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Efficacy of different weed management practices on weed density and seed yield of dill (*Anethum graveolens* L.)

Ruchika Choudhary, Arvind Verma, Roshan Choudhary, SC Meena, GL Meena, Kannoj, Manish Tomar, Ritesh Patidar and Satya Narayan Gurjar

Abstract
A field experiment entitled "Performance of Dill (*Anethum graveolens* L.) Under Different Weed Management Practices" was conducted during rabi 2021-22 at the Instructional Farm of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur. The experiment consisted of thirteen treatments *i.e.*, 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 were replicated thrice in Randomized Block Design (RBD). At 60 DAS, the minimum grassy weed density was registered with oxyfluorfen 75 g ha^{-1} PE *fb* HW at 40 DAS. However, the lowest broadleaved and total weed density was found with IC *fb* HW at 20 & 40 DAS. The maximum seed yield (1188.11 kg ha^{-1}) was observed under IC *fb* HW at 20 & 40 DAS.

Keywords: Dill, weed management, pendimethalin, oxadiargyl, quizalafop ethyl, oxyfluorfen, propaquizafop

Introduction
Spice is a dried seed, fruit, root, bark or vegetative substance used to season, flavour, and add aroma to a variety of meals and drinks. A large number of spices cultivated in India are native to the subcontinent, giving the country the title of "Home of Spices" (Meena *et al.*, 2019) [7] owing to the country's diverse agro-climatic conditions.

India is the largest producer, consumer and exporter of seed spices and their products. Rajasthan and Gujarat have emerged as "seed spice bowl" and together contribute more than 80 per cent of the total seed spices produced in the country (Sharma *et al.*, 2016) [13].

Dill is a fragrant and therapeutic annual herb of the Apiaceae family. It is commercially grown in Rajasthan, Gujarat, Maharashtra, Andhra Pradesh and Madhya Pradesh. In Rajasthan, Chittorgarh, Jhalawar, Udaipur, Kota and Bundi are the dill-producing districts with an area of 12.8 thousand hectares and a production of 6.0 thousand tonnes (DES, 2019) [3]. Dill seed and leaves are used as flavouring ingredients in sauces, vinegar, pastries and soups. The active ingredient in dill seeds is its essential oil, which contains the primary ingredients carvone and limonene (Bailer *et al.*, 2001) [1].

Dill crop grows slowly at first, it's important to keep the field clean and weed free in order to reduce weed menace. Weed control is an important practice among several agronomical requirements to increase crop production since it has a significant impact on crop output. Therefore, it is vital to control weeds by all means throughout the crop weed competition time either through the post-emergence application of herbicides or by inter-culturing or hand weeding (Patel *et al.*, 2019) [15]. Herbicide use has been found in studies to effectively suppress weeds and boost seed output by 43.2 to 86.9 per cent. (Patel *et al.*, 2017) [14].

Material and Methods
This field experiment was conducted at Instructional Farm, Department of Agronomy, Rajasthan College of Agriculture, Udaipur (Rajasthan) during the rabi season of 2021-22. The region of the experimental site falls under the agro-climatic zone IVa (Sub-Humid Southern Plains and Aravalli Hills) of Rajasthan and the soil of the experimental field was clay loam in

texture, slightly alkaline (pH 8.05) in reaction, medium in organic carbon (0.72%), available nitrogen (290.64 kg ha^{-1}) and phosphorus (32.28 kg ha^{-1}) but high in potassium (334.55 kg ha^{-1}). The experiment consisted of thirteen treatments *i.e*., 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}) which were laid out in Randomized Block Design (RBD) and replicated thrice. The crop was sown on 21st October 2021, for optimizing plant stand seed rate of 3 kg ha^{-1} was used and a seed was sown at depth of 2-3 cm. After pre-sowing irrigation, a total of 3 irrigation was applied during the whole growing period. Recommended doses of nitrogen, phosphorous and potassium *i.e*., 90, 40 and 20 kg ha^{-1} were applied through urea, SSP and MOP. As per the treatment, pre-emergence application of herbicide was sprayed one day after sowing, while post-emergence application of herbicide was applied at 3-4 leaf stage of weeds (25 DAS). The herbicides were sprayed with a knapsack sprayer fitted with flat fan nozzle using 500 litres of water per hectare after its calibration. The crop was harvested at physiological maturity when plants turned golden yellow. The harvested produce was kept for sun drying for a period of seven days. After threshing, winnowing and cleaning were done and seeds were weighed separately to record seed yield kg plot^{-1} and yield expressed in terms of kg ha^{-1}.

Results and Discussion

Weed density

The experimental field was infested with both grassy as well as broadleaved weeds. Among the total weeds, broadleaved weeds were more prominent (84.96%) as compared to grassy weeds (15.03%). The weed flora under broadleaved includes *Chenopodium album* L., *Chenopodium murale* L., *Fumaria parviflora* L., *Malva parviflora* L., *Melilotus indica* L. and *Convolvulus arvensis* L. whereas, *Phalaris minor* Retz. was the only grassy weed. (Singh *et al*., 2014, Malunjkar *et al*., 2022 in fenugreek, Verma and Choudhary, 2021 in dill) [12, 6, 17].

All the weed management treatments significantly reduced the weed density over crop kept weedy (Table 1 and Fig 1). Among the weed management treatments, oxyfluorfen 75 g ha^{-1} PE *fb* HW at 40 DAS (1.01 m^{-2}) recorded the lowest weed density of grassy weeds which was at par with IC *fb* HW at 20 & 40 DAS (1.05 m^{-2}), oxyfluorfen 100 g ha^{-1} PE (1.13 m^{-2}) and oxadiargyl 75 g ha^{-1} PE *fb* HW at 40 DAS (1.17 m^{-2}). While the lowest broadleaved and total weed density was found with IC *fb* HW at 20 & 40 DAS (5.43, 6.47 m^{-2}). It was followed by oxyfluorfen 75 g ha^{-1} PE *fb* HW at 40 DAS (6.81, 7.82 m^{-2}) and was at par with oxadiargyl 75 g ha^{-1} PE *fb* HW at 40 DAS (6.93, 8.10 m^{-2}). This might be due to the fact that pre-emergence application of herbicide used just after sowing effectively controlled early flushes of weeds that are to be emerged up to 25-35 DAS that is up to the most critical stage of crop-weed competition and later hoeing at 40 DAS controlled secondary flushes of weeds resulting in excellent performance compared to herbicides specially applied alone either as pre or post-emergence. The superiority of herbicide in integration with hoeing or weeding at 40 DAS was also been reported by Singh *et al*. (2013) [11], Singh *et al*. (2014) [12], Kumar *et al*. (2016) [5], Punia and Tehlan (2017) [16] and Malunjkar *et al*. (2022) [6] in fenugreek, Sagarka *et al*. (2005) [10] in coriander, Mehriya *et al*. (2008) [8] in cumin, Choudhary *et al*. (2022) [2] in fennel and Verma and Choudhary (2021) [17] in dill.

Seed yield

A thorough look at Fig.1 shows that all the weed management treatments tended to improve the seed yield over the weedy check. The highest per cent increase in seed yield is witnessed in IC *fb* HW at 20 & 40 DAS (148.21%) which was at par with oxadiargyl 75 g ha^{-1} PE *fb* HW at 40 DAS (142.57%) and oxadiargyl 100 g ha^{-1} PE (137.57%) over weedy check. Improvement in yield attributes was possible when weeds were controlled in the early growth stages, particularly during critical crop-weed completion period. Integration of physical and chemical methods of weed control brought down the competition and created a better environment for satisfactory growth of the crop. These results are in close conformity with the findings of Mehta *et al*. (2010) [9], Singh *et al*. (2014) [12], Kumar *et al*. (2016) [5] and Malunjkar *et al*. (2022) [6] in fenugreek, Singh *et al*. (2013) [11] in cumin, Gohil *et al*. (2015) [4] in fennel and Verma and Choudhary (2021) [17] in dill.

Table 1: Effect of weed management on weed density in dill at 60 DAS

Sr. No.	Treatment	Dose (g ha^{-1})	Application stage (DAS)	Weed density (No.m^{-2})		
				60 DAS		
				Grassy weeds	Broadleaved weeds	Total weeds
1	Pendimethalin	1000	PE	2.48 (5.66)	4.86 (23.10)	5.41 (28.76)
2	Pendimethalin *fb* HW at 40 DAS	750	PE	2.05 (3.70)	4.34 (18.36)	4.75 (22.07)
3	Pendimethalin *fb* quizalofop ethyl	750 *fb* 40	PE *fb* PoE (3-4 leaf stage)	2.09 (3.90)	3.71 (13.25)	4.20 (17.15)
4	Oxadiargyl	100	PE	1.67 (2.30)	3.48 (11.63)	3.80 (13.93)
5	Oxadiargyl *fb* HW at 40 DAS	75	PE	1.29 (1.17)	2.72 (6.93)	2.93 (8.10)
6	Oxadiargyl *fb* quizalofop ethyl	75 *fb* 40	PE *fb* PoE (3-4 leaf stage)	1.64 (2.20)	3.25 (10.06)	3.57 (12.27)
7	Oxadiargyl	50	PoE (3-4 leaf stage)	2.16 (4.17)	4.22 (17.31)	4.69 (21.49)
8	Oxyfluorfen	100	PE	1.28 (1.13)	3.13 (9.28)	3.30 (10.41)
9	Oxyfluorfen *fb* HW at 40 DAS	75	PE	1.21 (1.01)	2.70 (6.81)	2.88 (7.82)
10	Oxyfluorfen *fb* quizalofop ethyl	75 *fb* 40	PE *fb* PoE (3-4 leaf stage)	1.71 (2.42)	3.26 (10.12)	3.61 (12.54)
11	IC at 20 DAS *fb* HW at 40 DAS			1.24 (1.05)	2.43 (5.43)	2.64 (6.47)
12	Oxydiargyl + propaquizafop	50 +50	PoE (3-4 leaf stage)	2.18 (4.26)	4.33 (18.27)	4.80 (22.53)
13	Weedy check			5.39 (28.55)	12.46 (154.74)	13.56 (183.29)
	S.Em±			0.05	0.05	0.05
	CD (P=0.05)			0.16	0.15	0.16

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

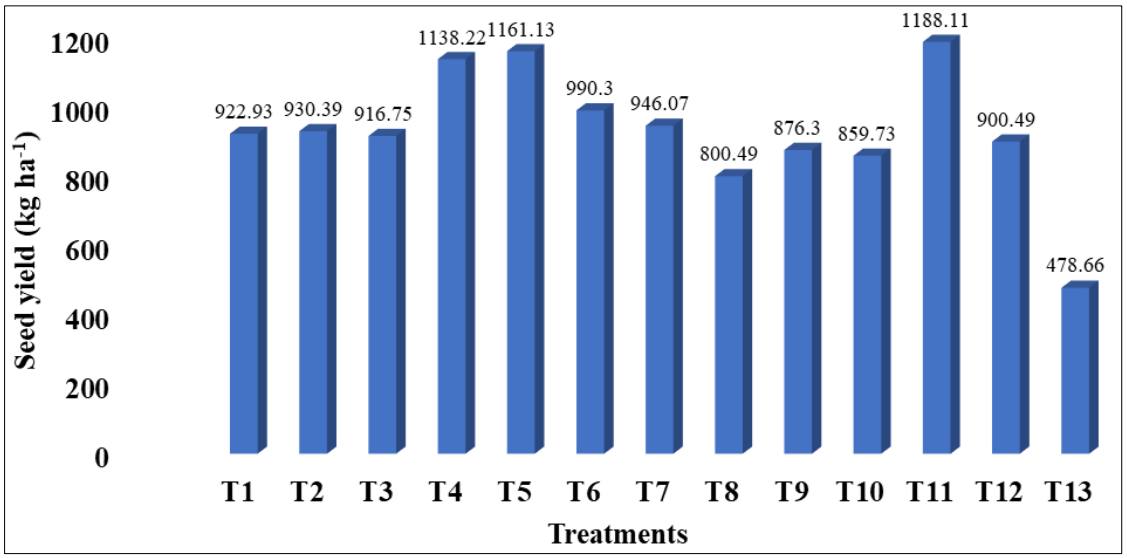

Fig 1: Effect of weed management on seed yield

Conclusion

Herbicides have been identified as an indispensable part of the crop production programme. Weed control through herbicide application contributed immensely to the growth and yield of dill by reducing the competition offered by weed growth. Therefore, on the basis of performance of Dill (*Anethum graveolens* L.) under different weed management practices it can be concluded that either pre-emergence application of oxadiargyl 75 g ha^{-1} followed by HW at 40 DAS, oxadiargyl 100 g ha^{-1} PE or IC *fb* HW at 20 & 40 DAS resulted in superior seed yield which are statistically equal and proved effective weed management practice for dill crop grown in sub-humid regions of southern Rajasthan.

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