International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

I J F B S International Journal of Fauna And Biological Studies

ISSN 2347-2677
IJFBS 2019; 6(3): 20-24
Received: 11-03-2019
Accepted: 15-04-2019

Sahaja Deva
Department of Agronomy, Indira Gandhi Krishi Viswavidyalaya, Raipur, Chhattisgarh, India

SS Kolhe
Department of Agronomy, Indira Gandhi Krishi Viswavidyalaya, Raipur, Chhattisgarh, India

Correspondence
Sahaja Deva
Department of Agronomy, Indira Gandhi Krishi Viswavidyalaya, Raipur, Chhattisgarh, India

Irrigation time and weed management to enhance productivity of chickpea (*Cicer arietinum* L.)

Sahaja Deva and SS Kolhe

Abstract
Field experiment was carried out at Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) during *Rabi* seasons of 2013-14 and 2014-15 to study the effect of irrigation time and weed management practices on weed competition and growth, yield as well as economics of chickpea. Irrigation application before or after sowing of chickpea was observed equally effective for enhancing dry matter of chickpea, yield components *viz*., number of pods/plant, number of seeds/pod, 100 seed weight, seed and haulm yield as well as harvest index. Similarly, weed competition in terms of dry matter of weeds, weed control efficiency and weed index was remained unaltered due to irrigation applied before or after sowing of chickpea. Among weed management practices, hand weeding twice was the best treatment in controlling weeds and produced the highest seed yield, haulm yield, gross returns and net returns as well as B: C ratio. Among herbicides, oxyfluorfen 0.3 kg/ha as pre-emergence was found significantly superior over other herbicides in producing dry matter, yield attributes, seed and haulm yield of chickpea and recorded the highest weed control efficiency (WCE). It also gave the higher gross return, net return as well as benefit: cost ratio than rest of the treatments. The minimum yield (0.90 t/ha) and the maximum weed index (47.82%) was recorded under untreated control.

Keywords: chickpea, herbicide, irrigation time, weed control efficiency, weed index, weed management

Introduction
Protein starvation is causing a most serious malnutrition problem of the mankind particularly in developing countries. The pulse crops are, in general, rich in protein and contributing the major protein dietaries especially for vegetarian communities. The pulse production can be increased either through increased cropped area or productivity to meet the demand of future generation. In high rainfall areas, monocropping is followed during *Kharif* season and thereafter the land remains fallow during *Rabi* season. These areas can be converted into double cropping with growing of pulses during *Rabi* season. Chickpea is one of the best options among pulses in India. In India, its area, production and productivity are 9.54 mha, 9.08 mt and 951 kg/ha, respectively (Agricultural statistics at a glance, 2010) which contribute highest share in area (65.3%) and production (67.2%) in the world (FAO, 2009) [4]. In Chhattisgarh, chickpea is also one of the important pulses and occupies an area of 375.76 thousand ha with production and productivity of 402.06 thousand ton and 1070 kg/ha, respectively (Anonymous, 2013) [2].
Because of initial slow growth rate and limited leaf area development, it is a poor competitor to weeds. Introduction of herbicides has made it possible to control wide spectrum of weed species in pulses effectively. Proper use of herbicides may manage weeds during critical crop-weed competition period and thereby helps in enhancing the productivity of crops. Hence, there is need to develop suitable weed management practices in chickpea.
In rice-chickpea cropping system, irrigation is applied either after harvest of rice to facilitate ease of field preparation or sowing of chickpea or after field preparation and sowing of chickpea. The impact of application of irrigation before or after sowing of chickpea has not been evaluated. So there is need to know the correct time of irrigation *i.e* irrigation before sowing or irrigation after sowing. In light of the above the field experiment was carried out to find out the suitable herbicide and time of irrigation.

Materials and Methods
The present investigation on ‘‘Effect of irrigation time and weed management practices on growth, yield, economics and weed dynamics of late sown

chickpea in rice based cropping system'' was carried out during *Rabi* seasons of 2013-14 and 2014-15 at the Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) located between 21°4' N latitude and 81°39' E longitude with an altitude of 298 me above mean sea level having sub tropical humid climate. The experimental soil was clayey (vertisol) with pH 7.12, EC 0.20 m mhos m^{-1}, low in available nitrogen (212.6 kg N ha^{-1}), medium in available phosphorus (12.50 kg P ha^{-1}), high in available potassium (300.3 kg K ha^{-1}) and organic carbon (0.48 %). The experiment was laid out in strip plot design with three replications with a plot size of 3.5 m x 4.5 m. Vertical strip consisted of irrigation time *viz* (i) irrigation before sowing, and (ii) irrigation after sowing. Horizontal strip consisted of seven weed management practices *viz.* (1) pre- emergence application of pendimethalin 1.0 kg/ha, (2) pre- emergence application of imazethapyr 0.04 kg/ha, (3) pre- emergence application of oxyfluorfen 0.3 kg/ha, (4) pre- emergence application of metribuzin 0.4 kg/ha, (5) pre- emergence application of sulfentrazone 0.3 kg/ha, (6) hand weeding twice at 20 and 40 DAS and (7) untreated control. Mode of action of sulfentrazone is protoporphyrinogen oxidase inhibition (membrane disruption). Recommended dose of N, P_2O_5 and K_2O *i.e.* 20:50:30 Kg/ha was applied through urea, single super phosphate and muriate of potash, respectively as basal dose. Chickpea seed variety 'JG-226' was treated with carbendazim @ 2-3 g/kg seed and *Trichoderma* sps @ 10 g/kg seed and then sown in lines at a spacing of 30 cm manually. After sowing, seeds were covered with soil while planking. Initial irrigation *i.e.* before or after sowing was given according to the treatments. Herbicides were sprayed 3 DAS using knapsack sprayer. Hand weeding was done at 20 and 40 DAS.

The data on weeds were recorded and analyzed using square root transformation ($\sqrt{X + 0.5}$) to normalize their distribution. The weed index, weed control efficiency and relative dry weight were calculated using the standard formulas. Cost of cultivation, gross and net returns in each season were calculated on the basis of prevailing price of chickpea as well as inputs applied. All observations on growth, yield and weed dynamics were statistically analysed as suggested by Gomez and Gomez (1984) [5].

Results and Discussion

Growth parameters

Dry matter accumulation remained unaltered due to time of irrigation to chickpea. Whereas weed management exhibited significant influence on dry matter accumulation and pods/plant in chickpea (Table 1).

Weed management practices exerted significant impact on dry matter accumulation of chickpea at 45 DAS and at harvest. Hand weeding produced the maximum dry matter accumulation followed by pre- emergence application of oxyfluorfen 0.3 kg/ha. Among herbicides, pre-emergence application of oxyfluorfen 0.3 kg/ha exhibited the maximum dry matter accumulation. In variance, the minimum dry matter accumulation was recorded in untreated control. Higher dry matter accumulation is due to less competition of weeds lead to more uptake of nutrients. Gupta *et al* (2012) [6] reported that hand weeding twice produced higher dry matter accumulation of chickpea. Singh *et al* (2003) [10] reported higher dry matter in all weed control measures compared to unweeded control.

Yield attributes

Non-significant influence on yield attributes were recorded by the irrigation time treatment. Weed management practices showed significant influence on number of pods/plant but number of seeds/pod and test weight does not influenced significantly (Table 2). Hand weeding produced the maximum number of pods/plant which was at par with pre-emergence application of oxyfluorfen 0.3 kg/ha. Amongst different herbicides treatments, pre-emergence application of oxyfluorfen 0.3 kg/ha produced maximum number of pods/plant, was at par with pre-emergence application of metribuzin 0.4 kg/ha and sulfentrazone 0.3 kg/ha during both the years, and in turn at par with pre-emergence application of pendimethalin 1.0 kg/ha during 2013-14. The minimum number of pods/plant were recorded in untreated control. Hassan and Khan (2007) [7] reported that herbicides and hand weeding had significant effect on the number of pods $plant^{-1}$. The highest number of pods/ plant was recorded in hand weeding (45.00).

This could be due to the less competition at critical periods of crop growth and better suppression of weeds, which allowed the crop to grow better by absorbing sufficient nutrients, light, moisture and space which facilitate more translocation of photosynthates towards the reproductive parts as well as presence of favourable agro-climatic conditions due to removal of weeds led to more dry matter accumulation of chickpea and number of pods/plant.

The interaction effect of irrigation time and weed management practices was found to be non- significant on dry matter accumulation (g/plant), number of pods/plant, number of seeds/pod as well as 100 seed weight.

Productivity

Seed and haulm yield of chickpea was not significant influenced by time of irrigation. Weed management practices exerted significant impact on seed and haulm yield of chickpea (Table 2). The highest seed yield (17.94 q/ha) was produced in hand weeding at 20 and 40 DAS. On the contrary, the lowest seed yield (9.48 q/ha) was observed under unweeded check. Among the herbicidal treatments, pre-emergence application of oxyfluorfen 0.3 kg/ha exhibited the maximum seed yield which was at par with pre- emergence application of metribuzin 0.4 kg/ha. Similar higher yield in two manual weedings was also reported by Dixit *et al* (2015) [3]. Higher yield in oxyfluorfen was also reported by Ratnam *et al* (2011) [9].

Higher seed yield under above treatments was due to the effective weed management at initial crop growth period which facilitated better crop growth in terms of higher dry matter production of chickpea. This resulted in higher production of photosynthates and greater translocation of food materials from source to reproductive parts which enhanced yield attributing characters and ultimately seed yield of chickpea. The higher weed control efficiency and positive correlation between yield attributes and seed yield under hand weeding and pre- emergence application of oxyfluorfen 0.3 kg/ha further confirm the lower weed-crop competition and beneficial effect of yield attributes on seed yield of chickpea.

On the other hand, the poor growth of chickpea plants as well as development of yield attributing characters in weedy check might be due to less moisture, nutrient, space and light availability at reproductive stage of chickpea adversely affected the seed yield. The lower seed yield under weedy

check may be due to the high weed interference.

The maximum haulm yield was recorded in two hand weedings followed by pre- emergence application of oxyfluorfen 0.3 kg/ha, whereas the lowest was observed in untreated control. Among the herbicidal treatments, pre-emergence application of oxyfluorfen 0.3 kg/ha produced the maximum haulm yield which was at par with pre- emergence application of Metribuzin 0.4 kg/ha, which is also at par with pre- emergence application of Sulfentrazone 0.3 kg/ha during 2014-15. Premnath *et al* (2013) [8] reported that hand weeding at 30 DAS proved its superiority over other methods of weed control in respect of all the growth characters and yield attributes as well as grain and straw yield of chickpea crop.

The higher haulm yield in above treatments was due to lesser weeds during early crop growth period and get higher yield attributes and pod yield which leads to higher haulm yield. While, in weedy check reverse trend was observed and therefore, the lowest haulm yield was noted under this treatment. The interaction effect of irrigation time and weed management practices was found non significant on seed and haulm yield.

The beneficial effect of yield attributes on yield was proved through the positive correlation presented in Table.

Weed

Medicago denticulata, *Chenopodium album* and *Melilotus indica* were the major weeds flora present in the experimental field. The major weed species recorded at 45 DAS and at harvest were depicted in Fig 1. The percentage composition of *Medicago denticulata* of 85% and 86% during 2013-14 and 2014-15, respectively at 45 DAS and 80% and 82% during 2013-14 and 2014-15, respectively at harvest followed by *Melilotus indica* and *Chenopodium album*. Imazethapyr could not controlled leguminous weeds and therefore, recorded the maximum weed flora as *Medicago denticulata* and *Melilotus indica* contributed more than 90% of weed flora. Pre-emergence application of Oxyfluorfen is the best in minimizing weed flora as it control the major species observed in the experimental field.

Dry matter of *Medicago denticulata* was highest followed by *Melilotus indica* and *Chenopodium album*. Hand weeding at 20 and 40 DAS proved to be the best in minimizing the dry matter of weeds and recorded the lowest dry matter at harvest followed by pre- emergence application of oxyfluorfen 0.3 kg/ha. Among herbicidal treatments, lowest dry matter of weeds was observed under pre- emergence application of oxyfluorfen 0.3 kg/ha followed by pre-emergence application of Metribuzin 0.4 kg/ha during 2013-14 and pre-emergence application of sulfentrazone 0.3 kg/ha during 2014-15. Ratnam *et al* (2011) [9] reported that hand weeded plot at 15 and 30 DAS gave lowest dry matter production of weeds. Irrigation time did not showed significant effect on dry matter of weeds, weed index and weed control efficiency but significantly influenced by weed management practices (Table 3).

Among the herbicidal treatments, pre- emergence application of oxyfluorfen 0.3 kg/ha showed the minimum weed index. It was comparable to pre-emergence application of metribuzin 0.4 kg/ha. This clearly indicated that weeds were controlled effectively under pre- emergence application of oxyfluorfen 0.3 kg/ha. In variance, the maximum weed index was recorded in untreated control.

Weed index indicate the reduction in yield due to weed competition as compared to the maximum attained seed yield. The maximum weed index under untreated control was due to the fact, that there was severe weed competition resulted in the minimum seed yield of chickpea.

The weed control efficiency at harvest was the maximum under hand weeding twice and it was comparable to pre-emergence application of oxyfluorfen 0.3 kg/ha during 2014-15 at 45 DAS. Among the herbicidal treatments, weed control efficiency is highest with pre- emergence application of oxyfluorfen 0.3 kg/ha, during both the years as well as in mean data followed by pre-emergence application of metribuzin 0.4 kg/ha.

These results might be due to owing to less weed density and production of dry matter by weeds in the treated plots.

Interaction effect of irrigation time and weed management practices were found non significant on dry matter of weeds, weed index, weed control efficiency.

The detrimental effect of weed dry matter on yield was proved through the negative correlation presented in Table.

Economics

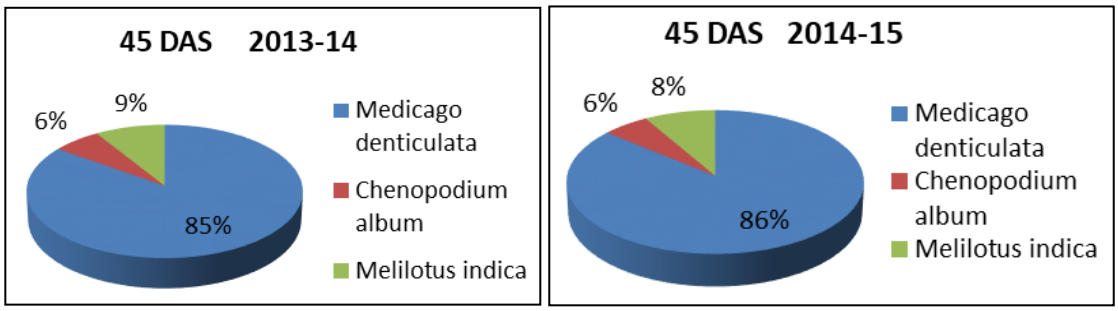
The effect of irrigation time on cost of cultivation, gross returns, net returns and benefit: cost ratio was found non significant (Table 4).

Amongst the weed management practices, hand weeding twice gave the maximum gross returns, net returns and benefit: cost ratio. Among the herbicides, oxyfluorfen 0.3 kg/ha recorded maximum gross returns, net returns and benefit: cost ratio. Minimum gorss returns, net returns and benefit: cost ratio was recorded in unweeded control.

The higher gross return, net return and B:C ratio under oxyfluorfen was due to the fact that higher seed and haulm yields associated with lower cost of cultivation.

Interaction effect of irrigation time with weed management practices on economics were found non-significant.

On the basis of results obtained, it can be concluded that irrigation before or after sowing of chickpea and weed management through hand weeding at 20 and 40 DAS was the best to achieve the maximum seed yield as well as net returns from chickpea. However, in the paucity of availability of labourers, pre- emergence application of oxyfluorfen 0.3 kg/ha is the appropriate proposition to obtain higher yield and net return of chickpea.



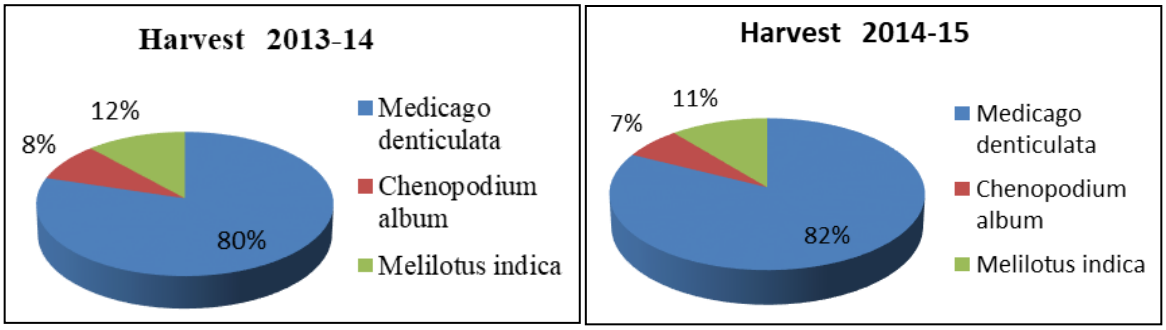


Fig 1: Weed flora composition at 45 DAS and at harvest in chickpea during 2013-14 and 2014-15 as influenced by irrigation time and weed management practices

Table 1: Effect of irrigation time and weed management practices on dry matter accumulation of Chickpea

Treatments	Dry matter accumulation of chickpea (g/plant)					
Irrigation time	45DAS			Harvest		
	2013-14	2014-15	Mean	2013-14	2014-15	Mean
Irrigation before sowing (4 DBS)	3.52	4.58	4.05	13.30	15.10	14.20
Irrigation after sowing (2 DAS)	3.67	4.76	4.22	14.18	15.66	14.92
SEm±	0.12	0.10	0.12	0.27	0.14	0.20
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	-	-	-	-	-	-
Weed management practices/Herbicide treatments						
Pendimethalin 1.0 kg/ha (PE)	3.50	4.47	3.99	13.23	15.02	14.13
Imazethapyr 0.04 kg/ha (PE)	2.65	3.98	3.32	11.60	13.22	12.41
Oxyfluorfen 0.3 kg/ha (PE)	4.21	4.98	4.60	15.29	16.76	16.03
Metribuzin 0.4 kg/ha (PE)	3.97	4.65	4.31	14.53	15.78	15.16
Sulfentrazone 0.3 kg/ha (PE)	3.65	4.56	4.11	13.98	15.34	14.66
Hand weeding twice (20 and 40 DAS)	4.88	6.33	5.61	16.11	17.50	16.81
Untreated control	2.80	3.71	3.26	10.44	13.06	11.75
SEm±	0.12	0.17	0.12	0.57	0.39	0.46
CD (P=0.05)	0.38	0.52	0.38	1.75	1.21	1.40
CV (%)	8.14	11.19	8.29	9.44	6.23	7.41
I X W	S	NS	NS	NS	NS	NS

I x W: interaction of irrigation time and weed management
S: significant, NS: non-significant

Table 2: Effect of irrigation time and weed management practices on yield attributes and yield of Chickpea

Treatments	No. of pods/plant			No. of seeds/pod			100 seed weight (g)			Seed yield (q/ha)			Haulm yield (q/ha)		
Irrigation time	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean
Irrigation before sowing (4 DBS)	29.29	33.81	31.55	2.00	2.00	2.00	13.37	14.55	13.96	11.32	15.07	13.19	13.79	16.36	15.07
Irrigation after sowing (2 DAS)	30.81	34.48	32.65	2.00	2.00	2.00	13.37	14.53	13.95	12.36	15.21	13.79	14.27	16.76	15.52
SEm±	0.47	0.60	0.50	0.03	0.09	0.05	0.11	0.27	0.12	0.31	0.17	0.25	0.26	0.08	0.16
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Weed management practices/Herbicide treatments															
Pendimethalin 1.0 kg/ha (PE)	29.00	32.67	30.84	2.00	2.00	2.00	12.60	14.45	13.53	10.41	14.54	12.48	13.10	16.26	14.68
Imazethapyr 0.04 kg/ha (PE)	24.83	28.90	26.87	2.00	2.00	2.00	12.45	13.93	13.19	9.17	11.14	10.16	11.87	13.74	12.81
Oxyfluorfen 0.3 kg/ha (PE)	33.67	37.67	35.67	2.00	2.20	2.10	13.95	15.10	14.53	13.42	18.22	15.82	15.68	19.00	17.34
Metribuzin 0.4 kg/ha (PE)	31.00	35.67	33.34	2.00	2.00	2.00	13.82	14.85	14.34	12.42	16.80	14.61	14.72	18.00	16.36
Sulfentrazone 0.3 kg/ha (PE)	30.00	34.00	32.00	2.00	2.00	2.00	12.65	14.62	13.64	11.33	15.64	13.48	13.70	16.76	15.23
Hand weeding twice (20 and 40 DAS)	36.50	38.00	37.25	2.20	2.20	2.20	14.05	15.32	14.69	16.20	19.67	17.94	18.15	20.50	19.33
Untreated control	22.83	28.17	25.50	2.00	1.80	1.90	12.07	13.52	12.80	8.95	10.01	9.48	11.98	13.21	12.60
SEm±	1.03	0.96	0.72	0.06	0.11	0.09	0.44	0.40	0.41	0.44	0.46	0.32	0.47	0.68	0.32
CD (P=0.05)	3.16	2.96	2.22	NS	NS	NS	NS	NS	NS	1.34	1.42	1.00	1.44	2.08	0.99
CV (%)	7.49	6.90	5.22	-	-	-	-	-	-	9.02	7.45	5.87	8.08	9.99	5.16
I X W	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Effect of irrigation time and weed management practices on dry matter, Weed index and Weed control efficiency of Chickpea

Treatments	Weed dry matter (g/m^2)						Weed index (%)			Weed control efficiency (%)					
Irrigation time	45DAS			Harvest						45 DAS			At harvest		
	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean	2013-14	2014-15	Mean
Irrigation before sowing (4 DBS)	7.31 (69.36)	6.92 (62.32)	7.12 (65.84)	9.76 (114.05)	9.41 (106.19)	9.58 (110.12)	26.73	21.30	24.02	51.41	51.34	51.37	47.74	49.73	48.74
Irrigation after sowing (2 DAS)	7.23 (65.36)	6.88 (59.85)	7.06 (62.61)	9.68 (110.17)	9.06 (96.95)	9.37 (103.56)	33.76	23.48	28.62	50.52	51.97	51.25	47.60	48.50	48.05
SEm±	0.21	0.20	0.21	0.08	0.11	0.10	4.10	1.75	3.24	1.73	1.80	1.68	2.70	2.64	2.50
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Weed management practices/Herbicide treatments															
Pendimethalin 1.0 kg/ha (PE)	10.45 (108.61)	9.91 (97.37)	10.18 (102.99)	13.16 (172.53)	12.52 (156.27)	12.84 (164.40)	38.66	25.42	32.04	19.65	21.14	20.40	19.09	21.81	20.45
Imazethapyr 0.04 kg/ha (PE)	11.62 (134.56)	11.21 (124.96)	11.42 (129.76)	14.19 (200.74)	13.50 (182.12)	13.85 (191.43)	45.58	42.90	44.24	3.64	1.61	2.63	5.13	8.50	6.82
Oxyfluorfen 0.3 kg/ha (PE)	3.46 (10.98)	2.98 (7.97)	3.22 (9.48)	5.11 (25.19)	4.74 (21.50)	4.92 (23.35)	20.72	6.23	13.47	91.71	93.68	92.70	88.08	89.21	88.65
Metribuzin 0.4 kg/ha (PE)	6.28 (38.64)	5.92 (34.09)	6.10 (36.37)	9.04 (81.30)	8.51 (71.76)	8.78 (76.53)	26.89	13.70	20.30	70.86	72.36	71.61	62.07	64.03	63.05
Sulfentrazone 0.3 kg/ha (PE)	6.32 (39.12)	5.90 (33.88)	6.11 (36.50)	8.97 (79.49)	8.65 (73.90)	8.81 (76.69)	32.55	19.93	26.24	70.85	72.81	71.83	62.53	63.02	62.78
Hand weeding twice (20 and 40 DAS)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	2.80 (7.01)	2.54 (5.52)	2.67 (6.26)	0.00	0.00	0.00	100.0	100.0	100.0	96.79	97.24	97.02
Untreated control	11.78 (139.63)	11.36 (129.35)	11.57 (134.49)	14.77 (218.52)	14.17 (199.94)	14.47 (209.23)	47.30	48.56	47.93	0.00	0.00	0.00	0.00	0.00	0.00
SEm±	0.27	0.14	0.20	0.24	0.34	0.30	2.09	1.40	1.24	2.01	1.63	1.50	2.96	2.34	1.47
CD (P=0.05)	0.82	0.43	0.6	0.74	1.04	0.97	6.43	4.30	3.84	6.18	5.01	4.62	9.13	7.20	4.53
CV (%)	9.00	4.93	6.78	6.04	8.93	7.23	16.90	15.28	11.59	9.64	7.22	7.15	15.22	11.66	7.44
I X W	NS	NS	NS	S	S	S	NS	NS	NS	NS	NS	NS	S	S	NS

Table 4: Effect of irrigation time and weed management practices on economics of Chickpea

Treatments	Cost of cultivation (Rs/ha)			Gross returns (Rs/ha)			Net returns (Rs/ha)			B:C ratio		
Irrigation time	2013-14	2014-15	mean	2013-14	2014-15	mean	2013-14	2014-15	mean	2013-14	2014-15	mean
Irrigation before sowing (4 DBS)	21957	23459	22708	48923	69451	59187	26966	45992	36479	2.23	2.96	2.60
Irrigation after sowing (2 DAS)	21957	23459	22708	53339	70121	61730	31382	46718	39050	2.43	3.00	2.72
Weed management practices/Herbicide treatments												
Pendimethalin 1.0 kg/ha (PE)	20305	21751	21028	44932	66956	55944	24627	45205	34916	2.21	3.08	2.65
Imazethapyr 0.04 kg/ha (PE)	20160	21606	20883	39701	51504	45603	19541	29898	24720	1.97	2.38	2.18
Oxyfluorfen 0.3 kg/ha (PE)	19585	21031	20308	57932	83864	70898	38347	62833	50590	2.96	3.99	3.48
Metribuzin 0.4 kg/ha (PE)	20590	22036	21313	53636	77310	65473	33046	55274	44160	2.60	3.51	3.06
Sulfentrazone 0.3 kg/ha (PE)	19735	21181	20458	48956	72056	60506	29221	50875	40048	2.48	3.40	2.94
Hand weeding twice (20 and 40 DAS)	23561	25455	24508	74055	90538	82297	50494	65083	57789	3.14	3.56	3.35
Untreated control	18985	20431	19708	38788	46366	42577	19803	25935	22869	2.04	2.27	2.16

Acknowledgement
Financial support by DST- INSPIRE is duly acknowledged.

References

1. Agricultural statistics at a glance, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, 2016, 12
2. Anonymous. Krishi Darshika, I.G.K.V., Raipur, Chhattisgarh, 2013, 4.
3. Dixit AK, Kumar S, Rai AK, Kumar TK. System productivity, profitability, nutrient uptake and soil health under tillage, nutrient and weed management in rainfed chickpea (*Cicer arietinum*)-fodder sorghum (*Sorghum bicolor*) cropping system. Indian Journal of Agronomy. 2015; 60(2):205-211.
4. FAO. FAOSTAT Production Statistics, Food and Agriculture Organization, Rome, 2009. (http://www.fao.org)
5. Gomez KA, Gomez AA. Statistical procedures for agricultural research. A Willey Inter Sci. Publication. John Willey & Sons, New York, 1984.
6. Gupta V, Singh M, Kumar J, Kumar A, Singh BN, Jamwal BS. Screening of post- emergence herbicides in chickpea (*Cicer arietinum*) under rainfed conditions. Legume Res. 2012; 35(4):320-326.
7. Hassan G, Khan I. Post emergence herbicidal control of *Asphodelus tenuifolius* in desi chickpea (*Cicer arietinum* L.). Weed Sci. Soc. of Pakistan. 2007; 13(1-2): 33-38
8. Prem Nath, Jai Dev, Amar Nath, Shiv Nath, Satpal, Rajesh *et al*. Response of chickpea (*Cicer arietinum* L.) to phosphorus and weed control measures on yield and quality. Annals of Biology. 2013; 29(3):340-345.
9. Ratnam M, Rao AS, Reddy TY. Integrated weed management in chickpea (*Cicer arietinum* L.). Indian Journal of Weed Science. 2011; 43(1, 2):70-72.
10. Singh RV, Sharma AK, Tomar RKS. Weed control in chickpea (*Cicer arietinum*) under late sown condition. Indian Journal of Agronomy. 2003; 48(2):114-16.