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Influence of Weed Management on Weed Dynamics and Nutrient Assimilation by Weeds in Dill (*Anethum graveolens* L.)

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ABSTRACT

Dill (*Anethum graveolens* L.) is a minor aromatic seed spice crop grown on residual soil moisture. Since it's a long duration crop (140-150 days), weed menace is a major problem in it, keeping this in view, a research experiment was conducted during *rabi* 2020-21 & 2021-22 at MPUAT, Udaipur. The experiment consisted of thirteen treatments that were applied to dill in a three replication randomized block design (RBD). Among the herbicidal weed management treatments, post-emergence (15 DAS) application of oxadiargyl 75 g ha^{-1} PE *fb* HW at 40 DAS resulted in the lowest weed density and dry matter of grassy and broadleaved weeds with maximum weed control efficiency at harvest during both experimental years. Further, this treatment recorded lower nutrient uptake by weeds.

Key word: *Weed management, Nutrient assimilation*

Introduction

Dill is predominantly cultivated in countries like India, Romania, Iran, Germany and Hungary with significant commercial production in Indian states such as Gujarat, Maharashtra, Andhra Pradesh, Rajasthan and Madhya Pradesh (Lal *et al*., 2023). Dill seeds are nutrient-rich containing vitamins A, C, B_2, B_3 and B_9 and minerals like Cu, K, Ca, Mn, Fe, and Mg (Fatima *et al*., 2020). They are widely used to flavour sauces, vinegar, pastries and soups and possess medicinal properties, including diuretic, antispasmodic and galactagogue effects. However, dill seeds exhibit delayed germination and slow initial growth, particularly when broadcast sown on marginal land, leading to significant weed challenges during early growth stages (Pickett & Zheljazkov, 2016). Weeds compete with dill for essential resources, impeding growth and reducing yield and quality. Effective weed management is critical for optimizing crop productivity and quality. Pre-emergence herbicides can reduce weed germination but are insufficient for complete control. Post-emergence herbicides, inter-culturing and hand weeding are necessary to manage weeds during early growth (Patel *et al*., 2019). Integrating chemical and mechanical weed control methods may offer a more effective strategy.

Research on weed management in dill (Anethum graveolens L.) is limited, particularly regarding weed dynamics and nutrient competition. Most studies focus on major crops, leaving gaps in understanding how weeds affect dill growth and nutrient uptake. This study addresses these gaps by evaluating the impact of different weed management practices on weed dynamics and nutrient assimilation, providing insights for more effective and sustainable control strategies in dill cultivation.

Material and Methods

An experiment was conducted at the agronomy farm of Rajasthan College of Agriculture, MPUAT Udaipur, Rajasthan, India, during the *rabi* seasons of 2020-2021 and 2021-2022. The site is situated at an altitude of 581.13 meters above sea level, with geographical coordinates of 24°35′N latitude and 74°42′E longitude. It falls within the agro-climatic zone IVa of Rajasthan, characterized by the Sub-Humid Southern Plain and Aravalli Hills. The experimental field's soil was sandy clay loam, non-saline and slightly alkaline with a pH of 8.05. It contained medium levels of available nitrogen (318.64 kg ha{^{1}), organic carbon (0.56%), and phosphorus (25.11 kg ha{^{1}), along with high levels of available potassium (465.55 kg ha{^{1}). Udaipur experiences typical winters, moderate summers and an average annual rainfall of 637 mm, primarily received from June to September during the *Kharif* season. This study evaluated the effects of various weed management strategies on both weeds and the dill crop. The experiment included thirteen treatments: pendimethalin 1000 g ha^{-1} PE (T_1), pendimethalin 750 g ha^{-1} PE *fb* HW at 40 DAS(T_2), pendimethalin 750 g ha^{-1} PE quizalofop ethyl 40 g ha^{-1} PoE(T_3), oxadiargyl 100 g ha^{-1} PE(T_4), oxadiargyl 75 g ha^{-1} PE *fb* HW at 40 DAS(T_5), oxadiargyl 75 g ha^{-1} PE *fb* quizalofop ethyl 40 g ha^{-1} PoE(T_6), oxadiargyl 50 g ha^{-1} PoE(T_7), oxyfluorfen 100 g ha^{-1} PE(T_8), oxyfluorfen 75 g ha^{-1} PE *fb* HW at 40 DAS(T_9), oxyfluorfen 75 g ha^{-1} PE *fb* quizalofop ethyl 40 g ha^{-1} PoE(T_{10}), IC *fb* HW at 20 & 40 DAS(T_{11}), oxadiargyl 50 g ha^{-1} + propaquizafop 50 g ha^{-1} PoE(T_{12}) and weedy check(T_{13}). These treatments were arranged in a randomized block design with three replications. Dill variety 'Ajmer Sowa-1' was sown at a seed rate of 3 kg ha^{-1}. Herbicidal treatments were applied using a knapsack sprayer equipped with a flat fan nozzle with a water carrier volume of 500 L ha{^{1}. Pre-emergence herbicides were applied one day after sowing and post-emergence herbicides were applied 15 days after sowing. No weeding was performed in the weedy check plot. Standard agronomic practices were adhered to throughout the experiment. Weed density and dry matter were recorded using a 0.5 × 0.5 m^2 quadrat at two locations within each plot. Weed control efficiency along with nitrogen, phosphorus and potassium content, were determined using standard analytical methods. The data was subjected to statistical analysis at 5% significance level as per the guidelines outlined by (Gomez & Gomez, 1984)

Results and Discussion

Major Weed Flora

Dill crop was primarily infested with complex weed flora that comprised *Phalaris minor*, *Chenopodium album*, *Chenopodium murale*, *Fumaria parviflora*, *Melilotus indica*, *Convolvulus arvensis* and *Malva parviflora*. Similar findings were reported by (Malunjkar *et al*., 2022; Punia and Tehlan, 2017). At harvest, the treatment with oxadiargyl 75 g ha{^{1} PE followed by hand weeding at 40 DAS demonstrated the lowest weed density and dry matter accumulation for total weeds. This treatment was followed closely by inter-culturing followed by hand weeding at 20 and 40 DAS. The highest weed control efficiency was also recorded for the oxadiargyl 75 g ha{^{1} PE followed by hand weeding at 40 DAS (Table 1). This might be due to the action of broad-spectrum herbicide oxadiargyl primarily utilized as a pre-emergence treatment effectively manages both early and late weed flushes up to the most critical phase of crop-weed competition. This is attributed to its persistence and extended residual activity in the soil. Hand weeding at 40 DAS further controls late-emerging weeds, resulting in superior weed management compared to treatments relying solely on pre or post-emergence herbicides. Similar findings regarding the efficacy of integrating herbicide application with manual weeding at 40 DAS have been reported in fenugreek by (Malunjkar *et al*., 2022) and (Choudhary *et al*., 2021) in fennel.

Nutrient uptake by weeds

All weed-control treatments significantly reduced the uptake of N, P and K by total weeds compared to the weedy check (Table 1). Specifically, the application of oxadiargyl 100 g ha{^{1} and IC *fb* HW at 20 & 40 DAS markedly decreased the nutrient uptake by weeds compared to pendimethalin, oxyfluorfen, propaquizafop and other herbicide combinations. The integration of one hand weeding at 40 DAS with oxadiargyl 75 g ha^{-1} further significantly reduced the

Table : Effect of weed management on weed density & dry matter of total weeds, nutrient content and uptake of weeds in dill

Treatment	Weed density (m^{-2})	Weed dry matter ($g\ m^{-2}$)	Weed control efficiency (%)	Nutrient content in weeds (%)						Nutrient uptake by weeds (kg ha^{-1}) by total weeds		
				Grassy	Broadleaved	grassy	Broadleaved	Grassy	Broadleaved	N	P	K
T_1	4.74(22.03)	25.75	88.87	1.45	1.49	0.23	0.24	1.37	1.39	3.82	0.61	7.70
T_2	4.43(19.19)	25.59	88.95	1.55	1.59	0.26	0.26	1.56	1.57	4.06	0.66	9.65
T_3	5.75(32.60)	44.06	80.96	1.57	1.57	0.37	0.37	1.56	1.57	6.92	1.64	16.83
T_4	3.99(15.51)	19.04	91.78	1.58	1.58	0.38	0.38	1.57	1.58	3.01	0.72	7.35
T_5	3.39(11.06)	13.17	94.32	1.58	1.59	0.37	0.37	1.58	1.58	2.09	0.49	5.11
T_6	5.48(29.55)	36.05	84.42	1.58	1.59	0.37	0.37	1.57	1.58	5.72	1.34	14.04
T_7	4.17(16.97)	22.38	90.33	1.59	1.60	0.37	0.37	1.58	1.58	3.57	0.84	8.67
T_8	5.18(26.36)	31.47	86.40	1.60	1.60	0.38	0.39	1.62	1.62	5.03	1.21	12.57
T_9	4.93(23.88)	30.81	86.69	1.62	1.63	0.39	0.39	1.61	1.62	5.01	1.20	12.37
T_{10}	6.03(35.90)	42.95	81.44	1.63	1.64	0.38	0.39	1.62	1.63	7.03	1.65	17.25
T_{11}	3.73(13.49)	16.26	92.98	1.65	1.66	0.38	0.38	1.63	1.63	2.70	0.62	6.54
T_{12}	6.36(40.00)	48.26	79.14	1.67	1.67	0.38	0.38	1.63	1.63	8.06	1.85	19.72
T_{13}	13.74(188.31)	231.19	0.00	1.62	1.63	0.38	0.38	1.62	1.62	37.58	8.79	90.64
S.Em.±	0.034	0.240		0.03	0.02	0.00	0.00	0.02	0.02	0.11	0.03	0.45
CD (P=0.05)		0.096	0.683	0.07	0.04	0.01	0.01	0.05	0.05	0.31	0.07	1.28

Data subjected to $\sqrt{x + 0.5}$ transformation and figures in parenthesis are original weed count per sq. m

N, P and K uptake by total weeds compared to the sole application of herbicides. Similar reductions in nutrient depletion by weeds under various weed control treatments have been reported by (Mehriya *et al*., 2007; Yadav *et al*., 2004).

Conclusion

In conclusion, the integration of oxadiargyl at 75 g ha^{-1} applied 20 days after sowing (DAS), combined with a single hand weeding at 40 DAS, proved to be the most effective weed management strategy. This approach achieved the highest weed control efficiency, significantly reducing weed populations and demonstrating its potential for optimizing weed management in dill cultivation.

Conflict of interest

None

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