The Pharma Innovation Journal 2022; 11(2): 2054-2057

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(2): 2054-2057

www.thepharmajournal.com
Received: 18-12-2021
Accepted: 27-01-2022

Vijay Laxmi Yadav
Ph.D., Research Scholar, Division of Agronomy, Rajasthan Agricultural Research Institute, Durgapura, SKNAU, Jobner, Rajasthan, India

UN Shukla
Assistant Professor, Department of Agronomy, College of Agriculture, AU, Jodhpur, Rajasthan, India

KK Bijarnia
Research Scholar, CCS Haryana Agricultural University, Hisar, Haryana, India

Devi Lal Kikraliya
M.Sc. Student, College of Agriculture, AU, Jodhpur, Rajasthan, India

Corresponding Author:
Vijay Laxmi Yadav
Ph.D., Research Scholar, Division of Agronomy, Rajasthan Agricultural Research Institute, Durgapura, SKNAU, Jobner, Rajasthan, India

Crop productivity, profitability and weed indices as influenced by various herbicides in chickpea (*Cicer arietinum* L.)

Vijay Laxmi Yadav, UN Shukla, KK Bijarnia and Devi Lal Kikraliya

Abstract
A field experiment entitled "Efficacy of pre and post-emergence herbicides on growth and yield of chickpea (*Cicer arietinum* L.)" was carried out at the Agricultural Research Station, Mandor, Jodhpur during the *rabi* season 2016-17. The investigation was laid out in the randomized block design (RBD) with sixteen treatments and replicated three times. Sixteen treatments were tested, with two doses of each herbicide, namely pendimethalin (0.40 and 0.60 kg *a.i.*/ha), Oxyfluorfen (100 and 200 g *a.i.*/ha), and imazethapyr (40 and 60 g *a.i.*/ha), with their combinations as pre and post-emergence, including weedy check and weed free. Among the weed management treatments, sequential application of pre and post-emergence herbicides *i.e.* pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS significantly reduced weed intensity at harvest that improved the productivity and profitability of chickpea over weedy check, but it was equally effective with the treatment combination pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS. Above treatments were also recorded higher weed persistence index, crop resistance index, herbicide efficiency index, weed management index and agronomic management index as compared to weedy check.

Keywords: Chickpea, weed management, herbicides, weed intensity, productivity, Profitability

Introduction
Pulses are considered as the most significant food crops after cereals which are not only provide a major source of dietary protein for the world's vegetarian population, but also provide 20% of dietary calories. Chickpea (*Cicer arietinum* L.) occupies crucial position amid the pulses by virtue of its short growth period, huge tonnage capacity and outstanding nutrient value as food, feed and forage. Weed control is a critical aspect of crop production, particularly in pulses. Early and heavy weed flushes are recognized as a significant bottleneck in recognizing he full yield potential of chickpea (Dubey *et al.*, 2018) [1]. This is a short stature crop with slow initial growth that is heavily infested with a diverse range of weeds. Ratnam *et al.* (2011) [2] has also narrated that chickpea is poor competitor to weeds, because of its slow growth rate at early stage of crop establishment, if weed management is neglected under these conditions, resulting in yield loss of 60%. Hand weeding still widely practiced for controlling weeds is costly for local farmers. The high cost and non-availability of labour at right time force the farmers for opting alternative, cheaper and easier method of weed control. To control these weed flushes, the sequential application of pre and post-emergence herbicides is only the effective ways. In view of the above major agronomic constraints in chickpea cultivation, the present investigation entitled "Efficacy of pre and post-emergence herbicides on growth and yield of chickpea (*Cicer arietinum* L.)" was conducted during *rabi* season of 2016-17.

Material and Methods
The experiment was carried out at research farm, Agricultural Research Station, Agriculture University, Jodhpur. The climate of Jodhpur is typically arid with hot dry summers. The soil of the experiment has medium range of pH and EC that favoured better crop management during the year of investigation.
The experiment was laid out in randomized block design (RBD) with sixteen weed control treatments, *viz.*, Weedy Check, Weed free, Pendimethalin @ 0.40 kg *a.i.*/ha (PE), Pendimethalin @ 0.60 kg *a.i.*/ha (PE), Oxyfluorfen @ 100 g *a.i.*/ha (PE), Oxyfluorfen @ 200 g *a.i.*/ha (PE), Imazethapyr @ 40 g *a.i.*/ha at 20 DAS, Imazethapyr @ 60 g *a.i.*/ha at 20 DAS, Pendimethalin @ 0.40 kg *a.i.*/ha (PE) + imazethapyr @ 40 g *a.i.*/ha at 20 DAS, Pendimethalin

@ 0.40 kg *a.i.*/ha (PE) + imazethapyr @ 60 g *a.i.*/ha at 20 DAS, Pendimethalin @ 0.60 kg *a.i.*/ha (PE) + imazethapyr @ 40 g *a.i.*/ha at 20 DAS, Pendimethalin @ 0.60 kg *a.i.*/ha (PE) + imazethapyr @ 60 g *a.i.*/ha at 20 DAS, Oxyfluorfen @ 100 g *a.i.*/ha (PE + imazethapyr @ 40 g *a.i.*/ha at 20 DAS, Oxyfluorfen @ 100 g *a.i.*/ha (PE) + imazethapyr @ 60 g *a.i.*/ha at 20 DAS, Oxyfluorfen @ 200 g *a.i.*/ha (PE) + imazethapyr @ 40 g *a.i.*/ha at 20 DAS and Oxyfluorfen @ 200 g *a.i.*/ha (PE) + imazethapyr @ 60 g *a.i.*/ha at 20 DAS. As per treatments, pre-emergence application of pendimethalin and oxyfluorfen were applied within three days of sowing, while post-emergence application of imazethapyr was applied at 20 DAS.

The data on different weed indices calculated on the basis of mean data at harvest and have been presented in along with crop productivity and profitability per day.

Weed Intensity (WI): Weed intensity was worked out as per Rana and Kumar (2014) [3]:

$$WI = \frac{\text{Weed population}}{\text{Weed + crop population}}$$

Weed persistence index (WPI): This index indicates the resistance in weeds against the tested treatments and confirms the effectiveness of the selected herbicides, and the same was computed using the given formula as suggested by Mishra and Mishra (1997) [4]:

$$WPI = \frac{W_T}{W_C} \times \frac{W_{PC}}{W_{PT}}$$

Where

W_T = Weed dry weight in treated plot
W_C = Weed dry weight in control (unweeded) plot
W_{PC} = Weed population in control (unweeded) plot
W_{PT} = Weed dry weight in treated plot

Crop resistance index (CRI): The relationship between the crop biomass and weed biomass can be correlated with the help of crop resistance index and its shows indirect proportionate relationship to each other. The index can be calculated with the help of below mentioned formula given by Mishra and Mishra (1997) [4] as follows.

$$WPI = \frac{W_{CT}}{W_{CC}} \times \frac{W_C}{W_T}$$

Where

W_{CT} = Dry matter production by the crop in treated plot
W_{CC} = Dry matter production by the crop in control plot
W_C = Dry matter production of weed in control
W_T = Dry matter production of weeds in treated plot

Herbicide Efficiency Index (HEI): This index indicates the potential of herbicides for killing weeds and their phytotoxicity on the crop and was computed using the following formula (Krishnamurthy *et al.*, 1975) [5].

$$HEI = \frac{\frac{Y_T - Y_C}{Y_C}}{\frac{W_T}{W_C}}$$

Where

Y_T = Yield of treated plot
Y_C = Yield of control (unweeded) plot
W_C = Weed dry weight in control (unweeded) plot
W_T = Weed dry weight in treated plot

Weed Management Index (WMI): This index indicates the yield increase with respect to control because of weed management options taken and percent control of weeds by the respective treatment.

$$WMI = \frac{\text{Percent crop yield increase over control}}{\text{Percent control of weeds}}$$

Agronomic Management Index (AMI)

$$AMI = \frac{\frac{Y_T - Y_C}{Y_C} - \frac{W_C - W_T}{W_C}}{\frac{W_C - W_T}{W_C}}$$

Where

Y_T = Yield of treated plot
Y_C = Yield of control (unweeded) plot
W_C = Weed dry weight in control (unweeded) plot
W_T = Weed dry weight in treated plot

Results and Discussion

Weed Studies

The most dominant weed species found in the experimental site were *Chenopodium murale* L. *Chenopodium album* L. and *Rumex dentatus* L. Data pertaining to weed indices (WI, WPI, CRI, WMI and AMI), crop productivity and profitability per day were significantly affected due to all the weed management methods.

Weed Intensity (%): Weed intensity indicates (Table 1) the percent counts of weeds due to weed control measures showed that the application of pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS resulted in higher persistence index (9.12%) closely followed by pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS (13.11%). Weedy recorded highest weed intensity (86.20%) as compared to weed free (0%) due to higher infestation of weeds in weedy.

Weed persistence index (WPI): Weed persistence index indicating relative dry matter accumulation of weeds per count (Table 1) indicated that the sequential application of pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS resulted in higher persistence index (3.08) closely followed by pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS (2.44).

Crop resistance index (CRI): The crop resistance index (Table 1) indicating increased vigour of crop plant due to weed management methods indicated that the sequential application of pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS recorded maximum crop resistance (37.47) to grow followed by pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS (30.64) indicating much less harmful effect of herbicides on crop as compared to other treatments. Weedy

recorded the lowest value of CRI (1.0) showing the highest harmful effect on crop.

Agronomic management index (AMI)

The agronomic management index (Table 1) indicating the effect of herbicides on environmental parameters revealed that pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS recorded the maximum AMI may be due to maximum phytotonic effect (1.20) closely followed by pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS (1.12). Decreasing value of AMI indicates its harmful effect on nontarget factors.

Herbicide efficiency Index (HEI)

HEI shows (Table 1) the yield advantage by adoption of the treatment over the control in relation to the reduction in weed dry matter over weedy. Among the treatments, sequential application of pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS recorded highest HEI (11.81) followed by pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS (9.78).

Weed management index (WMI)

WMI indicates (Table 1) the yield increase with respect to weedy because of weed control measures taken and percent control of weeds by the respective treatment. Among the weed control measures, application of pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS noted highest (2.20) followed by pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS (2.12).

Crop studies

Crop Productivity (kg/day)

Among the weed control measures (Table 2), pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS (15.56 kg) and pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS (15.08 kg) observed significantly higher crop productivity per day over weedy (4.92 kg), however these treatments were at par with each other and also showed equally effective as weed free treatment (15.73 kg). Thus, the result indicated that increase in yield contributing characters which improve crop productivity was owing to minimum weed infestation and crop-weed competition during critical growth period. These results were also confirmed by Singh *et al.*, 2014, Bhutada and Bhale, 2014, Dubey *et al.*, 2018 [1]. The seed yield and weed index was positively correlated with correlation co-efficient of 1.00. This was further supported by the regression analysis, which revealed that as the per day productivity of chickpea increased 1 kg/day, the profitability per day was increased by 42.65 Rs/day (Fig. 1).

Profitability (₹/day)

Profitability is a function of gains and losses. It is evident from data (Table 2) that highest profitability (₹/day) were recorded under sequential application of pre and post-emergence herbicide *i.e.* pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS (₹ 526.48) followed by similar combinations and lower doses treatment *i.e.* pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS (₹505.78), respectively as compared to rest of the treatments including weedy check (₹64.70), but both the treatments stand next to weed free (₹519.32) in this regards and showed fewer monetary differences. The computation of economics based on respective marketed price of grain and stalk yield were reflected as monetary benefit under different treatments. These results were supported by Dubey *et al.* (2018) [1], Rathod *et al.* (2017) [8] and Gore *et al.* (2015) [9].

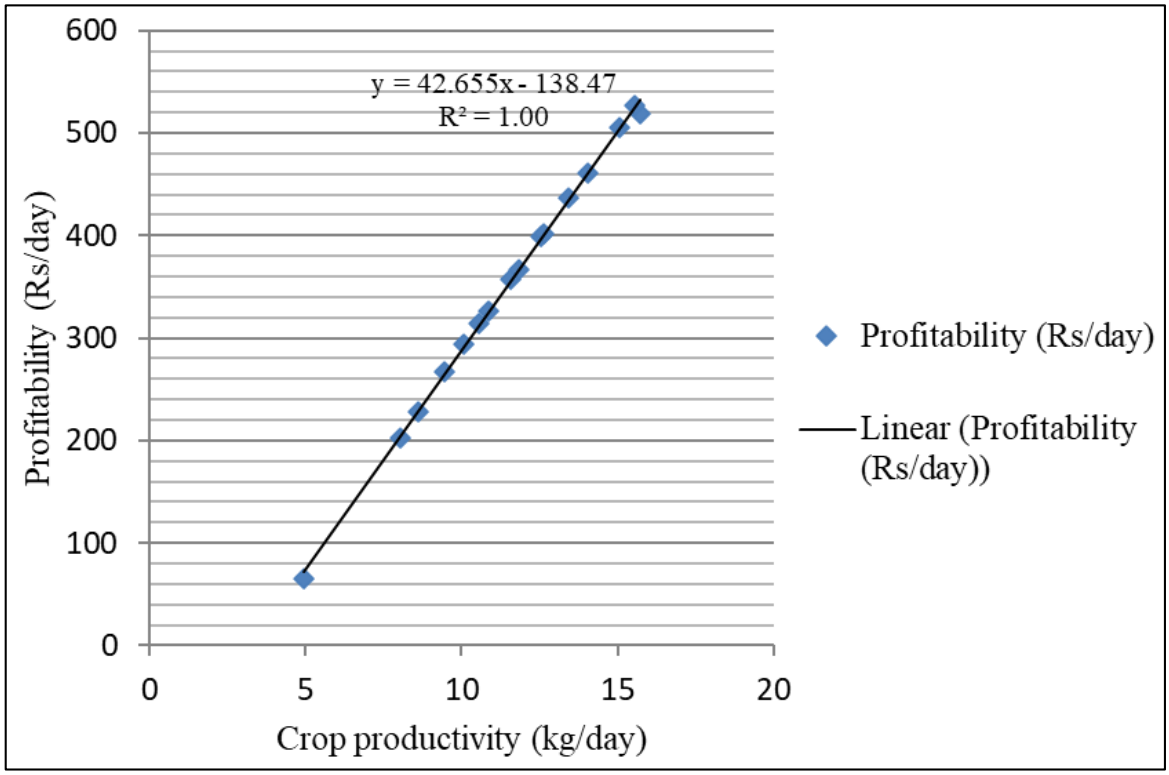

Fig 1: Relationship between crop productivity and profitability of chickpea

Table 1: Weed indices as influenced by different weed management treatments

Treatments	Weed Intensity (%)	WPI	CRI	HEI	WMI	AMI
Weedy	86.20	1.00	1.00	-	-	0.00
Weed free (Season long)	0.00	-	-	-	-	-
Pendimethalin @ 0.40 kg *a.i.* ha^{-1} (PE)	48.80	2.08	4.07	1.46	1.39	0.39
Pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE)	45.21	2.27	4.33	1.58	1.42	0.42
Oxyflourfen @100 g *a.i.* ha^{-1} (PE)	68.76	1.55	1.98	0.63	1.05	0.05
Oxyflourfen @ 200 g *a.i.* ha^{-1} (PE)	66.67	1.59	2.10	0.74	1.18	0.18
Imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS	57.87	1.63	3.36	1.17	1.23	0.23
Imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS	54.49	1.88	3.34	1.23	1.34	0.34
Pendimethalin @ 0.40 kg *a.i.* ha^{-1} (PE) + Imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS	21.58	2.13	17.63	5.86	1.83	0.83
Pendimethalin @ 0.40 kg *a.i.* ha^{-1} (PE) + Imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS	17.55	2.37	21.10	6.91	1.93	0.93
Pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + Imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS	13.11	2.44	30.64	9.78	2.12	1.12
Pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + Imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS	9.12	3.08	37.47	11.81	2.20	1.20
Oxyflourfen @100 g *a.i.* ha^{-1} (PE) + Imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS	38.00	1.74	8.17	2.93	1.53	0.53
Oxyflourfen @100 g *a.i.* ha^{-1} (PE) + Imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS	34.14	1.89	9.25	3.22	1.55	0.55
Oxyflourfen @ 200 g *a.i.* ha^{-1} (PE) + Imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS	28.81	2.07	11.49	3.90	1.67	0.67
Oxyflourfen @ 200 g *a.i.* ha^{-1} (PE) + Imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS	25.00	2.41	12.05	4.08	1.68	0.68

WPI=weed persistence index, CRI= crop resistance index, HEI= herbicide efficiency Index, WMI= weed management index, AMI= Agronomic management index

Table 2: Crop Productivity and Profitability as influenced by different weed management treatments

Treatments	Crop Productivity (kg/day)	Profitability (₹/day)
Weedy	4.92	64.70
Weed free (Season long)	15.73	519.32
Pendimethalin @ 0.40 kg *a.i.* ha^{-1} (PE)	10.55	314.66
Pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE)	10.86	326.51
Oxyflourfen @100 g *a.i.* ha^{-1} (PE)	8.03	203.13
Oxyflourfen @ 200 g *a.i.* ha^{-1} (PE)	8.61	228.15
Imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS	9.45	266.63
Imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS	10.06	293.76
Pendimethalin @ 0.40 kg *a.i.* ha^{-1} (PE) + Imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS	13.45	437.22
Pendimethalin @ 0.40 kg *a.i.* ha^{-1} (PE) + Imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS	14.04	461.56
Pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + Imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS	15.08	505.78
Pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + Imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS	15.56	526.48
Oxyflourfen @100 g *a.i.* ha^{-1} (PE) + Imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS	11.59	357.92
Oxyflourfen @100 g *a.i.* ha^{-1} (PE) + Imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS	11.82	366.59
Oxyflourfen @ 200 g *a.i.* ha^{-1} (PE) + Imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS	12.54	398.60
Oxyflourfen @ 200 g *a.i.* ha^{-1} (PE) + Imazethapyr @ 60 g *a.i.* ha^{-1} at 20 DAS	12.65	402.18
S.Em±	0.24	11.11
C.D.(*P*=0.05)	0.70	32.09

Conclusion

It can be concluded that sequential application of pre and post-emergence herbicides pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 60 g *a.i* ha^{-1} at 20 DAS significantly reduced weed intensity and recorded higher value of weed indices *i.e.* WPI, CRI, HEI, WMI and AMI resulted in higher crop productivity (kg/day) and profitability (₹/day) over weedy check. However, it showed equally effectiveness as observed under treatment combined with pendimethalin @ 0.60 kg *a.i.* ha^{-1} (PE) + imazethapyr @ 40 g *a.i.* ha^{-1} at 20 DAS as pre and post-emergence herbicide.

References

1. Dubey SK, Kumar A, Singh D, Pratap T, Chaurasiya A. Effect of different weed control measures on performance of chickpea under irrigated condition. International Journal of Current Microbiology and Applied Sciences. 2018;7(5):3103-3111.
2. Ratnam M, Rao AS, Reddy TY. Integrated Weed Management in Chickpea (*Cicer arietinum* L.). Indian Journal Weed Science. 2011;43(1, 2):70-72.
3. Rana SS, Kumar S. Research Techniques in Agronomy. Department of Agronomy, College of Agriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, 2014, 64.
4. Mishra M, Mishra A. Estimation of IPM index in Jute: A new approach. Indian Journal of Weed Science. 1997;29(1):39-42.
5. Krishnamurthy K, Raju BG, Raghunath G, Jagnath MK, Prasad TVR. Herbicide efficiency index in sorghum. Indian Journal of Weed Science. 1975;7(2):75-79.
6. Singh RP, Verma SK, Singh RK, Idnani LK. Influence of sowing dates and weed management on weed growth and nutrients depletion by weeds and uptake by chickpea (*Cicer arietinum*) under rainfed condition. Indian Journal of Agricultural Sciences. 2014;84(4):468-72.
7. Bhutada PO, Bhale VM. Efficacy of Herbicides and Cultural Management on Weed Control in Gram (*Cicer Arietinum*). IOSR Journal of Agriculture and Veterinary Science. 2013;4(5):1-2.
8. Rathod PS, Patil DH, Dodamani BM. Evaluation of time and dose of imazethapyr in controlling weeds of chickpea (*Cicer arietinum* L.). Legume Research. 2017;40(5):906-910.
9. Gore K, Gobade SM, Patil PV. Effect of pre and post emergence herbicides on yield and economics of chickpea (*Cicer arietinum* L). International Journal of Tropical Agriculture. 2015;33(2):909-912.