Original Research Article

Studies on Chemical Weed Management Practices on Growth and Yield of Blackgram [*Vigna mungo* (L.)]

ABSTRACT

An investigation was carried out at Zonal Agricultural Research Station, Kalaburagi, University of Agricultural Sciences, Raichur during *kharif* 2021-22 entitled studies on chemical weed management practices on growth and yield of blackgram [*Vigna mungo* (L.)]. The experiment was laid out in randomized complete block design with nine treatments and three replications. Among all the treatments, hand weeing at 25-30 DAS, recorded significantly lower weed density, higher weed control efficiency that favoured higher growth and yield parameters. Whereas, among the chemical weed management practices, application of sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS as post emergent recorded significantly lower weed population (2.71/0.25 m^2), lower weed dry weight (1.53/0.25 m^2) and higher weed control efficiency (90.31 %) compared to other chemical weed management treatments. The treatment sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS as post emergent also recorded significantly higher growth parameters viz., plant height (40.18 CM), number of branches (9.18), and dry matter production at harvest (23.50 g $plant^{-1}$) and yield components *viz*., number of pods $plant^{-1}$ (46.69), number of seeds pod^{-1} (7.89), 100 seed weight (4.7 g), seed yield (1059 kg ha^{-1}) compared to other treatments. Significantly higher net returns (Rs.48,406) were recorded in hand weeding at 25-30 DAS and intercultivation at 45 DAS, which was on par with application of sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS (Rs.45,066 ha^{-1}). The higher benefit cost ratio was recorded with application of sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 1.0 kg a.i. ha^{-1} at 20-25 DAS (3.08) followed by hand weeding at 25-30 DAS and intercultivation at 45 DAS.

Keywords: *blackgram, weed density, weed control efficiency, growth, yield, economics*

1. INTRODUCTION

India is blessed with the largest area of production and consumption of pulses in the world. Pulses occupy a prime position in Indian farming system as a main crop, catch crop, cover crop, green manure crop and intercrop. They are the main source of protein particularly for vegetarians and contribute about 14 per cent of total protein of an average [1]. Pulses play a significant and most important role in meeting the nutrition requirements of human, maintaining the soil fertility and in improving of economy of small and medium farmers as the crop requires less investment, improve the soil fertility and requiring less water. Blackgram, a highly prized pulse crop of Leguminosae family, is widely cultivated in India and it is popularly known as “Urad dal”. The crop thrives well in a climate of 27- 30°C temperature with medium rainfall and loamy soil with good water holding capacity are most suitable . Blackgram is third important legume/pulse crop which is grown under rainfed area, in rice fallow, in irrigated conditions during both kharif and summer seasons. The crop matures within 70-75 days. It is mostly self pollinated crop which contains 24 per cent protein, 60 per cent carbohydrate, 1.3 per cent fat, 3.2 percent minerals, 0.9 per cent fibre, 154 mg calcium, 385 mg phosphorus, 9.1 mg iron per 100 g and small amount of vitamin-B complex [2]. Blackgram contributes about 13 per cent of total pulse area and 10 per cent of total pulse production of our country. In India, this crop is cultivated over an area of about 46 lakh hectares with a production of 24.50 lakh tonnes and productivity of 533 kg ha^{-1} [3]. It is majorly grown in Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka and Uttar Pradesh states. In Karnataka, it is cultivated over an area of 0.93 lakh hectares with a production of 0.48 lakh tones and productivity of 514 kg ha^{-1} [4]. Major Blackgram growing areas are Kalaburagi, Bidar, Gadag, Yadgir, Raichur, Dharwad districts. The lower productivity of blackgram is mainly because of several biotic and abiotic factors. Among the biotic factors, heavy weed infestation and high incidence of insects and diseases are the major factors responsible for poor yield of blackgram. Heavy weed infestation is recognized as a major bottleneck in realizing the potential yield of blackgram especially in *Kharif* season. The crop has to compete for light, water, nutrient, and space with weeds during inital growth phases. The report suggested that 30-50% losses in blackgram yield have been estimated due to weed infestation [5].

Weeds pose a serious threat in blackgram and cause up to 50-60 per cent yield losses [6]. Since the crop is grown in rainy season, it is infested by a large number of weeds which have quick growth habit. The first 25-35 days after sowing are most critical period of competition between crop and weed for resources. During this period, as the crop is having slow growth and weeds grow fast. They smother the crop and offer great completion for moisture, nutrients, light and space. They take most of the native and applied nutrients. The problem is further aggravated under the conditions of water stress where, weeds utilise the available moisture in

the root zone quickly as they have quick growth habit. There is 30 to 50 per cent reduction in yield [7] as weeds compete with crop for all the growth resources (nutrients, moisture, light and space) and results indicated that there is 42% yield reduction of blackgram, if the weeds are allowed to grow and remain in the field up to harvest of crop. Therefore, research methodologies need to be reoriented to evolve appropriate weed management practices for their better control and improving the productivity of blackgram.

2. MATERIAL AND METHODS

A field investigation was carried out during *kharif* season 2021-22 at Zonal Agricultural Research Station, Kalaburagi. The experimental site was having black clay soil in texture having alkaline pH of 8.4, with bulk density of 1.35 g/cc and with organic carbon content (0.52%). The soil was analysed for fertility status before sowing. The soil was having 178 kg ha^{-1} nitrogen, 22 kg ha^{-1} phosphorus and 328 kg ha^{-1} potassium contents. The soil analysis data are presented as under (Table 1)

Table 1. Soil analysis data of experimental field at ZARS, Kalaburagi

Properties	Values	Method employed
I. Physical properties		
1. Physical properties analysis		
a) Sand (%)	21.2	International pipette method [8]
b) Silt (%)	24.46	International pipette method [8]
c) Clay (%)	57.2	International pipette method [8]
2. Bulk density (Mg m^{-3})	1.35	Core sampler method [9]
II. Chemical properties analysis		
1. Soil pH	8.4	pH meter [8]
2. Electrical Conductivity (dS m^{-1})	0.23	Conductivity bridge [8]
3. Organic carbon (%)	0.52	Walkely and Black's wet oxidation method [10]
4. Available nitrogen (kg ha^{-1})	237	Alkaline permanganate method [11]
5. Available phosphorus (kg ha^{-1})	31	Olsen's method [10]
6. Available potassium (kg ha^{-1})	325	Flame Photometry method [10]

The area received rainfall of 720 mm annually and is classified as subtropical. The area was having 38.77^{o}C and 17.76^{o}C, as mean maximum and minimum temperature respectively. The total number of treatments were nine and the trial was laid out in randomized complete block design. Treatments were **T1**: weedy check, **T2:** hand weeding at 25-30 DAS and intercultivation at 45 DAS, **T3**: alachlor 50% EC @ 1.0 kg a.i. ha^{-1} (LASSO) as PE *fb* intercultivation at 30 DAS, **T4**: pendimethalin 38.7% CS @ 0.75 kg a.i. ha^{-1} (Stomp) as PE *fb* intercultivation at 30 DAS, **T5**: pendimethalin 30% EC + imazethapyr 2% EC @ 2 kg a.i. ha^{-1} (Valor) as PE, **T6**: propaquizafop 10 EC @ 50 g a.i. ha^{-1} (Agil) at 20-25 DAS, **T7**: propaquizafop 2.5% + imazethapyr 3.7% w/w (Shaked) @ 1.0 kg a.i. ha^{-1} at 20-25 DAS, **T8**: sodium acifluorfen 16.5% + clodinafop propargyl 8% EC (Irish) @ 1.0 kg a.i. ha^{-1} at 20-25 and **T9**: imazethapyr + imazamox @ 100 g a.i. ha^{-1} (Odyssey) at 20-25 DAS. The blackgram variety 'DU-1' having 70-75 days of duration was selected. Seeds were treated with biofungicide (trichoderma @ 4 g per kg to control seed borne diseases). The crop was sown with 30 cm row spacing. The seed rate used was 15 kg ha^{-1} recommended fertilizer dose of 40:20:20 kg ha^{-1} in the form of urea (87 kg ha^{-1}), single super phosphate (125 kg ha^{-1}) and muriate of potash (33 kg ha^{-1}) was applied to the soil at the time of sowing. Pre-emergent weedicides were applied on next day after sowing and post-emergent weedicides were applied at 20-25 DAS as per the treatments. Sprayer used was knapsack sprayer and flat fan nozzle was fitted to it for spraying weedicide. For applying weedicides, 750 l ha^{-1} spray volume was used. Insect and diseases of the crop ware controlled with use of appropriate insecticide (thiamethoxam 25% WG 0.2 g per litre to control agromyzid stem fly) and fungicides (tebuconazole 250 EC @ 1 ml per litreto control leaf spot) as per the need to avoid crop loss due to incidence of pests and diseases. All the weed management operations in the trial field were carried as per the treatments. An iron square quadrant with side 0.5 m (0.25 m^{2}) was used for recording weed density in each plot by at different places randomly. Weeds were uprooted slowly and they were dried under shade and later using hot air oven at 70^{o} C for 72 hours. Weeds were weighed and weight was recorded as g m^{-2}. The original data was subjected to square root transformation $(x+0.5)^{1/2}$. The average values were used for analysis of the data. Weed control efficiency (WCE) was calculated as per formula suggested by previous workers [12].

The growth parameters viz., plant height (cm), number of branches per plant, dry matter production and yield parameters *viz*., number of pods per plant, number of seeds per pod, test weight (g) and seed yield (kg ha^{-1}) were recorded at harvest by randomly selecting five plants in each plot. The Fisher's method of analysis of variance technique was used for statistical analysis [13] and means of treatment were compared using t-test at 5% probability level using least significant difference.

3. RESULTS AND DISCUSSIONS

3.1 Weed flora observed

Many different types of weeds were observed in the experimental plot. The most important grassy weeds observed in the experimental plot were *Cynodondactylon, Panicumrepens*, *Dactyloctenium aegyptium, Digitaria marginata* and *Erogrostis gangetica*. While common broad-leaved weeds observed were *Commelina benghalensis, Phyllanthus niruri, Tribulus terrestris, Abutilon indicum, Euphorbia hirta*, *Trichodesma* spp., *Portulaca oleracea*, *Tridax procumbens, Amaranthus viridis, Digeria arvensis* and *Leucus aspera* and the common sedge observed was *Cyperus rotundus.*

3.2 Effects of treatments on weed density weed dry weight and control efficiency

The weed density and weed dry weight were significantly reduced with the use of weedicide over the weedy check (Table 2). Significantly lower density of weeds (0.71) and dry weight of weed (0.71) were observed with hand weeding at 25-30 DAS and intercultivation at 45 DAS. Among the weedicide treatments, post emergent application of sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS resulted in significantly lower density of weeds (2.38, 2.71 and 2.90 at 25, 50 DAS and at harvest respectively) and weed dry weight (1.44, 1.53 and 1.57 g $plant^{1}$ at 25, 50 DAS and at harvest respectively). This was followed by propaquizafop 2.5% + imazethapyr 3.7% w/w @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS. Density of the weeds and dry weight of weeds was effectively reduced by hand weeding and intercultivation. Significantly higher weed density (5.45, 6.31 and 6.96 at 25, 50 DAS and at harvest respectively) and weed dry weight (3.98, 4.42 and 4.83 g $plant^{-1}$ at 25, 50 DAS and at harvest respectively) were recorded by weedy check [14, 15]. Hand weeding at 25-30 DAS and intercultivation at 45 DAS recorded significantly higher weed control efficiency (100%) followed by post emergent application of sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS (89.52%, 90.31% and 91.17% at 25, 50 DAS and at harvest). This was followed by propaquizafop 2.5% + imazethapyr 3.7% w/w @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS (65.07%, 88.50% and 89.74% at 25 50 DAS and at harvest respectively) [16,17]. Ready-mix application of sodium acifluorfen 16.5% and clodinafop propargyl 8% EC with 1.0 kg ha^{-1} ensured effective control of weeds in black gram [18. 19]. Clodinafop propargyl controls grassy weeds by inhibiting acetyl-CoA carboxylase while, Acifluorfen controls both grassy and broad leaves by inhibiting proto-porphyrinogen oxidase [20].

Table 2. Effect of different weedicide treatments on weed density, dry weight and weed control efficiency in blackgram

Treatments	Total weed density (No. 0.25 m^{-2})			Total weed dry weight (g)			Weed Control Efficiency (%)		
	25 DAS	50 DAS	At harvest	25 DAS	50 DAS	At harvest	25 DAS	50 DAS	At harvest
T_1-Weedy check	5.45 (29.42)	6.31 (39.64)	6.96 (48.14)	3.98 (15.54)	4.42 (19.33)	4.83 (22.96)	0.00	0.00	0.00
T_2-Hand weeding at 30 DAS and Intercultivation at 45 DAS	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.0)	0.71 (0.00)	100.00	100.00	100.00
T_3-Alachlor 50% EC @ 1.0 kg *a.i.* ha^{-1} as PE *fb* Intercultivation at 30 DAS	3.60 (12.45)	4.44 (19.18)	4.12 (16.52)	2.79 (7.30)	2.71 (6.87)	2.81 (7.40)	50.96	64.02	66.99
T_4-Pendimethalin 38.7% CS @ 0.75 kg *a.i.* ha^{-1} as PE *fb* Intercultivation at 30 DAS	3.33 (10.58)	4.14 (16.64)	3.94 (15.01)	2.64 (6.46)	2.69 (6.74)	2.78 (7.24)	56.60	64.70	67.56
T_5-Pendimethalin 30% EC + Imazethapyr 2% EC @ 2 kg *a.i.* ha^{-1} as PE	3.82 (14.12)	4.52 (19.97)	4.51 (19.83)	2.88 (7.8)	2.93 (8.10)	3.01 (8.55)	47.60	57.58	61.69
T_6-Propaquizafop 10 EC @ 50 g *a.i.* ha^{-1} at 20-25 DAS	4.46 (19.42)	5.16 (26.10)	5.24 (27.01)	2.93 (8.10)	3.00 (8.50)	3.06 (8.89)	45.58	55.48	60.15
T_7-Propaquizafop 2.5% + Imazethapyr 3.7% w/w @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS	2.88 (7.78)	3.24 (10.03)	3.46 (11.50)	2.39 (5.20)	1.62 (2.14)	1.67 (2.30)	65.07	88.50	89.74
T_8-Sodium Acifluorfen 16.5% + Clodinafop propargyl 8% EC @ 1.0 kg *a.i.* ha^{-1} at 20-25	2.38 (5.18)	2.71 (6.84)	2.90 (8.50)	1.44 (1.56)	1.53 (1.85)	1.57 (1.98)	89.52	90.31	91.17
T_9-Imazethapyr + Imazamox @ 100 g *a.i.* ha^{-1} at 20-25 DAS	3.02 (8.62)	3.66 (12.93)	3.59 (12.39)	2.71 (6.87)	2.67 (6.65)	2.71 (6.87)	53.85	65.17	69.35
S. Em. ±	**0.10**	**0.13**	**0.11**	**0.09**	**0.13**	**0.09**	**3.29**	**3.81**	**2.03**
C D @ 5%	**0.31**	**0.38**	**0.34**	**0.28**	**0.38**	**0.27**	**9.86**	**11.44**	**6.09**

PE: Pre-emergence; PoE: Post-emergence; DAS - Days after sowing; WCE - Weed control Efficiency,
*****figures in parentheses were original values

3.3 Effects of different treatments or weeding practices on growth and growth parameters

The growth parameters (plant height, number of branches and total dry matter production were significantly influenced by different weed management practices. (Table 3). At harvest, among all the treatments, significantly higher plant height (41.60 cm), number of branches (9.34) and total dry matter accumulation (24.12 g m^{-2}) were observed with hand weeding at 25-30 DAS and intercultivation at 45 DAS. Whereas, significantly lower plant height (22.73 cm), number of branches (5.64) and dry matter accumulations (9.17 g m^{-2}) were recorded in weedy check. Application of sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS as post emergent recorded significantly higher plant height (40.18 cm), number of branches (9.18) and total dry matter accumulation (23.5 g m^{-2}) in all the chemical weed management treatments. This treatment was found on par with propaquizafop 2.5% + imazethapyr 3.7% w/w @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS (37.20 cm, 8.57 and 20.95 g m^{-2}). Significantly superior growth parameters in these treatments were due to lower weed density and weed competition with crops for various growth factors (space, nutrients, moisture and solar energy) which helped in proper establishment of good crop stand which in turn favoured better cell division, higher production and accumulation of photosynthates and their subsequent translocation that decline in weed density leading to less competition for growth factors with the crop which favoured better growing conditions [21].

3.4 Effects of treatments or weeding practices on yield parameters and yield

Significant differences were found with respect to yield attributing parameters and yield due to different weed management treatments. Significantly higher yield attributing parameters *i.e.* number of pods $plant^{-1}$, number of seeds pod^{-1} and seed yield (Table 3) were found under all the weed management practices compared to weedy check. Among all the different treatments, number of pods $plant^{-1}$, number of seeds pod^{-1} and seed yield (48.91, 8.04 and 1139 kg ha^{-1} respectively) were significantly higher with hand weeding at 25-30 DAS and intercultivation at 45 DAS. Whereas, number of pods $plant^{-1}$, number of seeds pod^{-1} and blackgram seed yield (26.02, 4.73 and 540 kg ha^{-1} respectively) were found significantly lower with weedy check. Among all the chemical weed management treatments, sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS recorded significantly higher number of pods $plant^{-1}$, number of seeds pod^{-1} and blackgram seed yield (46.69, 7.89 and 1059 kg ha^{-1} respectively) followed by propaquizafop 2.5% + imazethapyr 3.7% w/w @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS (43.24, 7.52 and 1036 kg ha^{-1} respectively). Significantly lower number of pods $plant^{-1}$, number of seeds pod^{-1} and seed yield (37.23, 5.67 and 859 kg ha^{-1} respectively) were recorded with propaquizafop 10 EC @ 50 g a.i. ha^{-1} at 20-25 DAS [15, 22, 23].

Table 3. Effect of different weed management practices on growth parameters, yield attributes and yield of blackgram.

Treatments	Plant height (cm)	No. of branches	DMP (g plant^{-1})	No of pods plant^{-1}	No. of seeds pod^{-1}	100 Seed Weight (g)	Seed yield (g plant^{-1})	Seed yield (kg ha^{-1})
T_1 -Weedy check	22.73	5.64	9.17	26.02	4.73	3.60	1.62	540
T_2 - Hand weeding at 25-30 DAS and intercultivation at 45 DAS	41.60	9.34	24.12	48.91	8.04	4.72	3.42	1139
T_3 - Alachlor 50% EC @ 1.0 kg *a.i.* ha^{-1} as PE *fb* Intercultivation at 30 DAS	35.60	7.97	17.93	31.34	5.98	3.99	2.84	946
T_4 - Pendimethalin 38.7% CS @ 0.75 kg *a.i.* ha^{-1} as PE *fb* Intercultivation at 30 DAS	36.00	8.20	18.87	38.97	6.32	4.09	2.89	962
T_5 - Pendimethalin 30% EC + Imazethapyr 2% EC @ 2 kg *a.i.* ha^{-1} as PE	34.23	7.93	16.89	37.34	5.80	3.98	2.61	871
T_6 - Propaquizafop 10 EC @ 50 g *a.i.* ha^{-1} at 20-25 DAS	32.27	7.67	15.78	37.23	5.67	3.77	2.58	859
T_7 - Propaquizafop 2.5% + Imazethapyr 3.7% w/w @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS	37.20	8.57	20.95	43.24	7.52	4.43	3.11	1036
T_8 - Sodium Acifluorfen 16.5% + Clodinafop propargyl 8% EC @ 1.0 kg *a.i.* ha^{-1} at 20-25	40.18	9.18	23.50	46.69	7.89	4.70	3.19	1059
T_9 - Imazethapyr + Imazamox @ 100 g *a.i.* ha^{-1} at 20-25 DAS	36.20	8.30	20.57	42.10	6.55	4.17	3.05	1016
S. Em. ±	**1.37**	**0.24**	**0.56**	**1.15**	**0.19**	**0.13**	**0.08**	**28**
C D @ 5%	**4.12**	**0.72**	**1.67**	**3.46**	**0.58**	**0.38**	**0.25**	**86**

PE: Pre-emergence; PoE: Post-emergence; DAS - Days after sowing;

3.5 Economics

Gross returns, net returns and benefit cost (BC) ratio (Table 3) of blackgram were found significantly influenced by different weed management practices (Table 4). Significantly higher gross returns, net returns and B:C ratio (₹. 71,757 ha^{-1}, ₹. 48,406 and 3.07 respectively) were obtained with hand weeding at 25-30 DAS and intercultivation at 45 DAS. However, it was found on par with sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 1.0 kg a.i. ha^{-1} at 20-25 DAS (₹. 66,717 ha^{-1}, ₹. 45,066 and 3.08 respectively). Whereas, significantly lower gross returns, net returns and BC ratio was recorded with weedy check (₹. 41,202 ha^{-1}, ₹. 21,351 ha^{-1} and 2.08 respectively). Significantly higher gross returns with hand weeding at 25-30 DAS and intercultivation at 45 DAS followed by sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 1.0 kg a.i. ha^{-1} at 20-25 DAS was mainly due to higher yield in these treatments due to lower weed density, that resulted in better growth

owing to better utilization of natural resources (nutrients, moisture and solar radiation) and translocation of photosynthates to reproductive parts leading to higher yield that resulted in better economics of the crop [14, 22].

Table 4. Effect of different weed management practices on gross returns, net returns and BC ratio of black gram

Treatments	Gross returns (₹. ha^{-1})	Cost of cultivation (₹. ha^{-1})	Net returns (₹. ha^{-1})	B:C Ratio
T_1 - Weedy check	41202	19851	21351	2.08
T_2 - Hand weeding at 25-30 DAS and intercultivation at 45 DAS	71757	23351	48406	3.07
T_3 - Alachlor 50% EC @ 1.0 kg *a.i.* ha^{-1} as PE *fb* Intercultivation at 30 DAS	59598	23441	36157	2.54
T_4 - Pendimethalin 38.7% CS @ 0.75 kg *a.i.* ha^{-1} as PE *fb* Intercultivation at 30 DAS	60606	23036	37570	2.63
T_5 - Pendimethalin 30% EC + Imazethapyr 2% EC @ 2 kg *a.i.* ha^{-1} as PE	54873	21751	33122	2.52
T_6 - Propaquizafop 10 EC @ 50 g *a.i.* ha^{-1} at 20-25 DAS	54117	20626	33491	2.62
T_7 - Propaquizafop 2.5% + Imazethapyr 3.7% w/w @ 1.0 kg *a.i.* ha^{-1} at 20-25 DAS	65268	21991	43277	2.97
T_8 - Sodium Acifluorfen 16.5% + Clodinafop propargyl 8% EC @ 1.0 kg *a.i.* ha^{-1} at 20-25	66717	21651	45066	3.08
T_9 - Imazethapyr + Imazamox @ 100 g *a.i.* ha^{-1} at 20-25 DAS	64008	21011	42997	3.05
S. Em. ±	**1759**	**-**	**1759**	**0.08**
C D @ 5%	**5276**	**-**	**5276**	**0.24**

PE: Pre-emergence; PoE: Post-emergence; DAS - Days after sowing;

4. CONCLUSION

Hand weeding at 25-30 DAS and intercultivation at 45 DAS reduced the weed density and weed dry weight. Among the chemical weedicides, sodium acifluorfen 16.5% + clodinafop propargyl 8% EC @ 1.0 kg *a.i.*ha^{-1} at 20-25 as post-emergence was found most effective in controlling weeds at all stages and it recorded higher weed control efficiency, growth parameters and yield parameters. Seed yield and economics were better with hand weeding at 25-30 DAS and intercultivation at 45 DAS followed by same weedicide treatments. Lower values of growth parameters were observed in weedy check. Thus, with the use of right and efficient weedicide, timely weed control can be done leading to better growth, yield and economics of crop and dependence on labour can be minimized to a great extent.

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