International Journal of Environment and Climate Change

Volume 13, Issue 11, Page 2315-2321, 2023; Article no.IJECC.107651
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Effect of Herbicide on Root Nodules, Phytotoxicity and Economics of Chickpea (*Cicer arietinum* L.)

Santosh Kumar Dubey [a*], Arun Kumar [b++] and Ved Prakash [c]

[a] Department of Agronomy, N.D.U.A.T, Kumarganj, Faizabad, Uttar Pradesh, India.
[b] Agricultural and Director Planning- BAU, Sabour, Bhagalpur, Bihar, India.
[c] Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i113394

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/107651

Original Research Article

Received: 12/08/2023
Accepted: 16/10/2023
Published: 04/11/2023

ABSTRACT

The field experiment was done during *Rabi* season of 2011-12 at Agronomy Research Farm of NDUA&T, Kumarganj, Faizabad, UP. The fresh biomass and dry biomass nodules plant^{-1} (mg), branches numbers and grain yield significantly supreme was noted in weed free plot. Fresh and dry biomass, branches number was obtained statically at par with treatments pendimethalin 1000 g ha^{-1} PE, or *fb* quizalofop 60 g ha^{-1} PoE or clodinafop 60 g ha^{-1} PoE at 45 and 60 DAS, 60 DAS and at 90 DAS. The minimum Fresh and dry biomass, branches number was noted with rest all the treatments. Whereas drastic toxicity was detected tracked by oxyfluorfen 200 g + *fb* clodinafop 60 g ha^{-1} PoE and pendimethalin 1000 g PE *fb* imazethapyr 75 g + quizalofop 60 g ha^{-1} PoE, separately. The greatest drop in grain yield of chickpea were noted in PE application of pendimethalin 750 g tracked by mutual PoE application of quizalofop-ethyl 60 g + oxyfluorfen 200 g ha^{-1} at 35 DAS. The utmost net economic returns and B-C ratio were noted in PE application of pendimethalin 1000 g

---

[++] Dean;
**Corresponding author: E-mail: santoshdubeybau@gmail.com;*

and PoE application of clodinafop 60 g ha^{-1} and PE application of pendimethalin1000 g and PoE application of quizalofop-ethyl 60 g ha^{-1} at 35 DAS and the net monetary returns and B-C ratio were in negative with application of pendimethalin 750 g PE followed by mutual PoE application of quizalofop-ethyl 60 g + oxyfluorfen 200 g ha^{-1}at 35 DAS and PoE application of oxyfluorfen200 g + quizalofop-ethyl 60 g ha^{-1} PoE.

Keywords: Economics; herbicides; phytotoxicity; root nodulations; weed control.

1. INTRODUCTION

Chickpea is a topmost annual pulse crop and cover about 92 percent area and 89 percent production in tropic and semiarid regions [1]. According to a report by Anonymous (2013), the area under cultivation of chickpea in India has decreased after 1.06 million hectares in 1966-67 to 0.60 million hectares in 2012-13 due to slow initial growth. It suffers from serious weeds competition for various nutrients, space, water and light during the crop growth outcome into big reduction in yield about 40-45 percent [2,3]. chickpea is the richest source of protein food consequently agronomists wish to take full advantage of production and minimize the herbicides used. Though, if application of herbicides in chickpea field nitrogen fixation and subsequently reduced the yield [3] and reduction of chickpea production about 40-90 percent causes by weed [4]. A weed infestation in chickpeas can result in severe competition and a seventy-five percent decrease in output [5]. The first 60 days are thought to the crucial for weed crop competitiveness with chickpea [2]. The work of manually controlling weeds in chickpea is challenging since labor costs have increased and labor is in short supply. For farmers to better accept this crop, mixed weed flora may be effectively controlled with herbicides weed management.

2. MATERIALS AND METHODS

The field experiment was done during *Rabi* season 2011-12 at Agronomy Research Farm of NDUA&T Kumarganj, Faizabad UP India. The field soil status were clay-loam, organic carbon, available nitrogen and phosphorus is lower range, but potash is medium in range and alkaline in reaction of the soil. The *PG-186* variety was sown in early second fortnight of November, 2011 at 40 cm row spacing and 4-5 cm depth by using the spade. "The trial was put out in randomized block design with 14 treatments combination *viz.* T_1: Pendimethalin 1000 g ha^{-1} (PE), T_2: Pendimethalin 1000 g (PE) fb quizalofop 60 g ha^{-1} (PoE), T3: Pendimethalin 1000 g (PE) fb clodinafop 60 g ha^{-1} (PoE), T4: Pendimethalin 750 g (PE) fb quizalofop 60 g + oxyfluorfen 200 g ha^{-1} (PoE), T_5: Oxyfluorfen 200 g ha^{-1} (PE), T_6: Oxyfluorfen 200 g (PE) fb quizalofop 60 g ha^{-1} (PoE), T_7: Oxyfluorfen 200 g (PE) fb clodinafop 60 g ha^{-1} (PoE), T_8: Oxyfluorfen 200 g + quizalofop 60 g ha^{-1} (PoE), T_9: Oxyfluorfen 200 g + fb clodinafop 60 g ha^{-1} (PoE), T_{10}: Imazethapyr 75 g ha^{-1} (PoE), T_{11}: Pendimethalin 1000 g (PE) fb imazethapyr 75 g ha^{-1} (PoE), T_{12}: Pendimethalin 1000 g (PE) fb imazethapyr 75 g + quizalofop 60 g ha^{-1} (PoE), T_{13}: Weed free, and T_{14}: Weedy check and the treatments were replicated in thrice" [6]. The manual two hands weeding was done in weed free plot except all treatments. The uniform application of fertilizers doses (20-40-40, N-P_2O_5-K_2O) kg ha^{-1} was used at the time of sowing in furrows. The herbicides were sprayed as a pre-plant incorporation and PE before and after one day of sowing using a flat fan nozzle knapsack sprayer with volume of spray 600 liters of water in a hectare. Throughout the weed-free treatment trial, hand weeding was carried out with the help of a scabbard as necessary. After 45 days of oven drying and seeding and harvesting, the dry weight of each weed was measured by setting a quadrate measuring 25x25 cm at three random locations in all plot.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

Fresh and dry biomass: The evident of data presented in Fig. 1 the both 45 and 60 DAS. The application of pendimethalin 1000 g ha^{-1} as a PE with clodinafop or quizalofop 60 g ha^{-1} as a PoE each in the plots verified significantly higher fresh and dry biomass of nodules $plant^{-1}$ as compared to the single applied herbicide treatment like oxyfluorfen 200 g ha^{-1} PE and pendimethalin 1000 g ha^{-1} PE. While pendimethalin 1000 g PE *fb* imazethapyr 75 g ha^{-1} and imazethapyr 75 g ha^{-1} as PoE verified at par results to each other with respect to fresh and dry biomass of nodules. Though, application of these herbicide combination as an oxyfluorfen 200 g + quizalofop 60 g ha^{-1}, pendimethalin 1000 g *fb* quizalofop 60 g + oxyfluorfen 200 g, oxyfluorfen 200 g + clodinafop 60 g ha^{-1} and pendimethalin 1000g as PE *fb* imazethapyr 75 g + quizalofop 60 g ha^{-1} as

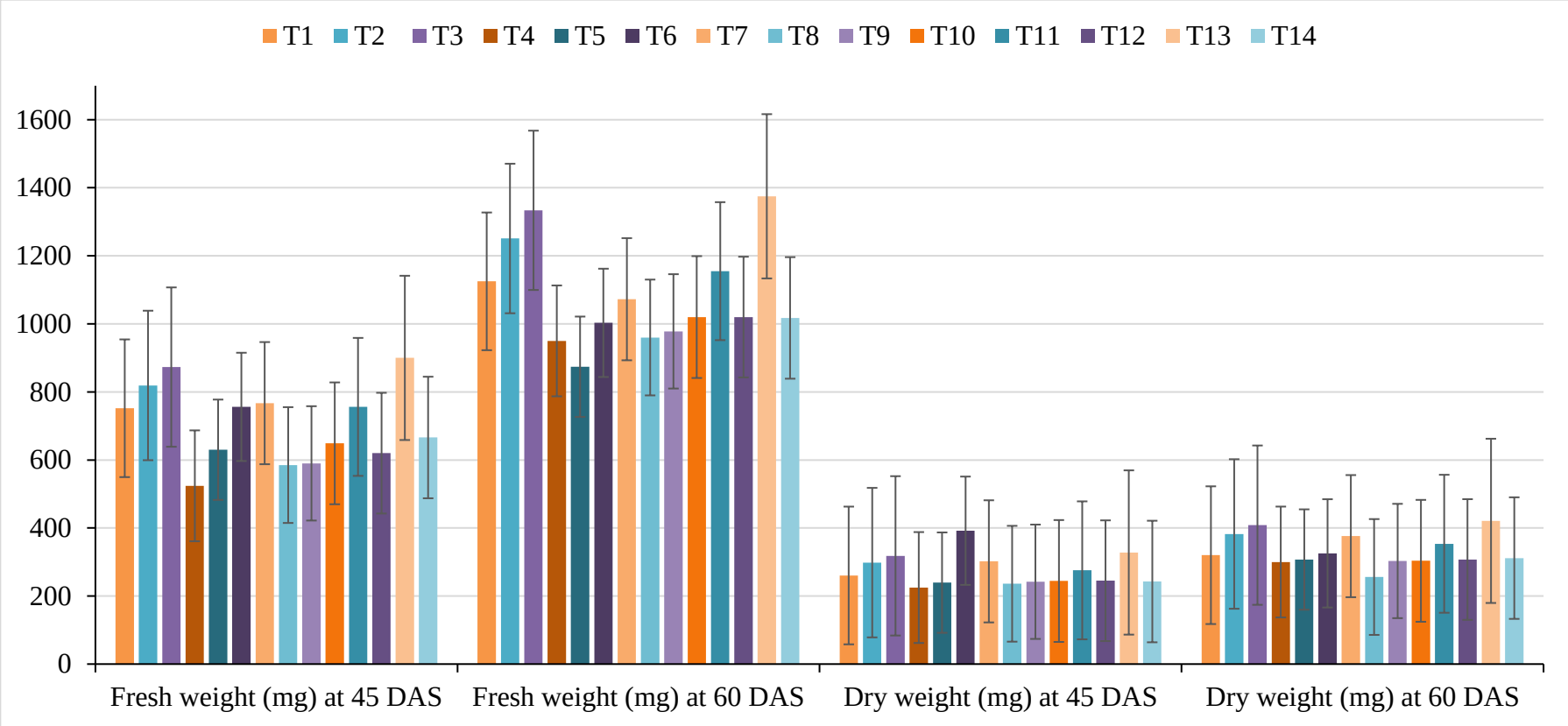

Fig. 1. Impact of herbicides on fresh and dry biomass of nodules plant^{-1} at 45 and 60 DAS of chickpea crop

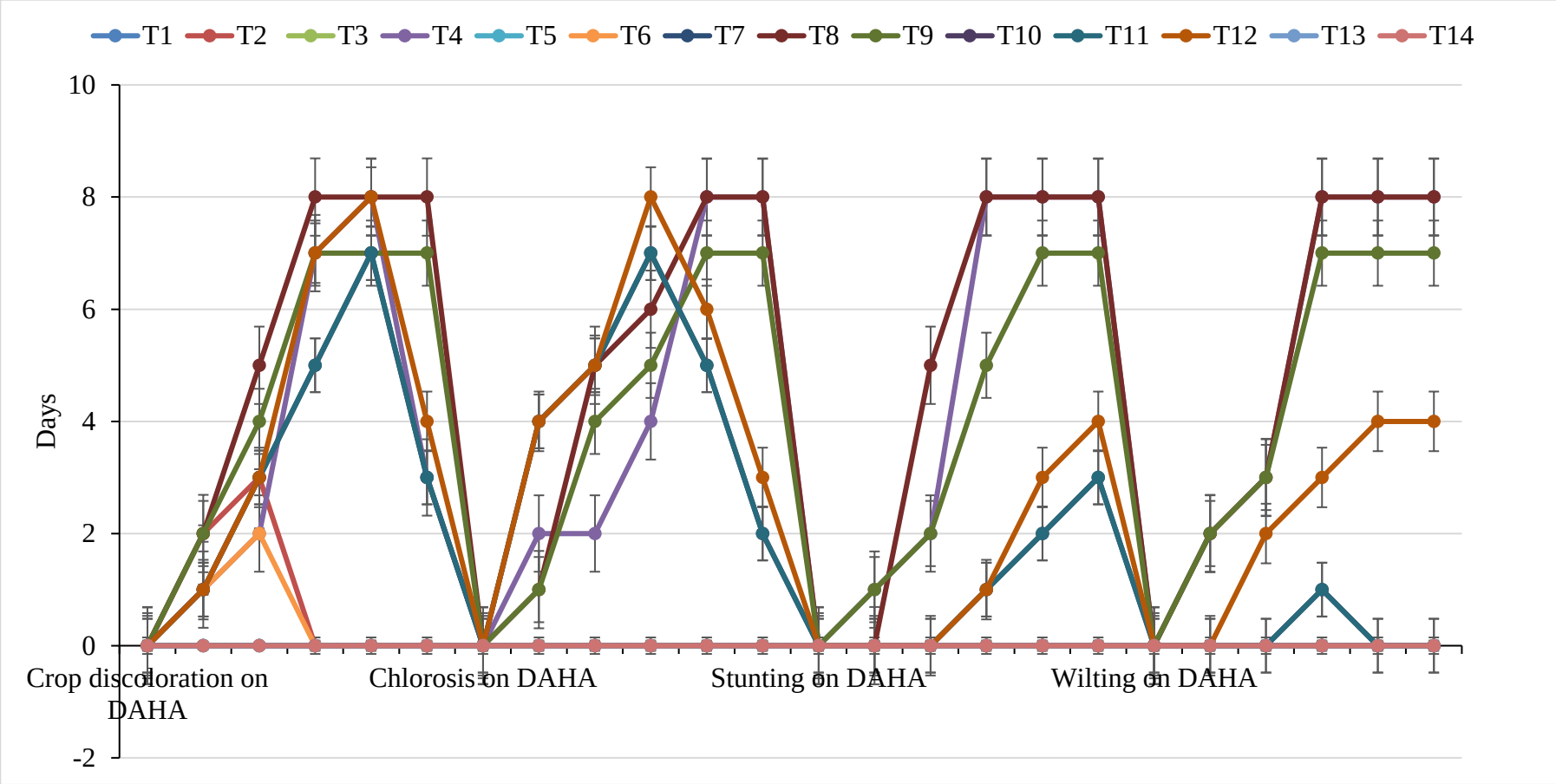

Fig. 2. Visualize remarks on phytotoxicity in chickpea due to various herbicides used (Score 0-10)
DAHA=Day After Herbicide Applied

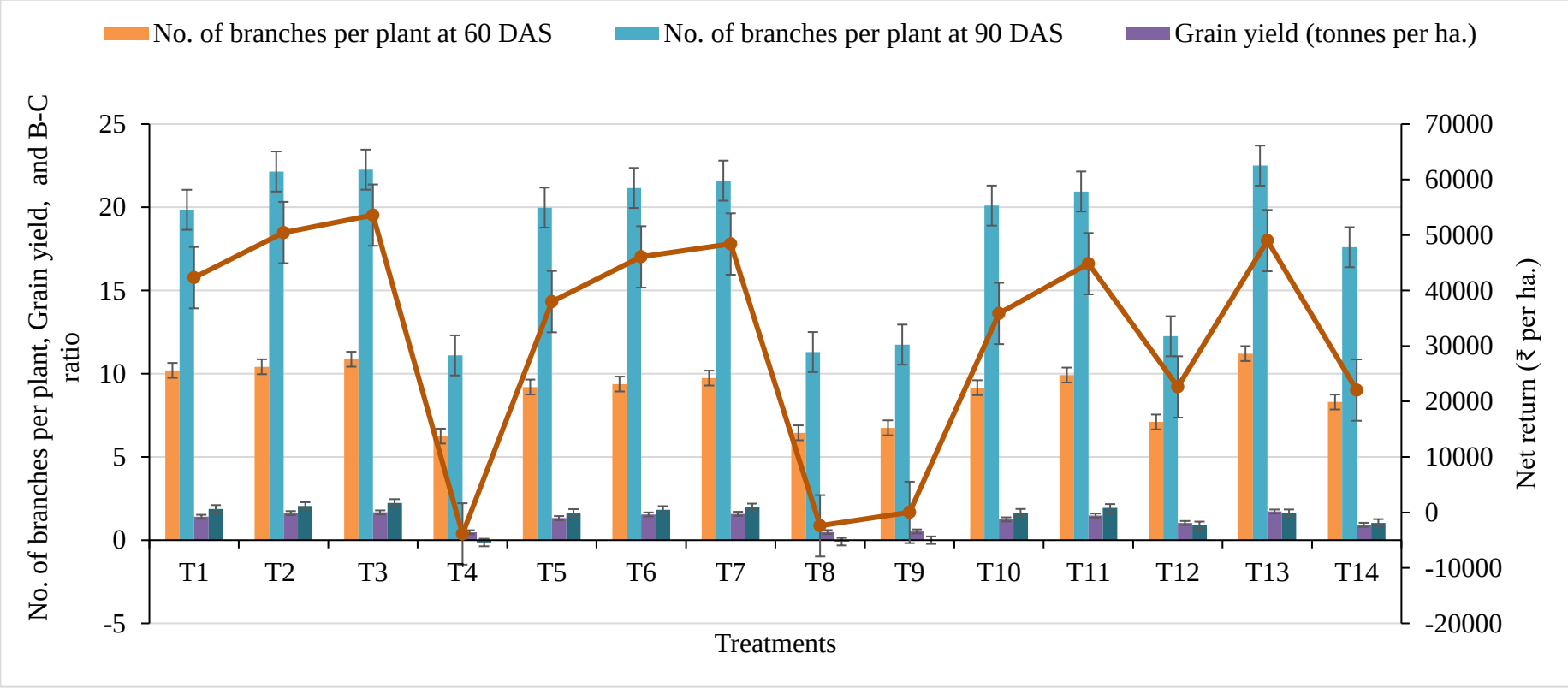

Fig. 3. Impact of herbicides on branches number, yield, and economics of chickpea crop

PoE recorded lesser values of fresh and dry biomass of nodules which were at par to each other. These results are in the conformity as described by Singh et al. [7] and Nandan et al. [8].

Phytotoxicity: The Fig. 3 presents the results of a study that investigated the phytotoxic effects of various weed management techniques on chickpeas. The physically mixed the applied of oxyfluorfen 200 g with quizalofop or clodinafop at 60 g ha^{-1} and pendimethalin 1000 g or oxyfluorfen 200 g ha^{-1} PE *fb* imazethapyr 75 g + quizalofop 60 g ha^{-1} showed phytotoxicity sign within 1-15 DAHA on crop plants. The highest toxicity was seen 7–10 days after application for pendimethalin 750 g PE fb quizalafop 60 g + oxyfluorfen 200 g ha-1 PoE and oxyfluorfen 200 g + quizalofop 60 g ha^{-1} PoE. The phytotoxic symptoms were found from 3DAHA in the case of PoE herbicides. Approximately 80% of the cases showed extremely severe toxicity, which was followed by pendimethalin 1000 g PE, oxyfluorfen 200 g + fb clodinafop 60 g ha^{-1} PoE, and 75 g of fb imazethapyr and 60 g of quizalofop ha^{-1} PoE, in that order. Nevertheless, visual observations revealed a small rejuvenation of crop plants (20–30%) in the case of treatments, namely imazethapyr 75 g ha^{-1} PoE, pendimethalin 1000 g PE fb imazethapyr 75 g ha^{-1} PoE, and pendimethalin 1000 g PE fb imazethapyr 75 g + quizalofop 60 g ha^{-1} PoE. This recovery occurred during the first two weeks of crop development following the onset of toxicity. The crop experienced extremely severe phytotoxicity (up to 80%) as a result of the physically mixed the application of quizalofop 60 g + oxyfluorfen 200 g as PoE. The symptoms included leaf chlorosis, discoloration, and finally wilting of the chickpea plant, which was noticed at 3 DAHA and recorded at 10 DAHA. The phytotoxicity of the oxyfluorfen 200 g and oxyfluorfen 200 g + clodinafop 60 g ha^{-1} were found to be very equivalent, with the latter having a toxicity level of almost 70%. The documented that the type phytotoxic indications of herbicides on chickpea crop verified by [9].

Branches number in plant: The Fig. 3 shows the data on the branches number $plant^{-1}$ verified at 60 and 90 DAS of growth stages. Applying pendimethalin 1000 g ha^{-1} as a PE and combination with 60 g ha^{-1} of quizalofop or clodinafop as a PoE is comparable to having at par results from weed-free. And weed free plot among all the treatments extremely significant branches per $plant^{-1}$ from weedy check. Similarly, application of oxyfluorfen 200 g PE sole and physically mixture with quizalofop 60 g ha^{-1} or clodinafop 60 g ha^{-1} PoE as well as imazethapyr 75 g ha^{-1} PoE and pendimethalin 1000 g PE *fb* imazethapyr 75 g ha^{-1} PoE verified significantly higher branches number $plant^{-1}$ over pendimethalin 750 g PE *fb* quizalafop 60 g + oxyfluorfen 200 g ha^{-1} PoE, oxyfluorfen 200 g + quizalofop 60 g ha^{-1} PoE and oxyfluorfen 200 g + *fb* clodinafop 60 g ha^{-1} PoE. In comparison to the pendimethalin 1000 g ha^{-1} PE together with clodinafop 60 g ha^{-1} PoE or quizalofop 60 g ha^{-1} PoE, and fb imazethapyr 75 g ha^{-1} PoE, and oxyfluorfen 200 g PE accompanied by clodinafop 60 g ha^{-1} PoE being at par verified significantly higher branches number $plant^{-1}$ as associated to weedy check, weed free plot did not show much variation at 60 and 90 DAS of crop growth. The similar results were detected at 90 DAS also (Pahwa and Prakash, 1992). This might be as a result of treatments with higher weed control efficacy producing more horizontal crop development, which in turn created more branches per plant.

3.2 Yield

Among all the weed management practices have highly significant impression in grain yield of chickpea crop over weedy check and presented in Figure 3. Significant uppermost values was recorded of the grain yield (t ha^{-1}) with weed free plot and at par with application of Pendimethalin 1000 g ha^{-1} PE fb quizalofop 60 g ha^{-1} (PoE), or fb clodinafop 60 g ha^{-1} PoE, Pendimethalin 750 g ha^{-1} PE fb quizalafop 60 g ha^{-1} + oxyfluorfen 200 g ha^{-1} PoE, Oxyfluorfen 200 g ha^{-1} PE, Oxyfluorfen 200 g PE fb quizalofop 60 g ha^{-1} PoE, or fb clodinafop 60 g ha^{-1} PoE among all the treatments, over weedy check. The significant reduction in grain yield with application of Pendimethalin 750 g(PE) fb quizalafop 60 g + oxyfluorfen 200 g ha^{-1} (PoE), Oxyfluorfen 200 g ha^{-1} + quizalofop 60 g ha^{-1} (PoE), or fb clodinafop 60 g ha^{-1} (PoE), Imazethapyr 75 g ha^{-1} (PoE), Pendimethalin 1000 g (PE) fb imazethapyr 75 g ha^{-1} + quizalofop 60 g ha^{-1} (PoE). This might be because the combination of oxyfluorfen and quizalofop-ethyl 60 g ha^{-1} + PE at 35 DAS, which was applied later in the growth phase and was less effective, reduced the amount of weed and phytotoxicity in pendimethalin [9].

3.3 Economics

The data is evident from figure 3 the greatest net returns and B-C ratio were recorded in PE

applied pendimethalin 1000 g ha^{-1} PE *fb* PoE clodinafop 60 g ha^{-1} and quizalofop-ethyl 60 g ha^{-1} at 35 DAS by registering net returns and B-C ratio noted to be the subsequent best treatment and PE application of Pendimethalin 750 g ha^{-1} tracked by combined PoE application of quizalofop-ethyl 60 g ha^{-1} + oxyfluorfen 200 g ha^{-1} at 35 DAS and PoE combined application of oxyfluorfen 200 g ha^{-1} + quizalofop-ethyl 60 g ha^{-1} at 35 DAS, the net monetary returns and B-C ratio were negative for the reason that high cost of cultivation [10].

4. CONCLUSION

The used of pendimethalin 1000 g ha^{-1} as a PE along with PoE of either clodinafop propargyl 60 g ha^{-1} or quizalofop ethyl 60 g ha^{-1} proved greater over rest of the treatments in respect to fresh and dry biomass, branches number, grain yield, B-C ratio and net economic returns of chickpea crop tracked by oxyfluorfen 200 g ha^{-1} as PE along with PoE used of clodinafop propargyl or quizalofop ethyl 60 g ha^{-1} each.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Rathore, PS. Techniques and management of field crop production. In Bengal gram. Jodhpur, India: Agrobios. 2000:336-340.
2. Singh G, Singh, D. Weed-crop competition studies in chickpea. Indian Journal of Weed Science, 1992;24:1-5.
3. Dubey SK, Prakash V. Performance of Various Chemicals Weed Management in Chickpea an Irrigated Environment. International Journal of Plant & Soil Science. 2023;35(21), 55–62.
4. Ahlawat, IPS. Bengalgram. In P.S. Rathore (Ed.), Technique and management of field crop production. New Delhi, India: Agrobios publications. 2000;317-335
5. Chaudhary BM, Patel JJ, Devadia DR. Effect of weed management practices and seed rates on weeds and yield of chickpea. Indian Journal of Weed Science. 2005;37(3-4):271-272.
6. Dubey SK, Arun Kumar, Choudhary SK, Vinod Kumar and Tej Pratap, Response of herbicide on root nodules, economics and phytotoxicity on chickpea, International Journal of Chemical Studies 2018;SP4:01-05
7. Singh, VK, Dixit Vivek, Singh R, Barthwal, Ashutosh. Efficacy of mechanical, cultural and chemical methods on weed suppression and yield of lentil. Indian Journal of Weed Science. 2011;43(3&4): 192-194.
8. Nandan Brij, Sharma BC, Kumar Anil, Sharma Vikas. Efficacy of pre and post-emergence herbicides on weed flora of urd bean under rainfed subtropical Shiwalik foothills of Jammu & Kashmir. Indian Journal of Weed Science. 2011;43(3&4): 172-174.
9. Ratnam M, Rao AS, Reddy TY. Integrated Weed Management in Chickpea (*Cicerarietinum L.*). Indian Journal of Weed Science. 2011;43(1-2):70-72.
10. Pedde KC. Integrated weed management in chickpea. Indian Journal of Weed Science. 2013;45(4):299.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/107651