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Efficacy of different weed control methods on the energy, economics, and yields of black gram

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Abstract
During the Kharif season of 2013, a field conduct trial on weed management with herbicides in black gram was conduct at the Research-cum-Instructional Farm, Rampur selaqui, Dehradun (UK). The maximal energy input and output were measured when Pendimethalin @100 g ha^{-1} was applied and manual weeding was done twice, 20 and 40 days after seeding, respectively. The use of imazethapyr @ 40 g ha-1 PoE (T_9) reported in the greatest energy output-input ratio and energy utilization efficiency. Under the weedy plot, the lowest energy metrics were recorded (Control).The maximum gross income (Rs. 38369.20 ha^{-1}) was achieved with weed-free treatments followed by twice hand weeding at 20 and 40 days after sowing (Rs. 20253.60 ha^{-1}) and B: C ration with post emergence appliance of Imazethapyr @ 40 g ha^{-1} (T_9) (1.33) follow by hand weeding twice (Rs. 20253.60 ha^{-1}) (1.20).

Keywords: Black gram, energetic, economics and yield

Introduction
During the Kharif season, urdbean is a popular Kharif crop planted all over the country. In our country, it contributes around a third of the whole pulse area and a tenth of the entire production. Urdbean was farmed on a 30.6 hectare area in India, with a total production of 17 metric tonnes (Anon., 2014) [1]. Urdbean (*Vigna mungo* L.), the fourth most significant pulse crop in India after gramme, pigeon pea, and mung bean, is an important Kharif pulse crop in India. (2006, Kanade) It's high in phosphoric acid, vitamins, and minerals, with 24 percent protein, 60% carbohydrates, and 1.3 percent fat (Islam *et al.*, 2011) [5].
Weed is a major competitor for natural resources like as nutrients, light, space, and CO_2 that could otherwise be used to boost crop growth (Singh and Sheoran, 2008) [13]. Weeds are said to reduce urdbean yields by 87 percent, with the extent of the decline based on the type and severity of the weed flora (Singh *et al.*, 2002) [12]. *Trianthema portulacastrum*, *Cyperus rotundus*, Euphobiahirta, and Phyllanthus niruri are the most common weed species found in urdbean fields. Uncontrolled weeds throughout a critical stage of crop-weed competition diminish urdbean yield by 80-90 percent, depending on the kind and severity of the weed infestation (Kumar *et al.*, 2001) [9]. Therefore, the removal of weeds at appropriate time using suitable methods is essential to achieve high yields of urdbean.
Chemical weed control has been demonstrated to be more successful, simple, and cost-effective in preventing weed seed development and soil seed bank replenishment. Pre-emergence treatment of Pendimethalin @1 kg ha^{-1} followed by one hand weeding at 40 DAS (days after sowing) was shown to be the most efficient in lowering weed population, dry weight of weeds, and attaining higher weed control efficacy (Khot *et al.*, 2012) [8] from Junagarh (Gujarat).

Materials and Methods
During the Kharif season of 2013, an experiment was undertaken at Rampur Agriculture farm selaqui, Dehradun, to observe the result of different weed control strategies on energy, economics, and yield of Urdbean (Pant Urd) (U.K.). Dehradun's climate is sub-humid to semi-arid, with an average annual rainfall of 1325 mm, with 85 percent falling between June and September and the remaining 15% falling between October and February. During the summer, the weekly maximum temperature reaches 460 ℃, while the minimum temperature dips to 60 ℃ during the winter.

The hottest and coolest months are May and December, respectively. From mid-June to March, atmospheric humidity ranges between 70 and 90 percent, while wind is strong from May to August, peaking in June and July. During the entire growth period, the crop expected 1182.2 mm of rain. The maximum temperature ranges from 33.40 degrees Celsius in the first week of July to 280 degrees Celsius in the I week of Sept., while the lowest temperature ranges from 17.70 degrees Celsius in the fourth week of October to 32.80 degrees Celsius in the 3 week of Aug.

Experimental details

The trial was laid out in RBD with11 treatment and replication thrice. The detail of treatment are obtainable below.

Table 1: Experimental details

Notations	Treatment	Dose (g ha^{-1})	Time of application
T_1	Weedy check,	-	-
T_2	Hand weeding,	-	20 & 40 DAS,
T_3	Pendimethalin,	1000	20 DAS PE,
T_4	Quizalofop – p – ethyl,	37.5	20 DAS PoE,
T_5	Fenoxaprop – p- ethyl,	50	20 DAS PoE,
T_6	Pendimethalin 30EC +Imazethapyr EC (Vallore 32),	750	20 DAS PE,
T_7	Pendimethalin 30EC +Imazethapyr EC (Vallore 32),	1000	20 DAS PE,
T_8	Imazethapyr,	25	20 DAS PoE,
T_9	Imazethapyr,	40	20 DAS PoE,
T_{10}	Imazethapyr,	55	20 DAS PoE,
T_{11}	Weed free plot,	-	

PE =Pre – emergence, PoE = post – emergence, DAS = Days after sowing

Energetic

The input and output of energy for all treatments have been determined from seeding to harvesting. In Mega Joules (MJ) ha^{-1}, it was determined using the standard values. The aforementioned formulas were used to determine the output/input ratio and energy consumption efficiency (Mittal *et al.*, 1985) [10].

$$\text{Energy use efficiency (q MJ}^{-1}\ 103\ \text{ha}^{-1}) = \frac{\text{Total produce (q)}}{\text{Energy input (MJ } 10^{-3})}$$

$$\text{Energy output-input ratio} = \frac{\text{Energy output}}{\text{Energy input}}$$

Economics

According to the present price of inputs, standard labor costs, and current prices for the produce, the economics of uradbean crop production for each treatment have been calculated in terms of cost of cultivation (in rupees per hectare), gross realization (in rupees per hectare), and net realization (in rupees per hectare).

Table 2: Cost of cultivation and economic return of black gram as influenced by weed management practices

Treatment	Dose (g ha^{-1})	Time of application	Total cost (Rs ha^{-1})	Gross income (Rs ha^{-1})	Net income (Rs ha^{-1})	B:C ration
T_1 Weedy check	-		13734.51	19760.10	6025.77	0.44
T_2 Hand weeding twice	-	20 & 40 DAS	16894.51	37148.10	20253.60	1.20
T_3Pendimethaln	1000	2 DAS	15964.51	28556.70	12592.30	0.79
T_4Quizalofop-p-ethyl	37.5	20 DAS	14950.51	27275.20	12324.70	0.82
T_5Fenoxaprop-p-ethyl	50	20 DAS	14705.11	25932.60	11288.50	0.77
T_6Pendimethalin 30EC +Imazethapyr 2EC (Vallore 32)	750	2 DAS	14523.01	31212.90	16689.90	1.14
T_7Pendimethalin 30EC +Imazethapyr 2EC (Vallore 32)	1000	2 DAS	14680.51	32932.60	18252.10	1.24
T_8Imazethapyr	25	20 DAS	14450.51	31817,60	17367.10	1.20
T_9Imazethapyr	40	20 DAS	14690.51	43300.40	19609.90	1.33
T_{10}Imazethapyr	55	20 DAS	13930.51	31048.40	17117.90	1.23
T_{11}Weed free plot			20054.51	38369.20	18314.70	0.91

Economics

The economics of different treatments as affect by different weed control practices are presented in Table 2. The highest cost of crop growing was associated with a weed-free plot and the minimum cost was involved under the weedy check. This was due to a maximum number of labours was involved in manual weedings to create weed-free conditions. The greatest gross profit (Rs. 38369.20 ha^{-1}) was computed under a weed free field (T_{11}) which was found equivalent to gross return from hand weeding two times at 20 and 40 DAS (T_2) and imazethapyr @ 40 g ha^{-1} (T_9). Whereas the maximum net income in terms of Rs ha^{-1} (Rs 20253.60 ha^{-1}) was obtained from hand weeding at 20 and 40 Days after sowing (T_2) follow by application of imazethapyr @ 40 g ha^{-1} (T_9) and the highest B: C Ratio (1.33) was obtained under imazethapyr @ 40 g ha^{-1} (T_9). The minimum was recorded under the weedy check (T_1).A related judgment was reported by Tiwari *et al*. (2006) [14], Rathi *et al.* (2004) [11] and Dhane *et al*. (2009) [4].

Energetics

The figures of energetic of black gram are show in Table No.3**.** Maximum energy input and energy output was involved in weed-free condition follow by request of Pendimethalin 1000 @ g ha^{-1} (T_3) in input and two times hand weeding at 20 & 40 days DAS (T_2) in output. The highest output-input energy ratio and energy utilize effectiveness were recorded under the application of imazethapyr @ 40 gha^{-1} (T_9) followed by two times hand

weeding at 20 & 40 DAS. The un weeded showed lower values for the previously mentioned energy measures.

Weed management through Imazethapyr @ 40 g ha^{-1} and twice hand weeding plot gave maximum the efficacy of consumption of energy and output-input energy proportion might be because of enhanced biological productivity with minimal energy consumption. Effective and better elimination of weeds offer enough space and moisture and solar radiation leads to more absorption of available nutrients for better growth and development of crop and also helped maximum photosynthates translocation from source to sink produced maximum biological yield. The same result also is given by Jain *et al*. (1998) [6] and Billore *et al*. (1999) [3].

Table 3: Energetic of urdbean as influenced by weed control practice

Treatment	Dose g ha^{-1})	Time of application	Energy input (MJ 10^{-3} ha^{-1})	Energy output (MJ 10^{-3} ha^{-1})	Energy output input ratio	Energy use efficiency (q MJ 10^{-3} ha^{-1})
T_1 Weedy check	-		4.31	14.78	3.42	2.58
T_2 Hand weeding twice	-	20 & 40 DAS	4.63	25.61	5.53	4.15
T_3 Pendimethaln	1000	2 DAS	4.74	21.02	4.43	3.34
T_4 Quizalofop-p-ethyl	37.5	20 DAS	4.44	20.23	4.38	3.43
T_5 Fenoxaprop-p-ethyl	50	20 DAS	4.41	19.32	5.07	3.31
T_6 Pendimethalin 30 EC +Imazethapyr 2EC (Vallore 32)	750	2 DAS	4.44	22.54	4.36	3.89
T_7 Pendimethalin 30 EC +Imazethapyr 2EC (Vallore 32)	1000	2 DAS	4.47	19.52	5.31	3.98
T_8 Imazethapyr	25	20 DAS	4.38	23.26	5.31	4.00
T_9 Imazethapyr	40	20 DAS	4.39	24.53	5.58	4.20
T_{10} Imazethapyr	55	20 DAS	4.41	22.62	5.14	3.86
T_{11} Weed free plot			4.44	26.44	5.35	4.01

Conclusion

On the basis of conducting tests, it can exist done to maximum net return (Rs. 20253.60) & the B: C ratio (1.33) be obtained by a post-emergence application of Imazethapyr 40 g ha-¹. The maximum input-output energy was noted with the use of pendimethalin @ 1000 g ha^{-1}. The highest output-input energy ratio and energy use effectiveness was recorded with the appliance of Imazethapyr @ 40 g ha^{-1} PoE.

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