Effect of herbicides mixture on productivity and Profitability of wheat (*Triticum aestivum*L.) cultivation in rainfedsubtropics

ABSTRACT

The effect of herbicide mixtures on the productivity and profitability of wheat (Triticum aestivum L.) cultivation in rainfed subtropics can vary based on several factors, including the specific herbicides used, their application rates, timing, and the local environmental conditions. Wheat (*Triticum aestivum* L.) is second most important staple crop in India after rice. Weeds have emerged as the major biotic stress in wheat. Post-emergence herbicidal combinations are used widely to control the complex weed flora in wheat crops. Over the past decades, micronutrient deficiency has emerged as major constraint in wheat production. Wheat (*Triticum aestivum* L.) is one of the world's major cereal food crops and has a very important role in attaining food security. About 19 percent of the calories and 21 percent of protein needs of human are satisfied by wheat day by day on the planet (Braun et al., 2010). Because of its wide adaptability, it tends to become established under different agro-climatic conditions. It is grown on about 215 million hectares (mha), with an annual production of about 700 million tonnes (mt) of wheat in the world (FAO, 2018). Besides this, the raise prediction of a decline in the cultivated area of wheat in India and China due to climate change (Nelson et al.,2010).

Keywords:herbicides Profitability, wheat, *Triticum aestivum*, cultivation, subtropics

Introduction

Several new herbicides viz., clodinafop, fenoxaprop, sulfosulfuron, carfentrazone, diclofop, pinoxaden and pre-mix sulfosulfuron+metsulfuron, clodinafop+metsulfuron, carfentrazone+sulfosulfuron, clodinafop+metribuzin, fenoxaprop+metribuzin and metsulfuron+carfentrazone have been found very effective in controlling weeds without any residual effect on succeeding crops as well as to prevent development of herbicide resistant weeds in wheat (Chopra et al., 2015; Sharma et al., 2015; Pal et al., 2015).Herbicide mixtures can be effective in controlling a broad spectrum of weeds, which is crucial for wheat cultivation as weeds can compete with the crop for resources. It's important to ensure that the herbicide mixture is safe for wheat and won't harm the crop. Selective herbicides that target

weeds without harming wheat are preferred. Effective weed control generally leads to increased wheat yields. Reduced weed competition allows the wheat plants to utilize nutrients, water, and sunlight more efficiently. Herbicides and their application can incur costs. It's essential to assess the cost-effectiveness of using herbicide mixtures compared to alternative weed control methods. Overreliance on herbicides can lead to weed resistance. Crop rotation and the use of different herbicides can help mitigate this risk. Consider the potential environmental impact of herbicide use, such as runoff into water bodies or harm to non-target species.

The effectiveness of herbicides may vary depending on local climate, soil type, and weed species present. Local research and adaptation are important. Profitability depends on factors like yield increase, cost of herbicides, market prices for wheat, and potential quality improvements in the crop.

To assess the specific impact of herbicide mixtures on wheat cultivation in rainfed subtropics, you should refer to local research studies or conduct your own field trials considering the factors mentioned above. Crop advisors and agricultural extension services can provide guidance tailored to your region's conditions.Proper timing of herbicide application is critical. Application at the right growth stage of both the weeds and the wheat is essential for effective weed control without harming the crop. Different herbicides target different weed species. It's important to understand the predominant weed species in your area to choose the right herbicide mixture. Ensure that the application equipment is calibrated correctly to deliver the right amount of herbicide. Calibration errors can lead to underdosing or overdosing. Consider the persistence of herbicides in the soil. Some herbicides may affect subsequent crops or leach into groundwater, potentially causing environmental issues. Rainfed agriculture is highly dependent on rainfall. Herbicide applications should be timed to coincide with expected rainfall to activate the herbicide and reduce the risk of crop injury. Continuous herbicide use can impact soil health. Regular monitoring and soil testing can help manage soil health issues. Integrated Pest Management (IPM) Herbicide use should be part of an overall IPM strategy that includes other practices like crop rotation, residue management, and use of resistant wheat varieties.

Market Demands: Consider the quality and market demands for wheat in your region. Herbicide use can impact grain quality, so it's essential to align your crop management with market requirements.
Record-Keeping: Keep detailed records of herbicide applications, crop performance, and costs to make informed decisions for future seasons.

Risk Assessment: Evaluate the potential risks associated with herbicide use and have a plan to mitigate them.
Remember that the impact of herbicide mixtures can be highly site-specific, and it's essential to collaborate with local agricultural experts and conduct trials on your specific farm to determine the best herbicide strategies for your rainfed subtropical wheat cultivation.
Crop Variety Selection: Choose wheat varieties that are well-suited to the local environmental conditions, such as heat and drought tolerance, which can enhance productivity in rainfed areas.
Pest Management: Some herbicides may also have activity against certain insect pests. Consider the potential dual benefit of herbicides in managing both weeds and pests.

Herbicide Resistance: Keep an eye on the development of herbicide-resistant weed populations. Implement strategies to prevent and manage herbicide resistance, such as herbicide rotation or tank mixing.
Herbicide Application Technology: Utilize modern application technologies to ensure even and effective coverage of herbicides. This can reduce the risk of uneven weed control.

Government Regulations: Be aware of and comply with local and national regulations regarding herbicide use, safety, and environmental protection.

Training and Safety: Ensure that farmers and farmworkers are properly trained in the safe use of herbicides, including handling, protective equipment, and disposal.
Crop Insurance: Consider crop insurance options to mitigate potential financial losses due to unforeseen circumstances, such as adverse weather conditions or crop failure.

Monitor and Adapt: Regularly monitor the effectiveness of herbicide treatments and be prepared to adapt your strategy if conditions change.

Sustainability: Strive for sustainable farming practices by minimizing the environmental impact of herbicide use and maintaining long-term soil and crop health.

Collaboration: Collaborate with local agricultural organizations, universities, and extension services to stay informed about the latest research and best practices in rainfed subtropical wheat cultivation.

Farm Diversification: Consider diversifying your farm by growing other crops or integrating livestock, which can provide alternative income sources and enhance overall farm resilience.

Economic Analysis: Continuously assess the economic viability of herbicide use and the overall profitability of your wheat cultivation.

The success of wheat cultivation in rainfed subtropics with herbicide mixtures depends on a combination of factors, and it's important to take a holistic and adaptive approach to achieve the best results. Consulting with local experts and staying updated on the latest agricultural research is crucial for making informed decisions.

Soil Conservation: Implement soil conservation practices such as no-till or reduced tillage to improve moisture retention, reduce erosion, and enhance soil health in rainfed areas.
Crop Rotation: Rotate wheat with other crops to break the weed and disease cycle, improve soil fertility, and diversify income sources.
Water Management: Consider water management practices like rainwater harvesting and efficient irrigation systems to optimize water use during dry periods.

Pest and Disease Management: Herbicides may have some impact on pests and diseases. Evaluate their effect on both weed and non-weed pests to optimize pest management strategies.

Herbicide Residue Testing: Regularly test for herbicide residues in your crops to ensure they meet quality and safety standards for human consumption.

Market Access: Explore local and international markets for your wheat, as market access and demand can significantly affect profitability.

Farming Networks: Join local farming networks or cooperatives to share knowledge and resources, which can improve your access to information and support.

Climate Change Adaptation: Be prepared for climate variability by developing strategies to adapt to changing weather patterns and their potential impact on your wheat cultivation.

Research and Innovation: Stay informed about the latest research and innovations in wheat cultivation, including herbicide technology, crop breeding, and sustainable farming practices.

Record and Data Management: Keep comprehensive records of all farming activities, which can help with decision-making and financial planning.

In rainfed subtropical regions, where water availability can be unpredictable, effective weed management and sustainable farming practices are critical for the success of wheat cultivation. Adaptability and continuous learning are key to thriving in such conditions.
Of course, here are a few additional considerations for wheat cultivation in rainfed subtropical regions:

Climate-Resilient Varieties: Select wheat varieties that are adapted to the local climate and are more resilient to drought and heat stress. Early Warning Systems: Stay informed about weather forecasts and early warning systems to make timely decisions regarding irrigation and other crop management practices.

Cover Crops: Consider planting cover crops during fallow periods to prevent soil erosion, improve soil health, and suppress weed growth.

Crop Monitoring: Regularly monitor the health and growth of your wheat crop to identify potential issues early and take corrective actions.
Crop Monitoring: Regularly monitor the health and growth of your wheat crop to identify potential issues early and take corrective actions.

Training and Education: Invest in ongoing training and education for yourself and your workforce to stay updated on best practices and new technologies.

Government Support: Explore government subsidies, grants, or support programs that may be available for rainfed wheat cultivation in your region.

Market Diversification: Diversify your marketing strategies by exploring opportunities for exporting wheat, processing it into value-added products, or participating in local farmer's markets.

Soil Testing: Periodically test your soil to ensure proper nutrient management, which is essential for healthy wheat crops.

Pest Scouting: Regularly scout for pests and diseases in your crop and implement integrated pest management (IPM) strategies to minimize damage.

Risk Management: Develop a comprehensive risk management plan that includes strategies for dealing with adverse weather events, market fluctuations, and other potential challenges.

In rainfed subtropical areas, success in wheat cultivation depends on a combination of factors, including proper management practices, adaptability to changing conditions, and a commitment to sustainable and profitable farming. Continual learning and adaptation are key to long-term success.
Explore the integration of trees and shrubs into your agricultural system to provide shade, windbreaks, and additional income sources. Consider organic or low-input farming practices, which can be suitable for rainfed agriculture while also catering to consumer demand for organic products. Secure access to credit or financial support that can help you invest in necessary resources and infrastructure for your rainfed wheat cultivation. Explore crop insurance options to mitigate the financial risks associated with weather-related crop losses. Conduct thorough market research to understand the demand for wheat and related products in your region and identify niche markets.

Sustainable Practices: Embrace sustainable agricultural practices that reduce the environmental footprint of your farming activities.

Farmer Collaboratives: Consider joining or forming farmer cooperatives or associations to pool resources and negotiate better deals for inputs and crop sales.

Continuous Learning: Attend workshops, seminars, and conferences related to rainfed agriculture and wheat cultivation to stay updated on best practices.

Post-Harvest Handling: Invest in proper post-harvest handling and storage facilities to maintain wheat quality and reduce post-harvest losses.

Community Engagement: Engage with your local community to build support networks, share knowledge, and advocate for policies that benefit rainfed farmers.

Remember that successful wheat cultivation in rainfed subtropical regions often requires a combination of strategies tailored to your specific location, market conditions, and resources. Adaptability and a proactive approach to addressing challenges are essential for long-term success.

All the herbicidal combinations tested under study improve the productivity by improving the growth and yield attributing characters also improved the weed control efficiency WCE (%). Tank mixing of herbicides further lowered the weed index. Any treatment resulting in higher net returns could be evaluated as the best treatment, and in the current study Sulfosulfuron + Metsulfuron(32 gha^{-1}) resulted in highest net returns and benefit cost ratio. Hence, it was adjudged to be the best treatment for control of complex weed flora in wheat than the other treatments.

REFERENCES

Braun, H. J., Atlin, G. and T. Payne.2010. Multi-location testing as a tool to identify plant response to global climate change. In: Reynolds, M.P. (Ed.) Climate Change and Crop Production (pp. 115-138). CABI Climate Change Series, Surrey, UK.

Cakmak, I. and U. B. Kutman.2018. Agronomic bio-fortification of cereals with zinc: a review. Eur. J. Soil Sci.,**69**:172-180.

Chhokar, R. S., Sharma, R. K., Jat, G. R., Pundir, A. K. and M. K. Gathala.2007. Effect of tillage and herbicides on weeds and productivity of wheat under rice–wheat growing system. Crop Protection, **26**: 1689-1696.

Chhokar, R. S., Sharma, R. K. and I. Sharma.2012. Weed management strategies in wheat-A review. J. WheatRes.,**4**: 1-21.

Fageria, N. K., Barbosa Filho, M. P., Moreira, A. and C. M. Guimarães.2009. Foliar fertilization of crop plants. J. Plant Nutr,**32**: 1044-1064.

FAO.2018.FoodandAgricultureorganizationoftheUnitedNations.http://www.fao.org/faostat/en/

Kaur, T., Bhullar, M. S. and U. S. Walia.2015. Bio-efficacy of ready-mix formulation of clodinafop-propargyl +metasulfur on for control of mixed weed flora in wheat. IndianJ.WeedSci.,**47**:121-124.

Kumar,S.,Yadav,R.A.,Pal,V.andS.S.Verma.2014.Bio-efficacy of pinoxaden 5EC in combination with broad leaf herbicides on weed species with relation to economics of wheat (Triticum aestivum L.). Environment & Ecology, **32**:154-158.

M.Habib.2009. Effect of foliar application of Zn and Fe on wheat yield and quality. African J. Biotech.,**8**:6795-6798.

Nelson, G. C., Rosegrant, M. W., Palazzo, A., Gray, I., Ingersoll, C., Robertson, R., Tokgoz, S., Zhu, T., Sulser, T.B., Ringler, C., Msangi.S. and L. You.2010. Food security, farming and climate change to 2050: Scenarios, results, policy options. IFPRI Research Monograph, Washington, DC, IFPRI.

P.Sabeti. 2015. Evaluation the effect of micronutrients on herbicide mixture 2,4-D+MCPA, Bromoxynil +MCPA and Tribenoron-methyl efficacy in wheat (Triticum aestivum). Bio. Forum–An Intern. J., **7**:1855-1858.