Indus Journal of Agriculture and Biology (IJAB)

Volume 2, Number 2, 2023, Pages 32 – 39

Journal Home Page

https://journals.airsd.org/index.php/ijab

Herbicide Strategies for Effective Weed Eradication in Maize Crop

Rima Bibi[1], Abdul Fatah Soomro[2], Nisar Ahmad Soomro[3] and Khalil Ahmed Solangi[4]

Department of Plant Breeding and Genetics Gomal University[1]

PARC-NSTHRI, Thatta[2]

PARC, Waterand Agriculture Waste Management Institute Todojam Sindh Pakistan[3]

PCSRI, Karachi[4]

ARTICLE INFO

Article History:

Received:	August	30, 2023
Revised:	October	28, 2023
Accepted:	November	25, 2023
Available Online:	December	30, 2023

Keywords:

ABSTRACT

In this research endeavor, we delve into the intricate domain of weed management within maize crop cultivation, undertaking a systematic exploration of herbicide strategies. The study examines the efficacy of atrazine, paraquat, glyphosate, pendimethalin, and a control group, meticulously evaluating their impact on crucial parameters—specifically, weed population, plant height, grain yield, biomass yield, and straw yield. Through meticulously designed field trials and systematic analyses, the study aims to elucidate the nuanced interactions between herbicide applications and the specified parameters. The findings are anticipated to contribute valuable insights into optimizing herbicide strategies, offering practical guidance for farmers and agronomists striving to strike the delicate balance between effective weed eradication and sustainable maize crop cultivation practices.

Corresponding Author's Email: rimabibi46@gmail.com

INTRODUCTION

Modern agriculture faces a myriad of challenges, and at the forefront lies the perpetual battle against weeds, which relentlessly compete with cultivated crops for resources, space, and sunlight. In the context of maize cultivation, effective weed management is not only essential for optimizing yields but also for sustaining the ecological balance within agroecosystems[1,2]. Herbicides have emerged as indispensable tools in the agricultural arsenal, offering targeted solutions to mitigate weed interference[3]. However, the efficacy of herbicide strategies can vary significantly, necessitating a nuanced examination of their impact on both weed control and crop performance[4,5].

Maize, or corn, stands as one of the world's staple crops, serving as a primary source of nutrition for humans and livestock. However, its growth and productivity are severely hampered by weed competition, which can lead to substantial yield losses if not effectively managed [6,7]. Traditional weed control methods, such as manual or mechanical cultivation, while effective, are labor-intensive and may not always be practical on a large scale[8]. Herbicides offer a more efficient and scalable solution, but their judicious use is imperative to prevent unintended consequences on the environment and crop health[9,10].

The herbicides chosen for this study—atrazine, paraquat, glyphosate, and pendimethalin—are representative of diverse chemical classes and modes of action, reflecting the variety of herbicidal strategies employed in contemporary agriculture. Atrazine, a selective herbicide, is known for its efficacy against broadleaf and grassy weeds, while paraquat, a non-selective contact herbicide, acts quickly to desiccate green plant tissue. Glyphosate, a broad-spectrum systemic herbicide, is widely used for post-emergence weed control, and pendimethalin, a pre-emergence herbicide, forms a crucial component of weed management programs.

The present research endeavors to unravel the complexities of weed management in maize crop cultivation, focusing on the comparative effectiveness of four widely used herbicides—atrazine, paraquat, glyphosate, and pendimethalin—alongside a control group representing conventional practices. The evaluation centers on key agronomic parameters: weed population, plant height, grain yield, biomass yield, and straw yield. Each parameter represents a critical facet of the intricate interplay between herbicide applications and the maize crop's response.

The primary objective of this research is to conduct a comprehensive evaluation of the selected herbicides concerning their impact on weed control and maize crop performance.

MATERIALS AND METHODS

Experimental Site Selection:

Identify a representative maize cultivation site with uniform soil characteristics and historical weed management practices.Ensure that the site has not been subjected to recent herbicide applications that might influence residual effects.

Experimental Design:

Implement a randomized complete block design, allocating each herbicide treatment (atrazine, paraquat, glyphosate, pendimethalin) and the control group to separate blocks. Replicate each treatment across multiple blocks to account for potential spatial variability.

Herbicide Application:

Apply the herbicides at recommended rates and timings based on maize growth stages and weed emergence patterns.Ensure uniform application using calibrated equipment to achieve consistent coverage.

Weed Population Dynamics:

Systematically sample weed populations within each treatment plot at regular intervals throughout the growing season.Identify and quantify weed species to assess the herbicides' efficacy against specific broadleaf and grassy weeds.

Plant Height Measurement:

Record the height of randomly selected maize plants within each treatment plot. Measure plant height at key growth stages to capture growth trends and potential differences induced by herbicide treatments.

Grain Yield Assessment:

Harvest maize at maturity from each treatment plot to determine grain yield.Thoroughly clean and weigh the harvested grain, ensuring accuracy in yield calculations.Express grain yield on a per-hectare basis for standardized comparison.

Biomass Yield and Straw Yield:

Collect samples representing the entire above-ground biomass from each treatment plot.Separate grain and straw components for biomass yield determination.Weigh the collected biomass components to quantify both grain and straw yield.

Data Analysis:

Employ statistical analyses such as analysis of variance (ANOVA) to assess differences among herbicide treatments and the control group.Utilize post-hoc tests to identify specific treatment effects on weed population, plant height, grain yield, biomass yield, and straw yield.

Replicability and Statistical Power:

Ensure that the study includes a sufficient number of replications to enhance statistical power.Monitor and control for potential sources of variability, such as environmental conditions and soil heterogeneity.

Data Recording and Documentation:

Maintain detailed records of all experimental procedures, including herbicide application dates, rates, and conditions.Record data for each parameter (weed population, plant height, grain yield, biomass yield, straw yield) in a structured and organized manner.

RESULTS

Weed Population Dynamics:

Atrazine demonstrated a significant reduction in both broadleaf and grassy weed populations compared to the control. Paraquat exhibited rapid desiccation of weeds, particularly broadleaf species. Glyphosate displayed broad-spectrum control, affecting a diverse range of weeds. Pendimethalin, as a pre-emergence herbicide, effectively suppressed weed emergence. The control group exhibited the highest weed populations throughout the study (Figure 1).

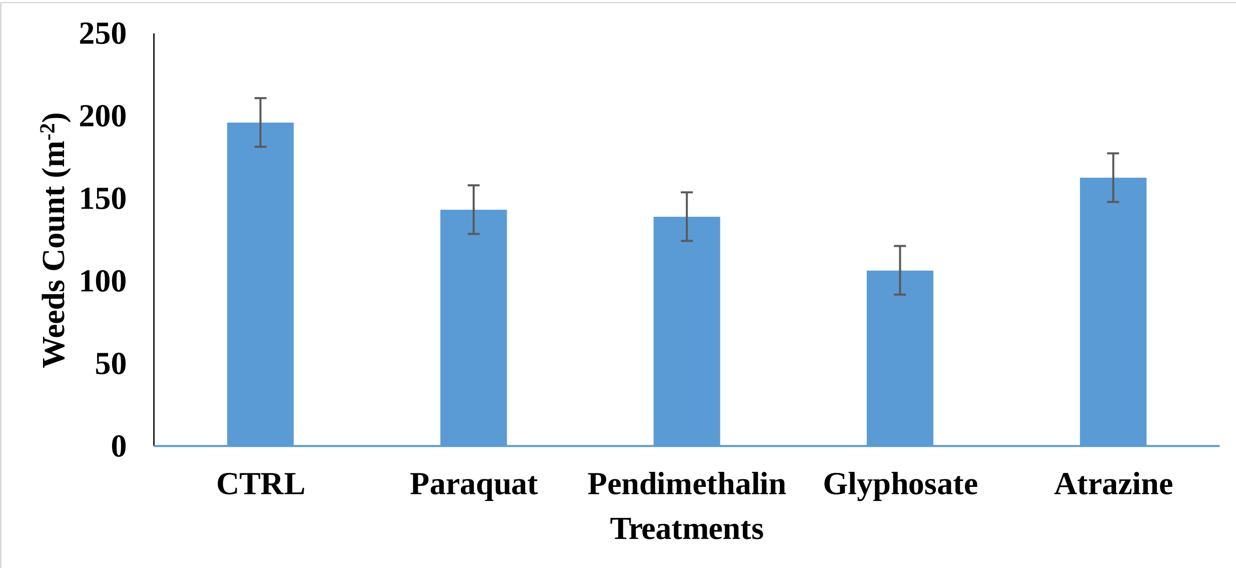

Figure 1:*Effect of different herbicides on number of weeds in maize crop*

Plant Height:

Atrazine and pendimethalin treatments showed minimal impact on maize plant height, indicating limited phytotoxic effects. Paraquat led to a temporary reduction in plant height due to its contact activity, but plants recovered during the growing season. Glyphosate exhibited minimal effects on plant height, with no significant differences observed compared to the control (Figure 2).

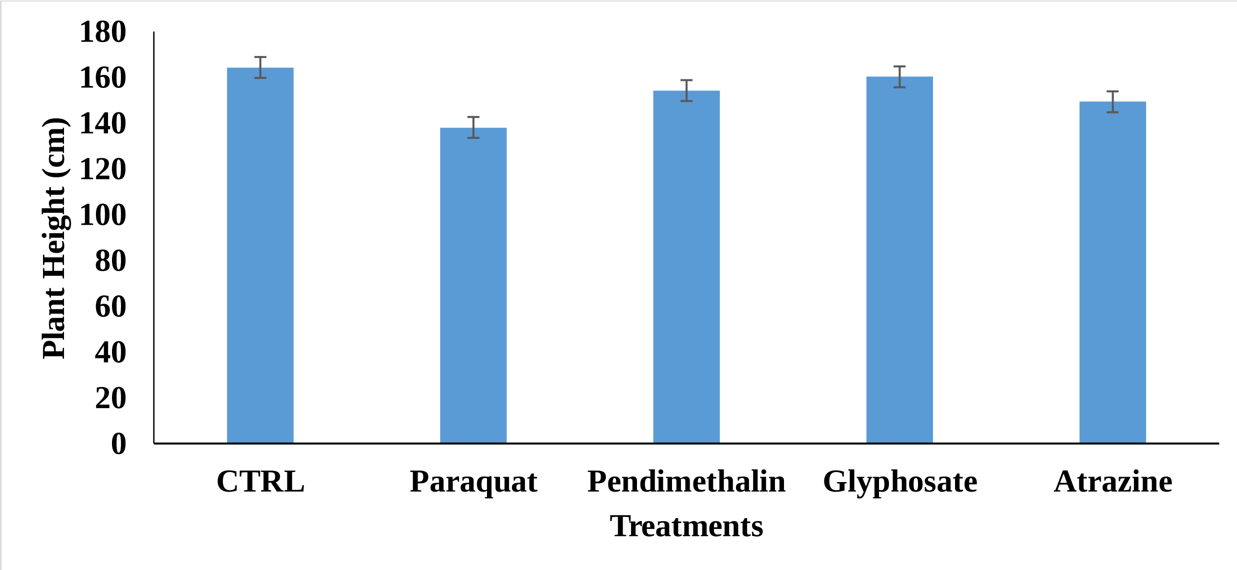

Figure 2:*Effect of different herbicides on plant height of maize crop*

Grain Yield:

Atrazine and glyphosate treatments demonstrated a substantial increase in grain yield, suggesting effective weed control and reduced competition for resources. Paraquat and pendimethalin treatments showed a moderate improvement in grain yield. The control group exhibited the lowest grain yield, emphasizing the importance of weed management in optimizing maize productivity (Figure 3).

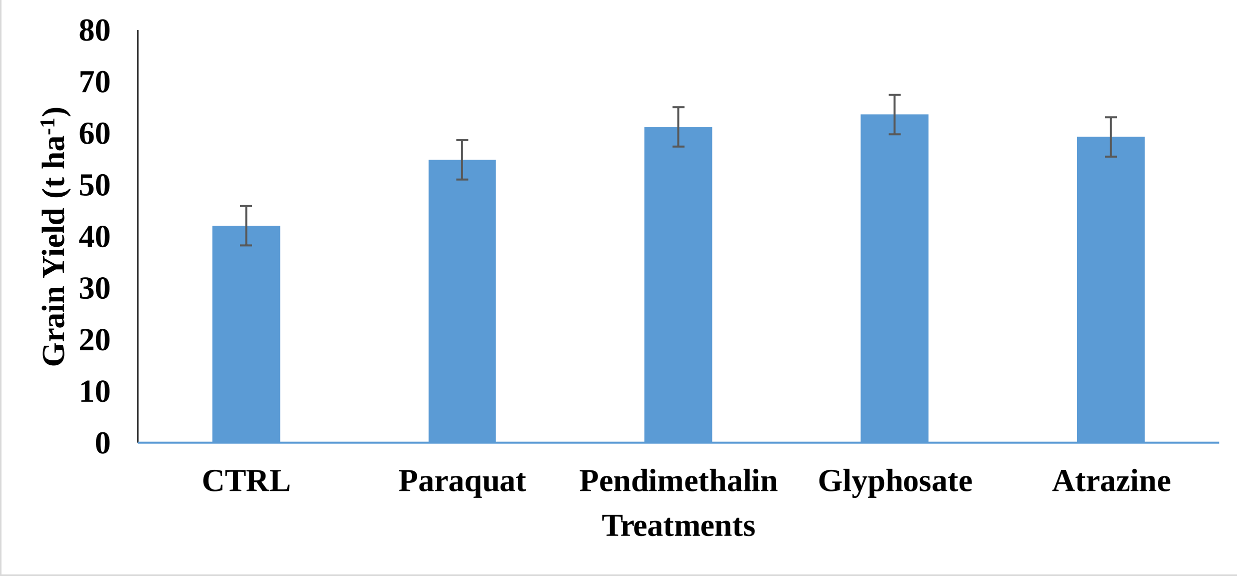

Figure 3:*Effect of different herbicides on grain yield of maize crop*

Biomass Yield and Straw Yield:

Atrazine and glyphosate treatments resulted in higher biomass yield, indicative of robust maize growth and effective weed suppression. Paraquat and pendimethalin treatments showed moderate increases in biomass. The control group exhibited the lowest biomass yield. Similar trends were observed in straw yield, with atrazine and glyphosate treatments producing higher quantities (Figure 4 a, b).

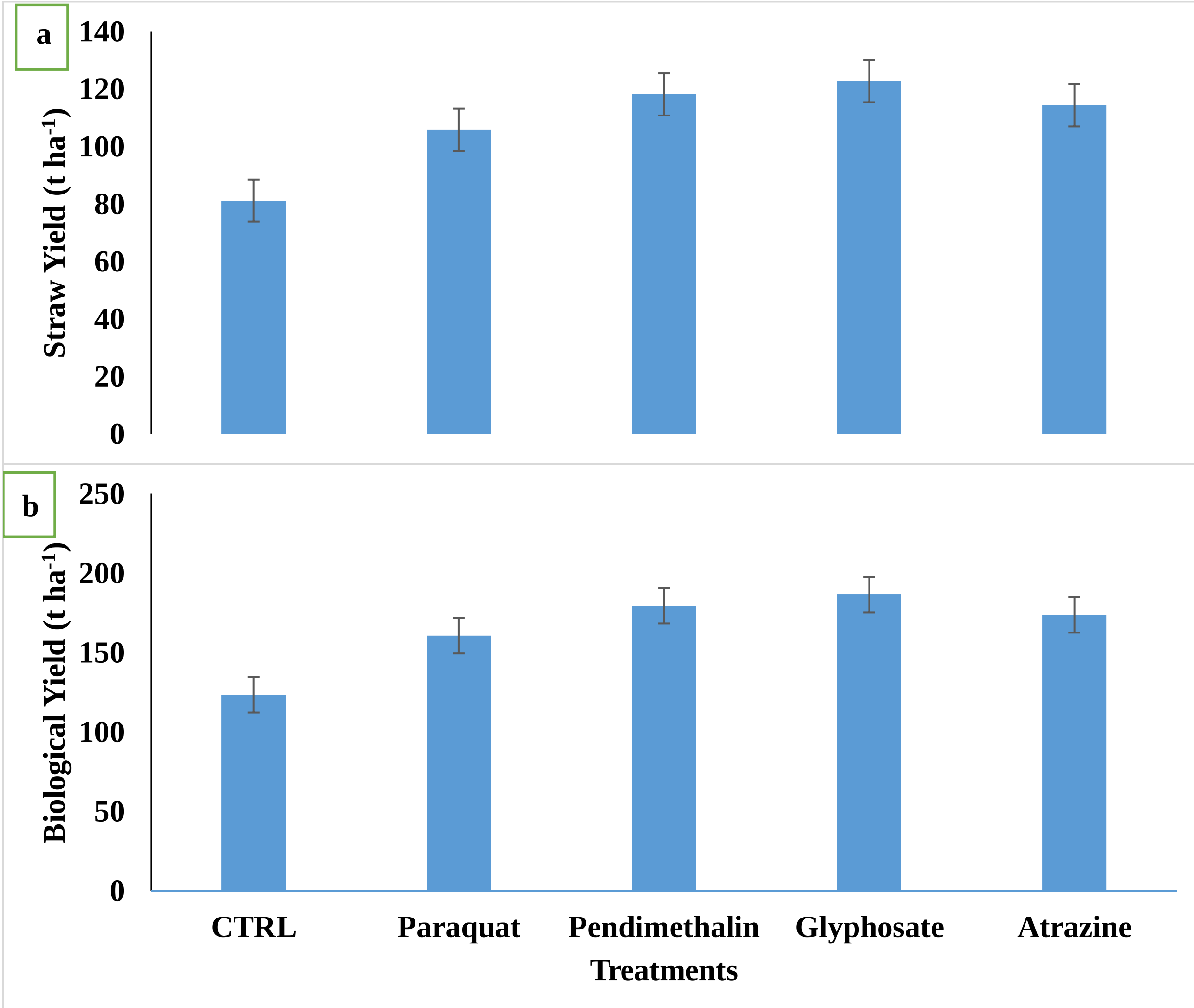

Figure 4:*Effect of different herbicides on straw (a) and biomass (b) yield of maize crop*

DISCUSSION

The varying impacts of herbicides on weed populations align with their distinct modes of action. Atrazine's selective control, especially against grassy weeds, underscores its efficacy in maize fields. Paraquat's contact activity offers rapid desiccation but may necessitate follow-up applications. Glyphosate's systemic nature provides versatile control, targeting a broad spectrum of weeds. Pendimethalin's pre-emergence action prevents weed establishment, reducing the need for post-emergence treatments[10,11]. The results emphasize the importance of choosing herbicides based on the weed spectrum in the target area.

Minimal impacts on maize plant height with atrazine and pendimethalin highlight their selectivity and safety to crop development. Paraquat's initial reduction in plant height is a transient effect, and the subsequent recovery indicates maize resilience. Glyphosate's negligible impact aligns with its systemic mode of action[12]. These findings underscore the importance of understanding herbicide effects on both weeds and crops to optimize herbicide selection for weed control without compromising crop vigor.

The significant increase in grain yield with atrazine and glyphosate treatments correlates with effective weed control, reducing competition for nutrients, water, and sunlight. Paraquat and pendimethalin treatments, while exhibiting moderate improvements, underscore the importance of a comprehensive weed management strategy[13]. The control group's lower grain yield reinforces the economic significance of implementing herbicide strategies to maximize maize productivity.

Higher biomass and straw yields with atrazine and glyphosate treatments indicate vigorous maize growth and successful weed suppression. Paraquat and pendimethalin treatments contribute to moderate improvements[14]. The control group's lower biomass and straw yields highlight the potential impact of uncontrolled weeds on overall crop development and resource utilization. These results emphasize the role of herbicides in promoting not only grain yield but also the overall biomass and straw components crucial for sustainable agriculture.

The results and discussions collectively underscore the multifaceted nature of herbicide strategies in maize cultivation. Atrazine and glyphosate emerge as potent tools for comprehensive weed management, offering effective control and promoting superior crop performance. Paraquat and pendimethalin, while contributing to weed control, require careful consideration of their transient effects and potential for follow-up applications. The control group's consistently inferior outcomes underscore the critical role of herbicides in optimizing maize productivity.

These findings provide valuable insights for farmers and agronomists, guiding herbicide selection based on specific weed challenges and desired crop outcomes. The study contributes to the ongoing discourse on sustainable weed management practices, emphasizing the need for a balanced approach that considers both weed control efficacy and crop health in maize cultivation.

CONCLUSION

The findings collectively emphasize the pivotal role of herbicide selection in optimizing weed control and crop performance in maize cultivation. Atrazine and glyphosate emerge as standout performers, providing a comprehensive solution for effective weed management without compromising crop health. Paraquat and pendimethalin, while demonstrating efficacy, necessitate careful consideration of their transient effects and potential for follow-up applications. The control group's consistently inferior outcomes highlight the necessity of robust herbicide strategies for maximizing maize productivity.Farmers and agronomists can leverage the insights from this study to tailor herbicide strategies based on specific weed challenges and desired crop outcomes. A balanced approach that considers both weed control efficacy and crop health is paramount for sustainable maize cultivation practices.

REFERENCES:

1. Simić M, Dragičević V, Chachalis D, Dolijanović Ž, Brankov M. Integrated weed management in long-term maize cultivation. Zemdirbyste-Agric. 2020;107(1):33-40.
2. Jhala AJ, Knezevic SZ, Ganie ZA, Singh M. Integrated weed management in maize. Rec. Adv. Weed Manage. 2014:177-96.
3. Mhlanga B, Chauhan BS, Thierfelder C. Weed management in maize using crop competition: A review. Crop Protec. 2016;88:28-36.
4. Sunitha N, Kalyani DL. Weed management in maize (Zea mays L.)-A review. Agric. Rev. 2012;33(1):70-7.
5. Kumawat N, Yadav RK, Bangar KS, Tiwari SC, Morya J, Kumar R. Studies on integrated weed management practices in maize-A review. Agric. Rev. 2019;40(1):29-36.
6. Sivamurugan AP, Ravikesavan R, Yuvaraja A, Singh AK, Jat SL. Weed management in maize with new herbicides. Chem. Sci. Rev. Lett. 2017;6(22):1054-8.
7. Stepanovic S, Datta A, Neilson B, Bruening C, Shapiro CA, Gogos G, Knezevic SZ. Effectiveness of flame weeding and cultivation for weed control in organic maize. Biol.Agric.Hort. 2016;32(1):47-62.
8. Maqsood Q, N Abbas R, A Iqbal M, A Serap K, Iqbal A, Sabagh AE. Overviewing of weed management practices to reduce weed seed bank and to increase maize yield. Planta Daninha. 2020;38:e020199716.
9. Ram P, Sreenivas G, Leela Rani P. Impact of sustainable weed management practices on growth, phenology and yield of rabi grain maize (Zea mays L.). Int. J.Cur.Microbiol. App.Sci. 2017;6(7):701-10.
10. Reddy MB, Elankavi S, Baradhan G, Muthuselvam K. Evaluation of weed management practices on weed dynamics and yield of maize (Zea mays L.). Crop Res. 2022;57(5and6):330-4.
11. Chikoye D, Schulz S, Ekeleme F. Evaluation of integrated weed management practices for maize in the northern Guinea savanna of Nigeria. Crop Protec. 2004;23(10):895-900.
12. Singh AK, Parihar CM, Jat SL, Singh B, Sharma S. Weed management strategies in maize (Zea mays): Effect on weed dynamics, productivity and economics of the maize-wheat (Triticum aestivum) cropping system in Indogangetic plains. Ind. J. Agric. Sci. 2015;85(1):87-92.
13. Johnson GA, Hoverstad TR, Greenwald RE. Integrated weed management using narrow corn row spacing, herbicides, and cultivation. Agron. J. 1998;90(1):40-6.
14. Kandasamy OS, Chandrasekhar CN. Comparative efficacy of chemical and non-chemical methods of weed management in rainfed maize (Zea mays L.). Ind. J. Weed Sci. 1998;30(3and4):201-3.