The Bioscan 13(1): 339-343, 2018 (Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

EFFECT OF WEED MANAGEMENT PRACTICES ON YIELD OF MUNGBEAN (*Vigna radiata* L.) AND ITS CARRY OVER EFFECT ON SUCCEEDING CHICKPEA (*Cicer arietinun* L.)

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KEYWORDS
Mungbean
Chickpea
Yield
Weed density
Weed control efficiency
Herbicides

Received on :
14.01.2018

Accepted on :
19.03.2018

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ABSTRACT
A field experiment was undertaken during *kharif* and *rabi* season of 2016-2017 at Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.) to find out the effect of different weed management practices in yield of mungbean and its carry over effect on succeeding chickpea. In mungbean crop, weed control efficiency was noted significantly maximum under manual weeding twice (84%) followed by Pendimethalin 30 EC + Imazethapyr 2 EC at 30 DAS (69 %). While, seed (531 kg/ha) and stover yield (2699 kg/ha) of mungbean were recorded significantly superior under Clodinafop propargyl 8% + Aciflourfen sodium 16.5% @ 187.5 g/ha at 15-20 DAS. Grain yield of chickpea was obtained significantly superior (774 kg/ha) under residual effect of Pendimethalin 30 EC + Imazethapyr 2 EC @ 0.75 kg/ha followed by Imazamox 35 WG + Imazethapyr 35 WG @ 40 g/ha (772 kg/ha) while, straw yield (2039 kg/ha) was noted higher in Imazamox 35 WG + Imazethapyr 35 WG @ 40 g/ha.

INTRODUCTION

Weed management is an important key factor for enhancing the productivity of green gram. If weeds are not controlled timely and properly, the reduction on seed yield of green gram ranges from 30 to 50% depending on the composition of weed flora, period of weed-crop competition and its intensity (Singh *et al*., 1996; Raman and Krishna Murthy, 2005). Generally farmers cultivate green gram on larger area but seldom adopt weed control practices in it. Traditional method of weed control viz. hand weeding with Khurpi, hand pulling, hand hoeing and mechanical intercultural are effective but costly and time taking as well as more labour consuming. Presently labour charges are higher and its efficiency is decreased thus these methods become costly. Under such circumstances, chemical control of weeds may be the viable and cost effective alternative for this crop. Effective herbicides at appropriate rate may prove as an efficient weed control method of weed management. Now-a-days various new herbicides are introduced as well as applied as pre and post emergence. Recently some new pre emergence viz. Pendimethalin 30 EC + Imazethapyr 2 EC and post emergence herbicides viz. Imazethapyr, Imazamox 35 WG + Imazethapyr 35 WG, Clodinafop propargyl + Aciflourfen sodium etc. are being marketed with the assurance of selective control of weeds in soybean and several other crops (Singh, 2014 ; Yadav and Bhullar, 2014) .

Mungbean and chickpea both crops are leguminous and almost recommended similar herbicides for weed control. Most of the research on weed control was done on single crop basis but due to longer persistant of herbicide in soil can also reduce the weed population to the succeeding crop. However, persistence of phytotoxic levels of a herbicide for more than one year can be a problem of some herbicides. Herbicide residues are most likely to occur following years with low rainfall because chemical and microbial activity needed to degrade herbicide are limited in dry soil. Lowest herbicide rate and mould board ploughing before planting the next crop reduces phytotoxicity of some herbicides. Several researchers demonstrated that some herbicides can be accumulated in soil and some herbicides may not be accumulated but their residues might be present in the soil (Sullivan *et al*. 1998; Singh, 2014; Yadav and Bhullar, 2014). If residues of herbicides may persist in the soil, the vigour of the non targeted species and the succeeding crop can be reduced. Farmers usually used herbicides without knowing or testing the residual effect of herbicides on the succeeding crops. Therefore, it was realized to evaluate these herbicides under mungbean – chickpea sequential cropping system with new pre and post emergence herbicide application to exploit the possibility of their success toward the complex weed flora. The present experiment describes here the efficacy of old and new herbicide with pre and post emergence application for mungbean - chickpea cropping system. Hence, there is urgent need for research on efficacy of new herbicide that would be help in making mungbean - chickpea system more

remunerative. Keeping these facts in view, the present study was carried out to evaluate the weed management practices on weed flora and yield of green gram and their residual effects on succeeding chickpea.

MATERIALS AND METHODS

The field experiment was conducted during *kharif* and *rabi* season in 2016-17 on a well levelled field at Agriculture farm of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.) to find out the appropriate weed management practices for higher productivity of green gram and its carry over effect on succeeding chickpea. The farm is situated in Kymore Plateau of Northern Madhya Pradesh ($25^0$10' N latitude and $80^0$52' E longitude and about 190-200 meter above mean sea levels). Agro-ecologically the field of study is characterized by semi-arid and subtropical climate with hot dry summer and cool winter. In mungbean-chickpea crop receives 905 mm rainfall from July to October with 36 rainy days. The soil of the experimental field was sandy loam in texture which has p^H 7.9 and low organic carbon (0.44 %) and available N (214.0 kg/ha), high available phosphorus (42.90 kg/ha) and low available potassium (50.15 kg/ha). In this study, 9 treatment was carried out which are as follows T_1 : Weedy check, T_2: Pendimethalin 1.0 kg a.i./ha-PE (Pre-emergence), T_3: Pendimethalin 30 EC + Imazethapyr 2 EC 0.75 kg a.i. /ha PE, T_4: Imazethapyr 10 SL 40g/ha at 15-20 DAS, T_5 : Imazamox 35 WG + Imazethapyr 35 WG 40 g/ha at 15-20 DAS, T_6 : Imazamox 35 WG + Imazethapyr 35 WG 60 g/ha at 15-20 DAS, T_7: Clodinafop propargyl 8% + Aciflourfen sodium 16.5% 125 g/ha at 15-20 DAS, T_8: Clodinafop propargyl 8% + Aciflourfen sodium 16.5% 187.5 g/ha at 15-20 DAS, T_9: Two manual weeding at 15-20 and 35-40 DAS. The mungbean 'PDM-139' was sown on 21.07.2016 at a row spacing of 30 cm using 20 kg seed/ha. The crop was fertilized with 20 kg N, 40 kg P_2O_5 and 20 kg K_2O/ha. Entire dose of fertilizer of mungbean was applied as basal dressing in furrows. Plant to plant spacing was maintained by thinning at 15 days after sowing. Herbicidal sprays were done either as pre-emergence or post emergence at 15-20 DAS as per treatment. The crop was protected from insect-pest through spray of Dimethoate. Mungbean was harvested on 28.09.2016.

The study on residual effect of herbicide was carried out for chickpea at the same place and having no herbicide application. The chickpea 'GNG-469' was sown on 23.10.2016 at a row spacing of 30 cm using 100 kg seed/ha. The crop was fertilized with 20 kg N, 50 kg P_2O_5 and 20 kg K_2O/ha. Entire dose was applied as basal dressing in furrows. All the plot of chickpea was observed the residual effect of herbicide application on preceding crop mungbean. All the standard cultural operations were followed for cultivation of chickpea. Chickpea was harvested on 23.03.2017

Density and weed dry weight were recorded at 30 DAS with the help of randomly placing quadrate (1m × 1m) of 1 m^2 in each plot. Three quadrate were thrown in each plot and then an average values were work out. Data on weed density and weed dry weight were subjected to square – root transformation ($\sqrt{X+1}$) before statistical analysis to normalize their distribution. Weed control efficiency (WCE) was calculated at 30 DAS with the help of formula given below (Mani *et al*., 1973).

$$WCE = \frac{\text{Dry weight of weeds - Dry weight of weeds in treated plot inunweeded control}}{\text{Dry weight of weeds in unweeded control}} \times 100$$

The relative density of individual weed was worked out as per formula proposed by Mishra (1968)

$$\text{Relative density (\%)} = \frac{\text{Number of individuals of the same species}}{\text{Number of individuals of the all species}} \times 100$$

Data were analyzed by using ANOVA and critical differences (CD) value at 5% level of significance were calculated and used to test significances between treatment means.

RESULTS AND DISCUSSION

Effect on Associated weed flora

The main weed species *Cynodon dactylon, Digitaria sanguinailis, Cyperus iria, Commelina cummunis,*

Table1: Weed population and relative weed density of different associated weed flora in experimental field at 30DAS

S.No.	Botanical Name	Family	Weed Population (per $m^{2)}$	Relative weed density (%)
A.	Monocot Weeds			
1.	*Cynodon dactylon*	Poaceae	3.67	3.42
2.	*Digitaria sanguinailis*	Poaceae	5.67	5.29
3.	*Cyperus iria*	Cyperaceae	6.00	5.61
4.	*Commelina cummunis*	Commelinaceae	3.00	2.80
5.	*Dactyloctenium aegyptium*	Poaceae	12.67	11.84
6.	*Echinocloa colonum*	Gramineae	10.33	9.65
		Sub. total	41.34	
B. Dicot Weeds				
1	*Phyllanthus niruri*	Euphorbiaceae	3.00	2.80
2	*Launaea nudicaulis*	Compositae	0.67	0.63
3	*Laucas aspera*	Lamiacease	3.00	2.80
4	*Cucumis melo*	Cucurbitaceae	3.00	2.80
5	*Digera muricata*	Amaranthaceae	53.00	49.53
6	*Convolvulus arvensis*	Convolvulaceae	3.00	2.80
		Sub. total	65.67	
		Total	107.01	99.97

Table 2: Effect of weed management practices on number of weeds/m², weed dry weight and weed control efficiency in mungbean and chickpea

Treatment	Mungbean at 30 DAS Weed density (per m²)	Weed dry weight (g/m²)	Weed Control Efficiency (%)	Chickpea at 30 DAS Weed density (per m²)	Weed dry weight (g/m²)	Weed Control Efficiency (%)
T_1: Weedy check	10.51 (111.0)	10.63 (112.12)	0.00	12.25 (149.00)	6.45 (41.33)	0.00
T_2: Pendimethalin 1.0 kg a.i./ha	7.07 (49.33)	8.10 (65.17)	41.00	11.60 (134.67)	6.04 (35.57)	37.68
T_3: Pendimethalin 30 EC + Imazethapyr 2EC 0.75kg/ha	6.92 (47.00)	5.94 (35.10)	69.00	11.18 (124.33)	4.43 (20.23)	56.52
T_4: Imazethapyr 10 SL 40g/ha at 15-20 DAS	8.70 (79.00)	7.55 (59.17)	46.67	10.17 (103.00)	3.43 (11.17)	47.83
T_5: Imazamox 35 WG + Imazethapyr 35 WG 40 g/ha at 15-20 DAS	7.84 (79.67)	8.54 (73.47)	33.33	11.13 (123.33)	3.99 (15.53)	33.33
T_6: Imazamox 35 WG + Imazethapyr 35 WG 60 g/ha 15-20 DAS	7.74 (62.00)	7.09 (51.70)	53.33	9.70 (95.33)	4.20 (16.87)	47.82
T_7: Clodinafop propargyl 8% + Aciflourfen sodium 16.5% 125 g/ha at 15-20 DAS	8.12 (59.33)	7.70 (60.83)	44.33	10.79 (117.33)	4.38 (19.03)	42.17
T_8: Clodinafop propargyl 8% + Aciflourfen sodium 16.5% 187.5 g/ha at 15-20 DAS	9.51 (65.33)	7.10 (50.80)	55.00	10.71 (114.33)	3.98 (9.63)	57.83
T_9: Two manual weeding at 15-20 and 35-40 DAS	9.87 (91.33)	4.23 (17.93)	84.00	10.88 (117.67)	4.33 (18.33)	64.35
S.Em ±	0.74	0.84	11.40	0.45	0.53	8.36
C.D. (P = 0.05)	2.23	2.50	34.17	1.34	1.59	25.06

*Data transformed using square root $\sqrt{X+1}$ and values in parenthesis are original

Dactyloctenium aegyptium, Echinocloa colonum, Phyllanthus niruri, Laucas aspera, Cucumis melo, Digera muricata and Convolvulus arvensis were found in mungbean field (Table 1). Out of total weed population in experiment field, *Digera muricata*, *Dactyloctenium aegyptium* and *Echinocloa colonum* were most dominant contributing about 71.02 percent of the total weed flora at 30 DAS. Relative density of mono cotyledonous weeds *Dactyloctenium aegyptium* and *Echinochloa colonum* was 11.84 and 9.65 % respectively whereas among the dicotyledonous weeds, *Digera muricata* recorded the highest relative density of 49.53%. The higher density of *Digera muricata* might be due to the fact that the favourable environment condition viz. temperature and moisture which provide quick germination, vegetative growth and survival capacity as well as the greater competitive ability than the other weeds. Sukhadia *et al.* (2000), Tomar *et al.* (2007) and Jyoti Bala (2016) were also found many weeds associated with pulse crops.

Effect on Weed density and Weed biomass

Weed density and weed biomass were recorded significantly higher in the treatment plots of weedy check (Table 2). In mungbean, the lowest weed population (per m²) was recorded under Pendimethalin 30 EC+Imazethapyr 2 EC 0.75 kg/ha ($T_{3)}$ as pre-emergence (47 weeds/m²) at 30 DAS while, the dry weight of weeds was found significantly least in manual weeding at 15-20 and 35-40 DAS (17.93 g/m²) followed by in Pendimethalin 30 EC + Imazethapyr 2 EC 0.75 kg/ha (35.10g/m²). This could be ascribed that pre-emergence application of Pendimethalin 30 EC + Imazethapyr 2 EC had having the high efficacy of weed control at early stage of crop which resulted in lower weed density. This results is in agreement with the previous findings reported by Singh and Rao (1992), Singh and Krishna Mohan (1994). Jyoti Bala (2016).Gupta *et al*. (2014) reported the good control of weeds with the application of Pendimethalin and Imazethapyr in blackgram.

In chickpea the lowest weed density per m² was recorded under Imazamox 35 WG + Imazethapyr 35 WG 60 g/ha 15-20 DAS (T_6) (95.33 weeds/m²) at 30 DAS. The dry matter of weeds was lowest in Clodinafop propargyl 8% + Aciflourfen sodium 16.5% 187.5 g/ha at 15-20 DAS (9.68 g/m²) followed by 11.17g/m² in Imazethapyr 10% SL 40g/ha at 15-20 DAS (T_4).

Effect on Weed control efficiency

In mungbean, weed control efficiency was maximum of 84 % in manual weeding at 15-20 and 35-40 DAS (T9) closely followed by 69 % in Pendimethalin 30 EC+Imazethapyr 2 EC 0.75 kg/ha (T3) and 55% in Clodinafop propargyl 8% + Aciflourfen sodium 16.5% 187.5 g/ha at 15-20 DAS (Table 2). These results are in confirmation to the findings of Singh and Krishna Mohan (1994), Padmaja *et al*. (2013) and Patil *et al*. (2016). Gupta *et al*. (2014) and Kumar *et al*. (2016) reported that post emergence application of Imazethapyr significantly reduced the weed population and weed biomass in black gram.

In chickpea, weed control efficiency (Table 2) was maximum of 72.08 % in Imazethapyr 10 SL 40g/ha at 15-20 DAS (T_4) closely followed by 62.41 % in Clodinafop propargyl 8% + Aciflourfen sodium 16.5% @ 187.5 g/ha at 15-20 DAS (T_8).

Table 3: Effect of weed management practices on yield of mungbean and chickpea

Treatment	Greengram		Chickpea	
	Seed Yield (kg/ha)	Stover Yield (kg/ha)	Seed Yield (kg/ha)	Stover Yield (kg/ha)
T_1 : Weedy check	404	1898	575	1675
T_2 : Pendimethalin 1.0 kg a.i./ha	504	2190	691	2031
T_3 : Pendimethalin 30 EC + Imazethapyr 2EC 0.75kg/ha	521	2421	774	1921
T_4 : Imazethapyr 10 SL 40g/ha at 15-20 DAS	528	2262	732	1722
T_5 : Imazamox 35 WG + Imazethapyr 35 WG 40 g/ha at 15-20 DAS	477	2143	772	2039
T_6 : Imazamox 35 WG + Imazethapyr 35 WG 60 g/ha 15-20 DAS	487	2143	758	1766
T_7 : Clodinafop propargyl 8% + Aciflourfen sodium 16.5% 125 g/ha at 15-20 DAS	498	2223	667	1729
T_8 : Clodinafop propargyl 8% + Aciflourfen sodium 16.5% 187.5 g/ha at 15-20 DAS	531	2699	570	1638
T_9 : Two manual weeding at 15-20 and 35-40 DAS	511	2540	697	1626
S.Em ±	21.54	144.8	43.81	135.28
C.D. (P = 0.05)	64.58	434.1	131.35	N.S.

Sullivan *et al*. (1998) reported that Imazamox soil residues were less injurious than Imazethapyr soil residues to vegetable crops grown in rotation. However, Singh (2014) was found the residual effect of Imazethapyr on succeeding sorghum crop. Similar results of Imazamox residues was reported by Yadav and Bhullar (2014).

Effect on mungbean yield

The seed and stover yield were recorded significantly higher in herbicidal treatment including manual weeding twice at 15-20 and 35-40 DAS than weedy check (Table 3). Application of Clodinafop propargyl 8% + Aciflorfen sodium 16.5% 187.5 kg/ha at 15-20 DAS (T_8) produced significantly maximum seed yield (531 kg/ha) of mungbean closely followed by 528 kg/ha in Imazethapyr 10 SL 40g/ha at 15-20 DAS (T_4), Pendimethalin 30 EC + Imazethapyr 2 EC 0.75 kg/ha (521 kg/ha) as pre-emergence (T_3) and Manual weeding at 15-20 and 35-40 DAS (511 kg/ha). It might be attributed to different yield attributes in general and seed weight/plant in particular. As the plant population was not affected by treatment, seed weight/plant has mainly responsible for seed yield per unit area which was statistically at par with each other. All these weed control treatment resulted in 18.06 to 31.43 % increase in seed yield/ha over weedy check. Such changes could be accredited to less crop-weed competition particularly at later stage of crop when effect of herbicide was diluted. Seed yield obtained lowest in weedy check treatment (404 kg/ha) which was due to maximum crop weed competition through out crop life. Stover yield also behaved in similar way. Stover yield of mungbean was noted significant superior in clodinafop propargyl 8% + Aciflourfen sodium 16.5% @ 187.5 g/ha at 15-20 DAS followed by two manual weeding at 15-20 and 35-40 DAS and Pendimethalin 30 EC + Imazethapyr 2 EC @ 0.75 kg a.i./ha PE which were statistically at par among them and statistically higher than rest of treatments including weedy check. The superiority of most weed control treatment over weedy check under increasing seed and stover yield are in close confirmity with those of Jyoti Bala (2016), Kumar *et al*. (2016) and Chaudhary *et al*. (2016), Gupta *et al*. (2014) and Aradhana *et al*. (2016).

Residual effect on chickpea yield

Grain yield (774 kg/ha) of chickpea was recorded significantly superior under residual effect of Pendimethalin 30 EC + Imazethapyr 2EC 0.75 kg/ha followed by post emergence application of Imazethapyr 10% SL 40g/ha (772kg/ha). Straw yield (2039 kg/ha) was obtained maximum with post emergence application of Imazamox 35 WG + Imazethapyr 35 WG @ 40 g/ha followed by application of Pendimethalin @ 1.0 kg a.i./ha (2031 kg/ha) as pre-emergence which gave higher than other herbicidal treatments (Table 3). These effects were due to suppression of weeds in crop in weedy check and higher weed control efficiency in herbicidal treatments. Singh (2014) observed the residual effect of Imazethapyr on sorghum crop. However, Yadav and Bhullar (2014) reported that highest sensitivity to Imazamox was observed on sugarbeet but oilseed, wheat, sunflower and maize was less sensitive to Imazamox residues. While, Nepaliya and Jain (2000) exhibited that yield and yield attributes of summer green gram was remain unaffected by pre emergence weed control practices of preceeding crop.

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