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Economical weed control in lentil (*Lens culinaris* Medik. L.)

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Abstract
A field experiment entitled "Effect of Weed Management on Weed Density, growth, and Productivity of Lentil (*Lens culinaris* Medik. L.)" was conducted during *rabi* 2021-22 at the Agronomy Instructional Farm, Rajasthan College of Agriculture, MPUAT, Udaipur. The experiment was arranged in Factorial Randomized Block Design (FRBD) consisting of 20 treatment combinations and three replications. Ten chemical weed control methods *i.e.*, pendimethalin 500 g ha^{-1} PE, pendimethalin 750 g ha^{-1} PE, pendimethalin 1000 g ha^{-1} PE, imazethapyr 50 g ha^{-1} PoE, imazethapyr 60 g ha^{-1} PoE, imazethapyr 70 g ha^{-1} PoE, pendimethalin + imazethapyr 500 g ha^{-1} PE, pendimethalin + imazethapyr 750 g ha^{-1} PE, pendimethalin + imazethapyr 1000 g ha^{-1} PE and control (No herbicides) were taken as factor A and HW at 40 DAS and control treatment were taken as factor B. Lentil variety Kota Masoor-3 was used as test crop. All the weed management treatments resulted in significantly higher net return from lentil crop. The maximum net return was realized by applying HW at 40 DAS which was 29.26 per cent higher over control (₹47645 ha^{-1}). The economic analysis of treatments in terms of B:C ratio reveals the highest B:C ratio (1.91) was obtained by Pendimethalin + Imazethapyr 1000 g ha^{-1} PE which was significantly superior over control (1.64).

Keywords: Lentil, economics, weed control, hand hoeing, herbicides

Introduction
Pulses are a vital part of the human diet since they are high in protein (20-27%), fibre, vitamins, and amino acids. They contain 15 vital mineral components that are required for mankind's well-being, in addition to protein (Wang *et al*., 2003) [6]. Pulse crops can be a good example of a sustainable cropping pattern because they can be grown in low-cost, low-fertility soils and marginal lands. Small and marginal farmers on the Indian subcontinent love them because of their low cultivation costs and hardiness. They also increase the nitrogen condition of the soil by fixing nitrogen. India is the greatest producer and consumer of pulses in the world, but yield are too low, with a large yield difference between India and other industrialised countries, as well as between research station yield and field yield within India. Pulse crops may overcome poor yields and deliver good profit to farmers in India by introducing improved varieties, promoting better management techniques and developing inclusive marketing channels. Chickpea (54.09%), pigeon pea (24.14%) and lentil are the three most important pulse crops farmed in India (7.02%).
Weeds are one of the most significant constraints to the lentil crop worldwide, with weed infestation reducing yield by up to 80%. Mainly, Weeds compete for moisture, nutrients, and space with lentils crop, as well as harbouring insects, pests, and pathogens that can harm the crop. Due to the crop's small height and poor early growth, weed control must be carefully considered for up to 40–45 days after sowing (Yadav *et al*., 2007) [7]. Thin and broad-leaved weeds and sedges are a major problem for lentil, since they compete with the crop and can cause output reductions of up to 60% (Chandrakar *et al*., 2016) [2].
Herbicides have transformed agriculture throughout the world, and they've helped boost output. They are widely recognised as a key tool in weed management since they significantly minimise labour requirements and are simple and convenient to operate. Low lentil productivity can be attributed to poor weed management (Lhungdim *et al*., 2013) [4]. Weeds compete heavily with lentils since they are a short-statured crop, reducing crop yields significantly. Various pre-emergence herbicides for controlling weeds in lentil, such as trifluralin and pendimethalin, are only effective for the first month or two, although lentils

crop is a long growing season crop (145 days) and later-sprouting weeds compete with crop plants. There is a scarcity of information on the usage of post emergence (PE) herbicides in this crop notably in India.

Materials and Methods

The Agronomy Instructional Farm, RCA, Udaipur, which falls under the agroclimatic zone IVa "Sub-Humid Southern Plain and Aravali Hills" of Rajasthan, is where the experiment was carried out. The soil in the trial field was clay loam in texture, somewhat alkaline in reactivity (PH 8.6), medium in available nitrogen and phosphorus (298.1 kg ha^{-1} and 22.12 kg ha^{-1}, respectively), and high in available potassium status (452.5 kg ha^{-1}). The experiment consisted of twenty treatments combinations *i.e*., two levels of weeding (control, hoeing at 20 DAS and weeding at 40 DAS) and ten weed management chemicals *viz.*, Pendimethalin 500 g ha^{-1}, Pendimethalin 750 g ha^{-1}, Pendimethalin 1000 g ha^{-1}, Imazethapyr 50 g ha^{-1}, Imazethapyr 60 g ha^{-1}, Imazethapyr 70 g ha^{-1}, Pendimethalin + Imazethapyr 500 g ha^{-1}, Pendimethalin + Imazethapyr 750 g ha^{-1}, Pendimethalin + Imazethapyr 1000 g ha^{-1}, and Control. These were replicated thrice in Factorial randomized Block Design (FRBD). Lentil variety kota Masoor-3 was used as test crop. A uniform dose of 20 kg N + 40 kg P_2O_5 ha^{-1} was applied. Urea and DAP were used as a sourse of nitrogen and phosphorus. The common weeds detected in lentil's experiment field were *Avena fatua* L. (Wild oat), *Chenopodium album* L. (lamb's quarters), *Phalaris minor* Retiz. (Bird's seed grass), *Anagallis arvensis* L. (Blue pimpernel), *Convolvulus arvensis* L. (field bindweed), *Melilotus indica* (L.) All.

Table 1: Effect of weed management on net return and B:C ratio of lentil

Treatment	Economics	
Levels of manual weeding	**Net Return (₹ ha^{-1})**	**B: C ratio**
Control	47645	1.64
HW at 40 DAS	61588	1.76
S.Em. ±	862	0.03
CD(P=0.05)	2469	0.08
Chemical weed management		
Pendimethalin 500 g ha^{-1} PE	56488	1.75
Pendimethalin 750g ha^{-1} PE	56767	1.77
Pendimethalin 1000g ha^{-1} PE	55961	1.74
Imazethapyr 50g ha^{-1} PoE	57771	1.81
Imazethapyr 60g ha^{-1} PoE	57523	1.80
Imazethapyr 70g ha^{-1} PoE	57187	1.79
Pendimethalin +Imazethapyr 500 g ha^{-1} PE	61702	1.92
Pendimethalin + Imazethapyr 750 g ha^{-1} PE	62165	1.92
Pendimethalin + Imazethapyr 1000 g ha^{-1} PE	62736	1.91
Control (No herbicides)	17866	0.57
S.Em. ±	1928	0.06
CD(P=0.05)	5520	0.17

Results and Discussion

Economics

The data deferring the effect of the treatments on net return is given in Table 1. All the weed management treatments noted significantly maximum net return from lentil crop. The maximum net return was realized by applying HW at 40 DAS which was 29.26 per cent higher over control (₹47645 ha^{-1}). Compared to control (₹17866 ha^{-1}), all the weed management treatments recorded significantly maximum net return from lentil crop. However, the magnitude of increase in net return varied from ₹ 38095 ha^{-1} to ₹ 44870 ha^{-1}. The maximum net return (₹62736 ha^{-1}) was realized by pre-emergence (PE) application of pendimethalin +imazethapyr 1000g ha^{-1} which was 251.14 per cent higher over weedy check. Net return obtained through this treatment was higher compare to the rest of the treatments while recorded at par with pendimethalin+ imazethapyr 500 g ha^{-1} PE (₹61702 ha^{-1}) and pendimethalin+ imazethapyr 750 g ha^{-1} PE (₹62165 ha^{-1}).

The data deferring the effect of the treatments on B:C ratio is given in Table 1. The economic analysis of treatments in terms of B:C ratio reveals the maximum B: C ratio (1.76) was obtained by HW at 40 DAS which was significantly superior over the control treatment (1.64). It is evident from the data in Table 1 that the highest B:C ratio (1.92) was recorded with pendimethalin 1000 g ha^{-1} PE or with, however, it persisted at par with all the treatments except control.

The minimum net monetary return was fetched under control (No herbicide). However, pendimethalin+ Imazethapyr 1000 g ha^{-1} PE was found most remunerative, as it fetched the highest net return and B: C ratio in chemical weed managements. The comparatively lower cost of treatment application coupled with a good economic yield may be the reason for high net monetary returns and B:C ratio. weed control treatments were superior over to weedy check in influencing net returns due to weed control. Similar results were reported by Kundra and Gill (1990) [3], Rana (2002) [5] and Angiras and Singh (2005) [1] and they also recorded higher net returns with better weed control.

Conclusion

The results of the field experimentation concluded that pre-emergence application of pendimethalin+ imazethapyr 1000g ha^{-1} minimize the infestation of main weed species and these practises could be suggested as an efficient, economically feasible, practically feasible and ecologically desirable for controlling weed species in lentil crop grown in southern Rajasthan.

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Conflict of Interest

None

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