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RESEARCH NOTE

Herbicides for knocking down *Sesbania aculeata* for brown manuring

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ABSTRACT

Sesbania aculeata (Willd.) Poir. is an important cover crop often used for improving soil health. The strategy of terminating *Sesbania* as a cover crop is different under conventional tillage and no-till conditions. In no-tillage systems, where mechanical incorporation is not feasible, brown manuring through herbicide application becomes necessary. Field studies were conducted during the 2023 and 2024 *Kharif* seasons to evaluate the effectiveness of various herbicides (glyphosate, glufosinate, paraquat, and 2,4-D ethyl ester) applied alone and in combinations to terminate *S. aculeata*. Studies revealed that 2,4-D ethyl ester (2,4-D-E) 500 g/ha and glufosinate 400 g/ha were highly effective in knocking down *Sesbania* as a brown manure crop and these herbicides provided a 100% reduction in biomass of *Sesbania*. Whereas, glyphosate 1500 g/ha and paraquat 500 g/ha were poor for killing *Sesbania* and these herbicides reduced its biomass only by 67.0 and 46.9%, respectively, compared to untreated control. Economically, 2,4-D-E proved more viable than glufosinate. Additionally, 2,4-D-E can be selectively used to kill *Sesbania* if it is grown as co-culture with Gramineae crops such as rice, maize and sugarcane. This research highlights the suitability of 2,4-D-E and glufosinate for brown manuring of *S. aculeata* in conservation agriculture.

Keywords*:* 2,4-D, Cover crop, Glufosinate, Glyphosate, Paraquat

Sesbania aculeata (Willd.) Poir., a fast-growing leguminous cover crop, plays a crucial role in improving soil fertility and structure through nitrogen fixation and biomass addition. Conventionally, *S. aculeata* is incorporated into soil via tillage to improve the soil physico-chemical properties of the soil. However, under conservation agriculture and no-tillage systems, where physical incorporation is not practiced, chemical termination using herbicides is essential and, in this process, browning of the crop is referred to as brown manuring (Singh *et al.* 2007). *S. aculeata* contains approximately 2.11-3.50% N, 0.25-0.6% P, and 1.20-2.14% K and add to the soil approximately 100-109 kg N/ha when turned down as a cover crop (Kharub *et al.* 2003, Kumar *et al.* 2014, Kurdali *et al.* 2019, Chander *et al.* 2023).

Brown manuring provides several agronomic benefits, including weed suppression, soil conservation, moisture conservation, enhanced microbial activity, sequestration of carbon, biological nitrogen fixation, addition of macro and micro-nutrients to soil, and improved physical, chemical, and biological properties of soil (Biswas and Das 2024, Iliger *et al.* 2017, Singh *et al.* 2007). Studies also reported that brown manuring can reduce the need for nitrogenous fertilizers by up to 25% in crops like rice (Sarangi *et al.* 2016) and increases actinomycetes populations in the rhizosphere (Sharma *et al.* 2017). As a consequence of multifarious benefits of brown manuring, various researchers reported improvement in crop growth, yield and economic return of maize, rice, and sugarcane (Singh *et al.* 2009, Anitha and Mathew 2010, Maity and Mukherjee 2011, Ramachandran *et al.* 2012, Gill and Walia 2013, Gangaiah and Babu 2016, Sarangi *et al.* 2016, Singh *et al.* 2007, Chaudhary *et al.* 2018, Fanish and Ragavan 2020).

Earlier literature indicates high susceptibility of *S. aculeata* to 2,4-D herbicide (Dhyani *et al.* 2009, Singh *et al.* 2009, Singh *et al.* 2007) and this herbicide can be effectively used for knocking down *S. aculeata* coexisting with rice or maize crops (Singh *et al.* 2007, Kumari *et al.* 2020, Behera *et al.* 2019). However, the comparative assessments of 2,4-D with other non-selective herbicides such as paraquat, glyphosate, and glufosinate remain limited, especially under no-tillage. Thus, the present study was conducted with aims to evaluate and compare the efficacy and economics of different herbicides for terminating *S. aculeata* as a brown manure crop.

Field experiments were conducted in the *Kharif* seasons of 2023 and 2024 at ICAR-Indian Institute of Wheat and Barley Research, Karnal, Haryana, India

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(Latitude 29°43'N, Longitude 76°58'E at an elevation of 245m above mean sea level). The *S. aculeata* was sown after wheat harvest using a seed rate of 25 kg/ha at a row spacing of 20 cm with a seed cum fertilizer drill on May 20, 2023, and June 2, 2024, respectively. The plot size was 20 m^2, that is, 10 rows spaced at 20 cm with a length of 10 m. A basal dose of 15.7 kg N and 40 Kg P was applied using diammonium phosphate.

The experiments were conducted in a randomized complete block design (RCBD) with three replicates. The herbicide treatments comprised of: glyphosate 1500 g/ha, paraquat 500 g/ha, glufosinate 400 g/ha, 2,4-D-E 500 g/ha, and their tank-mix combinations along with the untreated control (**Figure 1**). The herbicides were applied at 43-44 days after sowing using flat fan nozzles calibrated to deliver 500 litre/ha of the spray solution. Fresh biomass was sampled from 8 m^2 (1.6 x 5 m) per plot, weighed, and converted to kg/ha. The trend of both the years was similar therefore data were pooled over years and the percentage biomass reduction with various herbicide treatments was computed against the untreated control to identify the most suitable herbicide option. The economics analysis of herbicide treatments was performed based on the prevailing market prices of herbicides to identify the most economical knock down herbicide option.

Effect of herbicides on *Sesbania*

All herbicide treatments caused a significant reduction in the fresh weight of *S. aculeata* compared to the untreated control (**Figure 1**). Compared to the fresh weight of *S. aculeata* in the control, the reductions in fresh weight with the application of glyphosate 1500 g/ha, paraquat 500 g/ha, glufosinate 400 g/ha, and 2,4-D-E 500 g/ha were 67.0, 46.9, 100.0 and 100.0%, respectively. The tank-mix combination of glyphosate and paraquat caused a 69.9% *S. aculeata* fresh biomass reduction. This indicated that paraquat and glyphosate had lesser efficacy against *S. aculeata*. However, 2,4-D-E and glufosinate applied alone or in combination effectively reduced the fresh biomass of *S. aculeata* (**Figure 1**). Previous studies (Dhyani *et al.* 2009, Kumari *et al.* 2020, Behera *et al.* 2019) have also reported the effectiveness of 2,4-D in knocking down *S. aculeata.*

Our study showed the effectiveness of 2,4-D-E and glufosinate in killing *Sesbania.* These herbicides can be used to kill a pure stand of *Sesbania* cover crop (without co-culture with crops) as a brown manure crop. However, when *Sesbania* is grown as a co-culture with monocot crops, such as rice, sugarcane, and maize, 2,4-D is a suitable selective option. However, the advantage of glufosinate over 2,4-D-E is in situation having the infestation of grass weeds along with *Sesbania*, which can also be controlled by glufosinate. The application of 2,4-D-E had the fastest action, and symptoms appeared on the day of spraying. The symptoms of paraquat and glufosinate also appeared quickly compared to glyphosate. The combination of 2,4-D with glyphosate, paraquat, or glufosinate can be used to kill *Sesbania* cover crop, along with grass weeds. Both 2,4-D-E and glufosinate are effective in knocking down *S. aculeata*; however, 2,4-D-E is cost-effective (**Figure 2**). The herbicidal cost for 2,4-D-E and glufosinate was Rs 500/ha and Rs 2533/ ha, respectively.

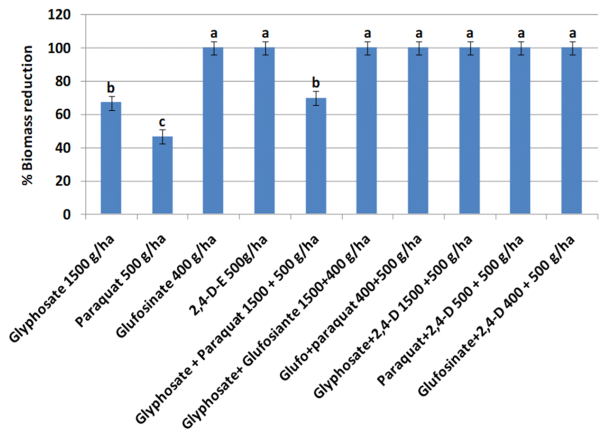

Figure 1. *Sesbania aculeata* fresh weight reduction with various herbicides applied alone and in combinations. Vertical bars represent ± LSD (p=0.05)

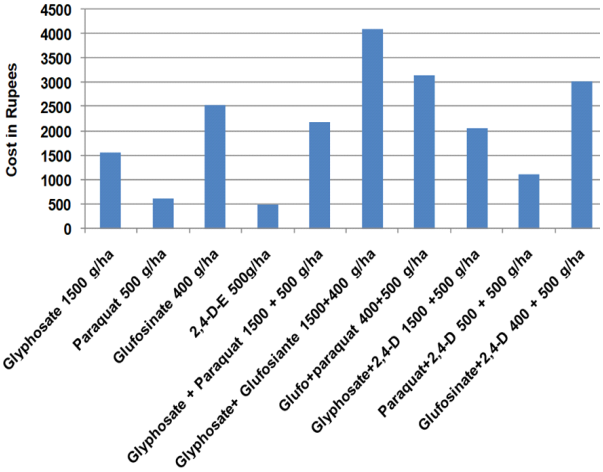

Figure 2. Comparative cost of various herbicidal treatments against *Sesbania aculeata*

Based on the present study, it can be concluded that both 2,4-D and glufosinate are highly effective for knocking down *Sesbania* as a brown manure crop. However, 2,4-D-E application is economical compared to glufosinate and can be selectively applied in co-culture cropping systems with monocot crops. Integration of brown manuring offers a promising, cost-effective strategy for sustainable agriculture under conservation tillage.

REFERENCES

Anitha S and Mathew J. 2010. In situ green manuring with dhaincha (*Sesbania aculeata* Pers.): A cost-effective management alternative for wet seeded rice (*Oryza sativa* L.). *Journal of Tropical Agriculture* **48**: 34–39.

Behera B, Das TK, Ghosh S, Parsad R and Rathi N. 2019. Effects of brown manure species, seed rate and time of application of 2,4-D on weed control efficiency, productivity and profitability in maize. *Indian Journal of Weed Science* **51**(4): 393–397.

Biswas S and Das R. 2024. Brown manuring-An eco-friendly approach towards sustainability in agriculture: A review. *Agricultural Reviews* **45**(3): 495–501.

Chander S, Tripathi SC, Venkatesh K, Kumar N, Meena RP, Chhokar RS, Kamboj N and Kumar N. 2023. Sustainability assessment of rice-wheat system through organic fertilizers and green manuring in sub-tropical humid climate. *International Journal of Plant Production* **17**: 219–234.

Chaudhary SK, Marahatta S and Chaudhary M. 2018. Performance of dry direct seeded rice and weeds on sesbania brown manuring as compared to farmers' practice and chemical control method. *International Journal of Applied Sciences and Biotechnology* **6**(3): 265–269.

Dhyani VC, Singh VP, Singh SP, Kumar A and Tripathi Neeta. 2009. Impact of *Sesbania* brown manuring on weeds and performance of direct seeded rice. *Indian Journal of Weed Science* **41**(3&4): 157–159.

Fanish SA and Ragavan T. 2020. Enhancing productivity of sugarcane by successful weed management through integration of brown manuring of *Sesbania* and pre and post emergence herbicides. *International Journal of Chemical Studies* **8**(3): 2076–2080.

Gangaiah B and Babu MBBP. 2016. Brown manuring as a tool of weed management and contributor to nitrogen nutrition of direct wet seeded rice. *Oryza* **53**(4): 415–421.

Gill JS and Walia SS. 2013. Effect of establishment methods and nitrogen levels on basmati rice. *Indian Journal of Agronomy* **58**(4): 506–511.

Iliger MD, Sutar R, Chogatapur SV and Parameshwarareddy R. 2017. Effect of brown manuring on soil properties, weed density, grain yield and economics of different crops. *Advances in Research* **12**(6): 1–11.

Kharub AS, Chauhan DS, Sharma RK, Chhokar RS and Tripathi SC. 2003. Diversification of rice *(Oryza sativa)* -wheat *(Triticum aestivum)* system for improving soil fertility and productivity. *Indian Journal of Agronomy* **48**(3): 149–152.

Kumar R, Mahajan G, Srivastava S and Sinha A. 2014. Green manuring: A boon for sustainable agriculture and pest management- A review. *Agricultural Reviews* **35**(3): 196–206.

Kumari Sneha, Kaur Tarundeep and Bhullar MS. 2020. Integrated weed management with brown manuring and herbicides in dry-seeded rice. *Indian Journal of Weed Science* **52**(3): 276–279.

Kurdali F, Al-Chammaa M and Al-Ain F. 2019. Growth and N_2 fixation in saline and/or water stressed *Sesbania aculeata* plants in response to silicon application. *Silicon* **11**(2): 781–-788.

Maity SK and Mukherjee PK. 2011. Effect of brown manuring on grain yield and nutrient use efficiency in dry direct seeded kharif rice (*Oryza sativa* L.). *Indian Journal of Weed Science* **43**(1&2): 61–66.

Ramachandran A, Veeramani A and Prema P. 2012. Effect of brown manuring on weed growth, yield and economics of irrigated maize. *Indian Journal of Weed Science* **44**(3): 204–206.

Sarangi DR, Sahoo TR, Sethy S, Chourasia M, Prasad SM, Mohanta RK and Sadangi BN. 2016. Effect of replacing a part of nitrogenous fertilizer by brown manuring in direct seeded rice: A field study. *Oryza*- An International Journal on Rice. **53**(2): 226–228.

Sharma A, Kachroo D, Puniya R, Ram H, Joshi D, Soni PG, Yadav T and Yadav MR. 2017. Impact of different transplanting dates and nutrient sources on soil microbial population and grain yield of basmati rice (*Oryza sativa* L.) grown under SRI. *International Journal of Current Microbiology and Applied Science* **6**(3): 778–782.

Singh S, Chhokar RS, Gopal R, Ladha JK, Kumar V and Singh M. 2009. Integrated weed man-agement : A key to success for direct-seeded rice inthe Indo-Gangetic plains. *In :"Integrated Crop and Resource Management in the Rice-Wheat System of South Asia"* (JK Ladha, Y Singh, O Erenstein, and B Hardy, Eds.), pp. 261–278. International Rice Research Institute, Los Banos, Philippines.

Singh S, Ladha JK, Gupta RK, Bhushan L. and Rao AN, Shiva Prasad B and Singh RP. 2007. Evaluation of mulching, intercropping with *Sesbania* and herbicide use for weed management in dry- seeded rice (*Oryza sativa*). *Crop Protection*. **26**(4): 518–524.