	3.770	0.005	15.27	12.76	169.15	220.84
	Equal variances not assumed	-	-	15.27	12.76	168.84	221.15

Fig 1. Yield of wet seeded rice by oxadiazon

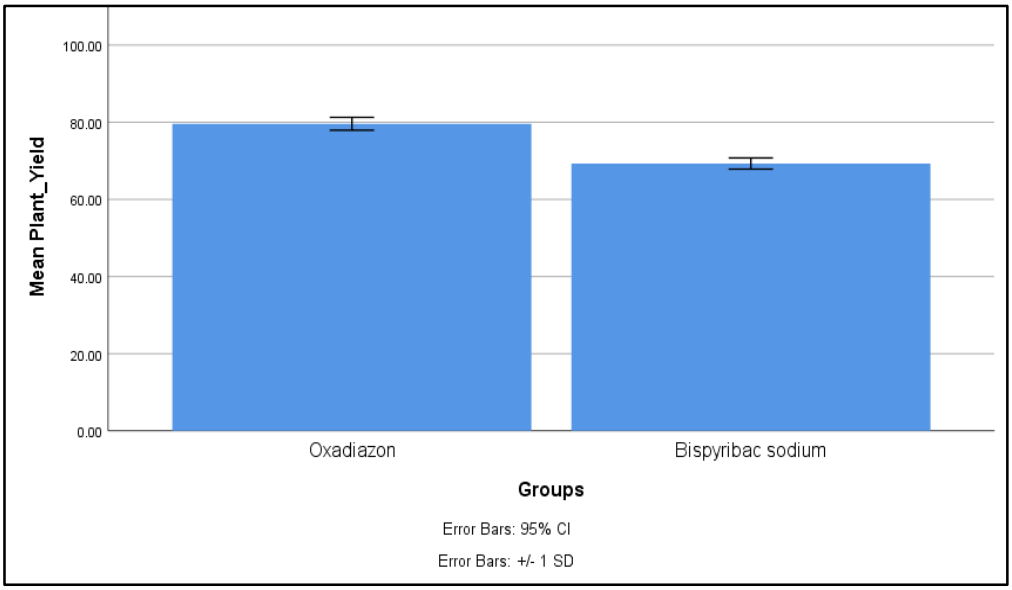

Fig. 2. Comparison of treatment T1 oxadiazon and T2 bispyribac in which the X-axis is yield and Y-axis is mean values. It shows the error bars with 95% confidence interval and +/- 1 standard deviations.