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Impact of herbicide application on yield and economics of chickpea (*Cicer arietinum* L.)

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Abstract

An experiment entitled “Impact of herbicide application on yield and economics of chickpea (*Cicer arietinum* L.)” was conducted during *rabi* 2021 at Agronomy Research Farm, Agronomy Department, College of Agriculture, Dhule. The experiment was comprised of ten treatments laid out in a randomized block design with three replications. Among the different herbicide application treatments, grain and straw yield was observed to be higher with the application of the pre-emergence herbicide of oxyfluorfen 0.1 kg *a.i.* ha⁻¹ *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) (T₁₀), and it was found to be at par with the application of pendimethalin 1 kg *a.i.* ha⁻¹ (PE) *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) (T₇), pendimethalin 1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₃), and oxyfluorfen 0.1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₄). Higher gross returns, net monetary returns, and B:C ratio was in the treatment with the application of the pre-emergence herbicide of oxyfluorfen 0.1 kg *a.i.* ha⁻¹ *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) among the different herbicide application treatments.

Keywords: Pre-emergence herbicide, tank mix post-emergence herbicide, grain yield and economics

Introduction

Chickpeas play a main role in improving soil productivity through their nitrogen-fixing capacity. It can fix up to 130 kg N per hain a growth cycle. It adds adequate natural matter for maintaining and increasing soil health. India contributes 60-70% of the total world chickpea production of 120 lakh metric tons cultivated on fewer than 112 lakh hectares with a productivity of 1040 kg per ha in 2021-22 (Anonymous 2022) [1]. In the legumes and pulse crops, mainly in the case of chickpea, pendimethalin @ 1 kg *a.i.* per ha applied as pre-emergence is a very representative herbicide that is used to control all types of weeds, but there are no herbicides accessible to apply as post-emergence to control the weeds effectively. Even if the pre-emergence application of herbicide is skipped due to any reason, in that issue, post-emergence herbicide application to control the grassy, as well as broad leaf weeds, is very much required. Hand weeding operations have been found to be very effective, but the scarcity of labor and weed management have not been successful during the critical crop weed competition period. So, the application of single herbicides alone is not much more efficient and economical than weed control methods in such a situation.

Materials and Methods

The field experiment was conducted at Post Graduate Research Farm, Agriculture College, Dhule. This farm is situated in Agroclimatic Zone -6, *viz.*, Scarcity Zone. The rainfall is mostly received in 30 to 40 rainy days in a year, with an average annual rainfall of 610 mm. The treatments consist with weedy check (T₁), weed free (T₂), pendimethalin 1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₃), oxyfluorfen 0.1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₄), pendimethalin 1 kg *a.i.* ha⁻¹ (PE) *fb* imazethapyr 0.1 kg *a.i.* ha⁻¹ (PoE) (T₅), pendimethalin 1 kg *a.i.* ha⁻¹ (PE) *fb* quizalofop ethyl 0.05. kg *a.i.* ha⁻¹ (PoE) (T₆), pendimethalin 1 kg *a.i.* ha⁻¹ (PE) *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) (T₇) oxyfluorfen 0.1 kg *a.i.* ha⁻¹ (PPE) *fb* imazethapyr 0.1 kg *a.i.* ha⁻¹ (PoE) (T₈), oxyfluorfen 0.1 kg *a.i.* ha⁻¹ (PPE)

fb quizalofop ethyl 0.05 kg *a.i.* ha⁻¹ (PoE) (T₉), and oxyfluorfen 0.1 kg *a.i.* ha⁻¹ (PE) *fb* tank mix imazethapyr (50%) + quizalofop ethyl (50% *a.i.*) (PoE) (T₁₀). The seed of chickpea variety Phule Vikram was sown on 17th November 2021 at a spacing of 30 cm x 10 cm using a seed rate of 70-75 kg per ha. The necessary quantity of herbicides, *viz.*, pendimethalin, oxyfluorfen, quizalofop ethyl, and imazethapyr, was measured at the time of preparation of the solution allowing for treatments. The spraying was done by using a knapsack sprayer with a flat fan nozzle and 500 liters of water per ha. The crop was grown with a suggested package of practices and was harvested at maturity on the third week of March 2021.

Results and Discussion

Effect of different herbicide treatments on yield attributes and yield of chickpea

The important yield-contributing characters like number of pods plant⁻¹, number of seeds pod⁻¹, weight of grain plant⁻¹, and test weight (g) were significantly maximum under weed-free treatment. Among the different herbicide treatments, application of oxyfluorfen 0.1 kg *a.i.* ha⁻¹ (PE) *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) (T₁₀) was significantly superior over other treatments, but it was found to be on par with application of pendimethalin 1 kg *a.i.* ha⁻¹ (PE) *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) (T₇), pendimethalin 1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₃), and oxyfluorfen 0.1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₄). The grain and straw yield (q ha⁻¹) of chickpea was recorded to be significantly higher (27.21 and 66.42 q ha⁻¹, respectively) in weed free treatment (T₂) and in different weed control practices, spraying of oxyfluorfen 0.1 kg *a.i.* ha⁻¹ (PE) *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) (T₁₀) which recorded significantly higher grain and straw yield (25.47 q ha⁻¹ and 62.94 q ha⁻¹, respectively) as compared to other treatments of weed control and it was found at par with application of pendimethalin 1 kg *a.i.* ha⁻¹ (PE) *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) (T₇), pendimethalin 1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₃) and oxyfluorfen 0.1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₄).

Application of pre-emergence herbicide followed by post-emergence tank mix herbicide treatment was found significantly superior to other treatments in respect of yield of chickpea. This may probably be due to healthier weed management resulting in enhancement in all growth and sink parameters, which contributed to higher yield owing to favorable conditions in absorbing soil moisture, nutrient content, and sunlight penetration during crop growing period. The grain and straw yield were significantly less under weedy check treatment. The findings agreed with the results obtained by Shiv *et al.* (2018) [3], Vijay *et al.* (2019) [5] and Sanketh *et al.* (2021) [2].

Effect of different herbicide management practices on the economics of chickpeas

The gross and net monetary returns were found to be maximum (Rs. 136060 and 89860 ha⁻¹, respectively) in weed-free (T₂) treatment. In the different weed control treatments of herbicide, pre emergence application of oxyfluorfen 0.1 kg *a.i.* ha⁻¹ *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) (T₁₀) recorded maximum gross and net monetary returns (Rs. 127345 and 89459 ha⁻¹, respectively) than other treatments. Of herbicide application and was found to be at par with application of pendimethalin 1 kg *a.i.* ha⁻¹ (PE) *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) (T₇) (Rs. 124856 and 86596 ha⁻¹, respectively), pendimethalin 1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₃) (Rs. 124228 and 84450 ha⁻¹, respectively) and oxyfluorfen 0.1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₄) (Rs. 122294 and 82890 ha⁻¹, respectively). The benefit cost ratio was also higher in the application of oxyfluorfen 0.1 kg *a.i.* ha⁻¹ (PE) *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) (T₁₀) (3.36), followed by pendimethalin 1 kg *a.i.* ha⁻¹ (PE) *fb* tank mix imazethapyr (50% *a.i.*) + quizalofop ethyl (50% *a.i.*) (PoE) (T₇) (3.26), pendimethalin 1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₃) (3.12) and oxyfluorfen 0.1 kg *a.i.* ha⁻¹ at PE *fb* one hand weeding (T₄) (3.10). These treatments were observed to be better than other treatments. Similar reports were also stated by Singh *et al.* (2020) [4], and Sanketh *et al.* (2021) [5].

Table 1: Growth and yield contributing characters of chickpea as influenced by different treatment of herbicide

Treatment Detail		No. of pods plant ⁻¹	Weight of pods plant ⁻¹ (g)	Weight of grain plant ⁻¹ (g)	100 grain weight (g)
T ₁	Weedy check	55	17.96	13.39	18.43
T ₂	Weed free	75	28.33	26.63	19.07
T ₃	Pendimethalin 1 kg <i>a.i.</i> ha ⁻¹ at PE <i>fb</i> one hand weeding	69	24.32	22.28	18.83
T ₄	Oxyfluorfen 0.1 kg <i>a.i.</i> ha ⁻¹ at PE <i>fb</i> one hand weeding	68	23.94	21.91	18.84
T ₅	Pendimethalin 1 kg <i>a.i.</i> ha ⁻¹ (PE) <i>fb</i> imazethapyr 0.1 kg <i>a.i.</i> ha ⁻¹ (PoE)	64	20.59	18.96	20.56
T ₆	Pendimethalin 1 kg <i>a.i.</i> ha ⁻¹ (PE) <i>fb</i> quizalofop ethyl 0.05 kg <i>a.i.</i> ha ⁻¹ (PoE)	63	19.40	18.05	17.60
T ₇	Pendimethalin 1 kg <i>a.i.</i> ha ⁻¹ (PE) <i>fb</i> tank mix imazethapyr (50% <i>a.i.</i>) + quizalofop ethyl (50% <i>a.i.</i>) (PoE)	70	24.71	22.53	15.91
T ₈	Oxyfluorfen 0.1 kg <i>a.i.</i> ha ⁻¹ (PE) <i>fb</i> imazethapyr 0.1 kg <i>a.i.</i> ha ⁻¹ (PoE)	64	21.21	19.17	17.94
T ₉	Oxyfluorfen 0.1 kg <i>a.i.</i> ha ⁻¹ (PE) <i>fb</i> quizalofop ethyl 0.05 kg <i>a.i.</i> ha ⁻¹ (PoE)	63	19.94	18.46	19.19
T ₁₀	Oxyfluorfen 0.1 kg <i>a.i.</i> ha ⁻¹ (PE) <i>fb</i> tank mix imazethapyr (50% <i>a.i.</i>) + quizalofop ethyl (50% <i>a.i.</i>) (PoE)	71	25.98	22.98	18.88
SE(m)		1.46	0.56	0.95	0.99
C. D. @ 5%		4.35	1.67	2.84	NS
General mean		66.16	22.64	20.44	18.33

Table 2: Grain and straw yield (q ha⁻¹) and economics of chickpea crop as influenced by different treatment of herbicide

Treatment Details		Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Gross returns (Rs.ha ⁻¹)	Total cost of cultivation (Rs.ha ⁻¹)	Net returns (Rs. ha ⁻¹)	B:C ratio
T ₁	Weedy check	5.69	23.37	028426	30000	-1574	0.94
T ₂	Weed free	27.21	66.42	136060	46200	89860	2.94
T ₃	Pendimethalin 1 kg a.i. ha ⁻¹ at PE <i>fb</i> hand weeding	24.97	61.94	124228	39778	84450	3.12
T ₄	Oxyfluorfen 0.1 kg a.i. ha ⁻¹ at PE <i>fb</i> hand weeding	24.46	60.92	122294	39404	82890	3.10
T ₅	Pendimethalin 1 kg a.i. ha ⁻¹ (PE) <i>fb</i> imazethapyr 0.1 kg a.i. ha ⁻¹ (PoE)	20.80	53.61	104022	36544	67478	2.84
T ₆	Pendimethalin 1 kg a.i. ha ⁻¹ (PE) <i>fb</i> quizalofop ethyl 0.05 kg a.i. ha ⁻¹ (PoE)	19.90	51.80	099506	37204	62302	2.64
T ₇	Pendimethalin 1 kg a.i. ha ⁻¹ (PE) <i>fb</i> tank mix imazethapyr (50% a.i.) + quizalofop ethyl (50% a.i.) (PoE)	24.85	61.69	124856	38260	86596	3.26
T ₈	Oxyfluorfen 0.1 kg a.i. ha ⁻¹ (PE) <i>fb</i> imazethapyr 0.1 kg a.i. ha ⁻¹ (PoE)	20.90	53.79	104486	36170	68316	2.88
T ₉	Oxyfluorfen 0.1 kg a.i. ha ⁻¹ (PE) <i>fb</i> quizalofop ethyl 0.05 kg a.i. ha ⁻¹ (PoE)	20.45	52.89	102232	36830	65402	2.77
T ₁₀	Oxyfluorfen 0.1 kg a.i. ha ⁻¹ (PE) <i>fb</i> tank mix imazethapyr (50% a.i.) + quizalofop ethyl (50% a.i.) (PoE)	25.47	62.94	127345	37886	89459	3.36
S.E(m)		0.48	0.97	973.74	698.31	1187.91	-
C. D. @ 5%		1.45	2.90	2893.23	2074.87	3529.60	-
General mean		21.47	54.94	110346	37827	69517	-

Conclusion

Application of pre-emergence herbicide, *i.e.*, oxyfluorfen 0.1 kg a.i. ha⁻¹, followed by post-emergence application of tank mix herbicides, *i.e.*, imazethapyr (50% a.i.) + quizalofop ethyl (50% a.i.), at 20 DAS will give more stable weed control than the other method of herbicide application. This kept the weeds in control and resulted in producing the highest yield of chickpea crop. The economic point of view pre-emergence application of herbicide, *i.e.*, oxyfluorfen 0.1 kg a.i. ha⁻¹, followed by post-emergence application of tank mix herbicides, *i.e.*, imazethapyr (50% a.i.) + quizalofop ethyl (50% a.i.) at 20 DAS, could be an economical better treatment based on the B:C ratio.

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