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MANAGEMENT OF NOXIOUS WEED *Cyperus rotundus* IN PEARLMILLET UNDER SEMI-ARID REGION OF RAJASTHAN INDIA

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ABSTRACT

A field experiment was conducted during *Kharif* season for three consecutive years from 2017 to 2019 under Rashtriya Krishi Vikas Yojna (RKVY) project to assess the suitability and efficacy of post-emergence application (PoE) of different herbicides in managing *Cyperus rotundus* in Pearlmillet crop. The research trial was conducted at the identified hot spots on the farmer's fields of IIIA zone of Rajasthan where there was heavy infestation of *Cyperus rotundus* in Pearlmillet crop. The seven treatments *viz.* T_0: Weedy check, T_1: Deep summer ploughing, T_2: T1+ 2,4 D @2.0 Kg/ha +Sugar (2%) as PoE , T_3: T1+Tembotrione @100 gm a.i/ha as PoE, T_4: T1+Metribuzin@ 0.75 Kg a.i/ha as PoE, T_5:T1+Fenoxaprop-p-ethyl@ 0.75 kg a.i/ha as PoE, T_6 : Weed free were tested in randomized block design with four replications. Results showed that after weed free, deep summer ploughing followed by the application of Tembotrione @ 100 g a.i/ha as post-emergence significantly managed *Cyperus rotundus* over other treatments during *Kharif*, 2017, 2018 and 2019. Highest grain yield and stover yield were observed in weed free, which was found at par with Tembotrione @ 100 ga.i/ha during all the years. Maximum net returns is fetched under the treatment Tembotrione @ 100g a.i./ha as post-emergence.

Keywords: Herbicides, Deep summer ploughing, Pearlmillet, *Cyperus rotundus*, Tembotrione.

Introduction

Pearl millet (*Pennisetum glaucum* L.) is an important cereal crop cultivated extensively in the arid and semi-arid regions of Rajasthan. It is valued for its ability to withstand drought, high temperatures, and poor soil fertility, making it an indispensable crop for food, fodder, and nutritional security under rainfed farming systems. India is the world's largest producer of pearl millet, with Rajasthan, Gujarat, Haryana, Maharashtra, and Uttar Pradesh accounting for the major share of its cultivation. Despite its adaptability, the productivity of pearl millet remains low due to several biotic and abiotic constraints, among which weed infestation is one of the most important yield-limiting factors. Weeds compete aggressively with the crop for nutrients, moisture, light, and space, particularly during the early stages of crop growth, resulting in significant reductions in grain and fodder yields.

Among the weed flora associated with pearl millet, *Cyperus rotundus* L. (purple nutsedge) is regarded as one of the world's most troublesome perennial weeds. It propagates primarily through underground rhizomes and tubers, enabling rapid multiplication and persistence in cultivated fields. The extensive underground tuber network allows the weed to regenerate even after repeated tillage or mechanical removal, making its management extremely difficult. In pearl millet, control of *C. rotundus* is particularly challenging because both the crop and the weed belong to the monocot group, limiting the availability of selective post-emergence herbicides.

Several researchers have highlighted the magnitude of weed competition in pearl millet.

Chaudhary *et al.* (2018) reviewed weed management practices in pearl millet and concluded that the crop is highly susceptible to weed competition because of its slow initial growth and wider row spacing. Their review emphasized that integrating pre-emergence herbicides with one timely manual or mechanical weeding provides more effective and sustainable weed control than relying on a single method. The authors also identified the need for developing suitable post-emergence herbicide options, particularly for difficult-to-control weeds such as *Cyperus rotundus*.

A comprehensive review by Dubey et al. (2023) reported that weeds can reduce millet yields by 15–97%, depending on crop species, weed density, and environmental conditions. The authors emphasized that the critical period of crop–weed competition generally occurs during the first 15–42 days after sowing and recommended integrated weed management involving cultural, mechanical, and chemical methods for sustainable weed suppression. They further stressed that herbicide use alone cannot provide long-term weed management and should be integrated with agronomic practices.

Raj *et al.* (2018), while reviewing invasive weed management research in India, described *C. rotundus* as one of the most difficult perennial weeds because of its prolific vegetative propagation and remarkable regenerative ability. They emphasized that sustainable management requires integrated approaches combining preventive, cultural, mechanical, and chemical control measures to reduce both above-ground growth and underground propagules.

Although considerable research has been conducted on weed management in pearl millet, information on the effective and economical management of *Cyperus rotundus* under diverse agro-ecological conditions remains limited. The increasing prevalence of this weed, coupled with the scarcity of selective herbicides and rising labour costs, necessitates the evaluation of integrated weed management strategies that can effectively suppress *C. rotundus* while ensuring higher crop productivity and profitability.

Keeping these facts in view, a study was undertaken at farmer's fields under Rashtriya Krishi Vikas Yojna (RKVY) project under the supervision of Rajasthan Agricultural Research Institute, Durgapura, Jaipur, to evaluate different weed management practices for effective suppression of *Cyperus rotundus*, improvement in crop growth and yield, and enhancement of economic returns under pearl millet cultivation.

Materials and Methods

The experiment was conducted for three consecutive years during *Kharif* seasons from 2017 to 2019 at the identified hot spots on the farmer's fields of IIIA zone of Rajasthan where there was heavy infestation of *Cyperus rotundus* in pearlmillet crop. This region falls under Agro-climatic zone IIIa (Semi-arid eastern plain zone) of Rajasthan.

The treatment consisted of seven treatments *viz.* T_0: Weedy check, T_1: Deep summer ploughing, T_2: T1+ 2,4 D @2.0 Kg/ha +Sugar (2%) as POE , T_3: T1+Tembotrione @100 gm a.i/ha as PoE, T_4: T1+ Metribuzin @ 0.75 Kg a.i/ha as PoE, T_5:T1+Fenoxaprop-p-ethyl@ 0.75 kg a.i/ha as PoE, T_6 : Weed free. They were replicated four times in Randomized Block Design. Pearlmillet seed was sown in rows at 45 cm apart with an inter-plant spacing of 15 cm. Recommended package of practices of the zone was adopted for crop production. Metribuzin, Tembotrione and Fenoxaprop-p-ethyl were sprayed at 15-20 DAS with a knapsack sprayer with flat-fan nozzle. Density of *Cyperus rotundus* was taken at 30 DAS from five random spots in each plot by counting the number of weeds per quadrate of 0.25 m^2 and the average was computed. The grain yield of each net plot was recorded in kg $plot^{-1}$ after cleaning the threshed produce and was converted as q ha^{-1}. Straw yield was obtained by subtracting the grain yield (q ha^{-1}) from biological yield (q ha^{-1}). Weed control efficiency (WCE) was worked out by taking weed biomass into considerationat 30 DAS. It was calculated by using the following formula. The formula was suggested by Mani *et al.* (1973).

$$\mathrm{WCE}\,(\%) = \frac{\begin{array}{c}\text{Weed dry matter in weedy check plot}\\ \text{- Weed dry matter in treated plot}\end{array}}{\text{Weed dry matter in weedy check plot}} \times 100$$

Weed index is a derived parameter from the crop yields obtained across the treatments of weed control researches (Gill and Vijaykumar, 1969). It is a measure of the crop yield loss accrued across treatments in comparison to a weed free plot adopted in an experiment. Following formula was used in calculating weed index:-

$$\text{Weed Index} = \frac{\begin{array}{c}\text{Crop yield in weed free plots}\\ \text{- Crop yield in the treated plot}\end{array}}{\text{Crop yield in weed free plots}} \times 100$$

In order to evaluate the effectiveness of different treatments and ascertain the most remunerative treatment, total expenses incurred on cultural operations from preparatory tillage to harvesting including additional treatment cost for each treatment were computed and subtracted from the respective gross income to workout net monetary returns ha^{-1}. Gross income was computed taking prevailing market prices of the commodities. Thus, net return was computed as:

Net return = Gross return – Cost of total inputs
(Rs/ha) (Rs/ha)

B:C ratio was calculated for each treatment by dividing net return with cost.The experimental data were analyzed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of overall difference among treatments by the F test and conclusions were drawn at 5% probability level.

Results and Discussion

Effect of herbicides on the weed *Cyperus rotundus*

The results indicated that after weed free, deep summer ploughing followed by Tembotrione @ 100 g a.i/ha as post-emergence significantly managed *Cyperus rotundus* over other treatments at 30 DAS during *Kharif*, 2017, 2018 and 2019. Among different herbicides, maximum Weed Control efficiency (WCE) of 82.03 % was observed in deep summer ploughing followed by Tembotrione @ 100 g a.i/ha as post-emergence, followed by deep summer ploughing followed by Metribuzin @ 0.75 kg a.i/ha as post-emergence (68.86 %) and deep summer ploughing followed by Fenoxaprop-p-ethyl@ 0.75 kg a.i/ha as post-emergence (65.96 %). Minimum Weed Index (WI) of 5.38 was found in deep summer ploughing followed by Tembotrione @ 100 g a.i/ha as post-emergence whereas maximum WI of 34.76 was observed in Weedy check. Comparable reductions in weed density and biomass, together with increased weed-control efficiency and a lower weed index, have been reported following the post-emergence application of tembotrione in maize (Yadav *et al.*, 2018; Kaur *et al.*, 2018; Sharma *et al.*, 2018). The efficacy of tembotrione may vary with its application rate, use of adjuvants and composition of the prevailing weed flora. Pandian *et al.* (2020) also reported considerable genotypic variation in the response of sorghum to tembotrione, indicating that crop tolerance depends on the sorghum genotype and herbicide dose. These findings are in conformity with those reported by Singh *et al*. (2012), Rani *et al*. (2021) and Gharsiram *et al.* (2022) in maize crop.

Table 1: Management of *Cyperus rotundus* (Motha) in Pearlmillet (*Kharif*, 2017, 2018 and 2019)

S.N	Treatments	Weed density (Motha) at 30 DAS (No./m^2)				WCE at 30 DAS (Mean)	WI (Mean basis)
		2017	2018	2019	Mean		
T0	Weedy Check	57.25	49.43	63.43	56.70	0	34.76
T1	Deep Summer Ploughing	45.00	43.08	50.85	46.31	18.33	31.09
T2	T1+ 2,4 D @2.0 Kg/ha +Sugar(2%) as POE	20.75	19.22	23.72	21.23	62.56	19.93
T3	T1+Tembotrione @100 gm a.i/ha as PoE	11.50	8.31	10.75	10.19	82.03	5.38
T4	T1+Metribuzin@ 0.75 Kg a.i/ha as PoE	17.75	16.86	18.36	17.66	68.86	14.19
T5	T1+Fenoxaprop-p-ethyl@ 0.75 kg a.i/ha as PoE	18.50	17.57	21.83	19.30	65.96	20.07
T6	Weed free	2.50	1.33	0.00	1.28	97.75	0.00
	SEM±	1.31	1.29	2.32			
	CD at 5%	3.93	3.83	6.91			
	CV (%)	10.47	11.56	17.21			

Effect of herbicides on yield of Pearlmillet crop

The results indicated that maximum grain and strover yield were observed in weed free, which was found at par with deep summer ploughing followed by Tembotrione @ 100 g a.i/ha as post-emergence during all the three years.. Minimum grain and strover yield were observed in weedy check. This yield improvement may be attributed to the effective suppression of *Cyperus rotundus*, which reduced crop–weed competition and consequently improved the availability of moisture, nutrients, light and space to the crop. Comparable improvements in crop yield following the post-emergence application of tembotrione have also been reported in maize (Yadav *et al.* 2018; Kaur *et al.* 2018). Similarly, Sharma *et al.* (2018) recorded reduced weed density and dry matter, accompanied by increased grain and stover yields, under tembotrione-based weed-management treatments. These findings are in conformity with those reported by Bhagat *et al.* (2019) and Kakade *et al.* (2020) in maize.

Table 3: Effect of herbicides on yield of Sorghum (*Kharif*, 2018, 2019 and 2020)

S.N	Treatments	Grain Yield (q/ha)				Stover Yield (q/ha)			
		2017	2018	2019	Mean	2017	2018	2019	Mean
T0	Weedy Check	19.43	18.69	16.83	18.32	41.00	38.42	39.37	39.59
T1	Deep Summer Ploughing	20.55	19.16	18.33	19.35	42.50	41.32	40.23	41.35
T2	T1+ 2,4 D @2.0 Kg/ha +Sugar (2%) as POE	24.10	22.13	21.22	22.48	45.25	44.18	42.62	44.02
T3	T1+Tembotrione @100 gm a.i/ha as PoE	28.80	26.24	24.66	26.57	48.25	45.46	47.75	47.15
T4	T1+Metribuzin@ 0.75 Kg a.i/ha as PoE	26.50	23.33	22.45	24.09	46.50	44.18	45.65	45.44
T5	T1+Fenoxaprop-p-ethyl@ 0.75 kg a.i/ha as PoE	24.88	22.02	20.42	22.44	46.00	43.83	47.04	45.62
T6	Weed free	29.95	27.43	26.85	28.08	49.50	47.06	51.75	49.44
	SEM±	1.01	0.92	1.30		2.16	1.80	1.49	
	CD at 5%	2.99	2.72	3.86		6.42	5.34	4.41	
	CV (%)	8.18	8.06	12.08		9.48	8.26	10.11	

Effect of herbicides on Economics of Pearlmillet crop

Maximum net returns of 42149 Rs./ha was found in deep summer ploughing followed by Tembotrione @ 100 g a.i/ha as post-emergence followed by Weed free (39885 Rs./ha) and deep summer ploughing followed by Metribuzin@ 0.75 Kg a.i/ha as PoE (37798 Rs./ha) Minimum net returns of 20483 Rs./ha was found in deep summer ploughing followed by Fenoxaprop-p-ethyl@ 0.75 kg a.i/ha as PoE. Highest Benefit: Cost ratio of 2.06 was obtained in deep summer ploughing followed by Tembotrione @ 100 g a.i/ha as post-emergence while minimum is obtained in deep summer ploughing followed by Fenoxaprop-p-ethyl @ 0.75 kg a.i/ha as PoE (0.61).The greater net return obtained with tembotrione, despite the weed-free treatment producing the maximum yield, was probably due to effective weed suppression combined with a lower cost of weed management, as maintenance of weed-free conditions required additional expenditure on manual weeding. Comparable economic advantages of tembotrione-based weed management over untreated or less effective treatments have been reported in maize (Kaur *et al.* 2018; Sharma *et al.* 2018). These findings are also in conformity with those reported by Pant *et al.* (2022) in maize.

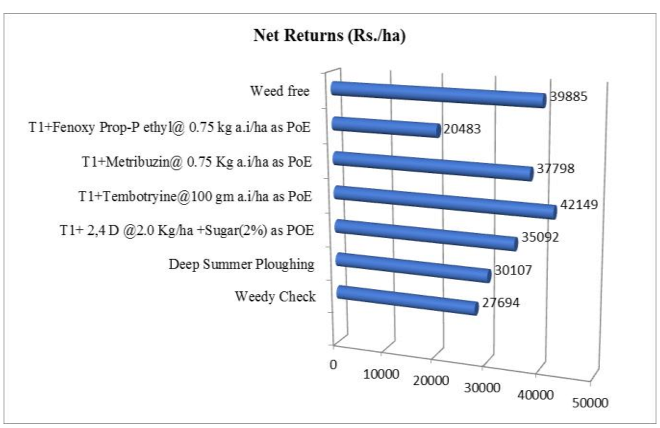

Fig. 1 : Effect of herbicides on Net Return(Rs./ha)

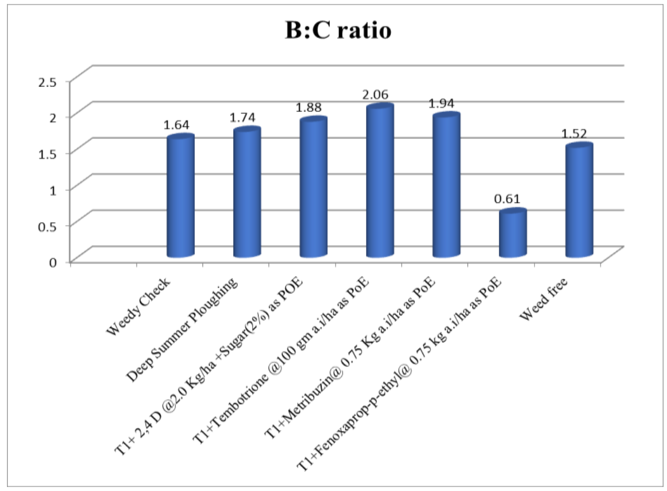

Fig. 2: Effect of herbicides on B:C ratio

Conclusion

From the above results, it can be concluded that for the management of the noxious weed *Cyperus rotundus (Motha)* in Pearlmillet crop, deep summer ploughing followed by Tembotrione @ 100 g a.i/ha as post-emergence is the most effective weed management practice, which gives the maximum yield and net returns.

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