Performance Of Different Weed Control Measures of Chickpea Under Irrigated Condition

ABSTRACT

Chickpea seems to be more sensitive to weed competition than many other crops and competition is more severe during early stages of crop growth because of its slow growth rate and less leaf area development If weeds are not controlled in early stages, may cause considerable damage to the crop. In India, losses caused by weeds have been reported in the range of 40-90 % (Vaishya et al., 1999). Thus, there is a tremendous scope to improve the yield of chickpea only by adopting a suitable weed management practice.The experiment was conducted during *Rabi* season of 2011-12 at Agronomy Research Farm of NDUA&T,Kumarganj, Ayodhya, Uttar Pradesh. The experiment was laid out in randomized block design with fourteen treatmentscombination replications in thrice*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, T_{14}: Weedy check.Results indicated that weed control treatments give significantly impact on number of nodules, nutrient (N, P, K) uptake, yields and economics of chickpea over weedy check at growth stage. Maximum yield (1.72 t ha^{-1}) and nutrient uptake (N- 63.60, P- 9.09 and K- 74.39kg/ha) by chickpea were recorded in weed free treatment but maximum nitrogen, phosphorous and potassium (23.22, 2.68 and 50.42 kg/ha) uptake by weed were obtained in weedy check treatment and lowest in weed free treatment. So, adoption of suitable weed management measures can enhance the performance of crop and provide more farmersincome.

Keywords: Check pea, Crop growth, economic, Root nodules. weed controls, yield

Introduction

Chickpea (*Cicer arietinum* L.) is an important pulse crop of our country, in India.

Theareaunderchickpeacrophasreducedto0.60 million hectares in 2014-15 from 1.06 million hectares in 1966-67 **(Anonymous 2016)**duetoslowinitialgrowthanditsuffersbadly by severe competition with weeds for nutrients, light, water and space. About 40- 45% reduction in yield of chickpea due to severe infestation of weeds was estimated by **Singh and Singh (1992)** while, **Chaudhary *et al.*, (2005)** reported 75% of yield reduction because of serious competition of chickpea crop with weeds. Poor weed management is one of the most important yield limiting factors in chickpea, some other factors are brackish irrigation water, hungry and discarded soils, lack of promising cultivars, improper fertilization, pest and diseases are responsible for much reduction in yield of chickpea. The initial 60 days' period considered to be the critical for weed crop competition in chickpea **(Singh and Singh 1992)**. But continuously facing of the scarcity of labour and increase in labour cost, manual weed control has become a difficult task. Suitable herbicide for effective control of mixed weed flora is required for better adoption in this crop by farmers. Introduction of herbicides has made it possible to control a wide spectrum of weeds in pulses effectively at a remunerative cost. Many research workers from the various parts of the country has been reported that the application of pendimethalin as pre-emergence (PE) at 1.0 kg ha^{-1}**(Tewari *et al.*,2003 and Vaishya *et al.*, 2005)**, imazethapyras post-emergence (PoE) at 0.1 kg ha^{-1} (Singh *et al.*,2003), cloinafop-propargyl (Topic 15 WP)as PoE at 0.03 kg ha^{-1}**(Marwat *et al.*,2004)** and oxyfluorfen (600 g ha^{-1}) as weed control treatment (Yousefi *et al.*, 2007) provided effective control of annual broad leaved and grassy weeds in chickpea field.In the legumes especially in case of chickpea pendimethalin at 1000 g ha^{-1} applied as PE is a very common herbicide which is used to take care of all type of weeds, but there is no herbicide available to applied as PoE to control the emergingBLWs effectively. Even if PE application of herbicide is missed due to any reason in that case PoE herbicide application to control the grassy as well as non-grassy weeds is very much required. So far, no herbicide is available which can be used to control the weeds especially BLWs by applying as PoE in pulses and more specifically in chickpea. However, manual weeding has been found very efficient but availability of labours at required time and at more rates has become a serious question. The chickpea, although is an important *rabi* pulse crop yet no adequate information on effective weed management are available especially for eastern part of Uttar Pradesh where sowing of chickpea is further delayed due to many problems. In the present time, some of the very effective high potency

herbicide molecules have been developed which may be useful to control the wide spectrum of weeds in chickpea further, if their molecules are used in a combination may be more effective to control the wide spectrum weeds.Hence, present investigation was carried out to study the efficacy of different herbicides on mixed weed flora and their effect on growth and yield of chickpea. In chickpea weeds germinate and grow fast in many flushes so, application of one herbicide alone is not much effective and economical weed control measure under such condition. Keeping in view this fact, a field trial having the sequential and tank mixed application of two or more herbicides was proposed to find out the suitable and effective weed management practice during critical period of crop-weed interference in chickpea.

MATERIALS AND METHODS

The experiment was conducted during *Rabi* season of the year 2011-2012 at Agronomy Research Farm of NDUA&T, Ayodhya, Uttar Pradesh, India, situated at $26^0$47' N latitude, $82^0$12' E longitude and an altitude of 113 meters above from mean sea level. Mean of minimum and maximum temperatures ranged from 5.0^0 C to 15.1^0 C and 15.3^0 C to 32.1^0C respectively while, total rainfall received during the crop season was 86.0 mm. The soil of the experimental field was silt-loam, low in organic carbon,available nitrogen, phosphorusmedium in potash and alkaline in reaction. Chickpea variety "PG-186" was sown in rows, at 40 cm apart and at 4-5 cm deep. The experiment was laid out in randomized block design with fourteen treatments combination in thrice, *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, T_{14}: Weedy check. Two hands weeding was done in weed free plot except weedy check. A uniform dose of fertilizers 20:40:40 N, P_2O_5, K_2O kg $ha^{-1}$was applied at the time of sowing in furrows. PEherbicides were applied one day after sowing, respectively using a knapsack sprayer fitted with flat fan nozzle with a spray volume of 600 litres of water per hectare. Hand weeding was done with the help of *khurpi*when

required in weed free treatment. Number of nodules was rerecorded at 45th, 60th, 75th, 90th day stages of crop growth. After harvesting yield of crop calculated by per plot basis and then it converted into t ha^{-1} after that economics of different treatments was calculated.

RESULTS AND DISCUSSION

Growth parameters

Number of root nodules: All the weed-control measures had significantly positive impact on number of root nodules of chickpea over weedy check at each growth stage (Table no. 1). Highest number of root nodules observed in weed free plot over weedy check and in herbicide treated plot there was less number of root nodules at 45, 60, 75 and 90 DAS. At 45 and 90 DAS the lowest number of root nodules observed in PoE application of oxyfluorfen 200g *fb* by clodinafop 60gha^{-1}at 35 DAS. And 60 and 75 DAS the lowest number of root nodules observed in PoE applicationofoxyfluorfen200gha^{-1}(PE)at30 DAS (Sharma. 2009). This results ware might be due to toxic effect of herbicide on chickpea which affect the development of nodules in roots. While in case of better weed control treatments, weed free condition provided professed root development and bacterial colonies, which ultimately resulted in more nodulation in crop. Almost similar trend was recorded at 60th day stage also. In case of 75th and 90th day stages, declined the number of nodules plant^{-1}, respectively due to cessation of nodulation and started drying of nodules. The results are in agreement with the finding of Vaishya *et al.,* (1995).

Nutrient (NPK) uptake by crop and weeds: Data presented inTable no. 2 Maximum nitrogen, phosphorous and potassium (63.60, 9.09 and 74.39 kg ha^{-1}) uptake by chickpea were recorded in weed free treatment and among the herbicidal treatment minimum nutrient, Nitrogen (18.71 kg ha^{-1}) and potassium (22.63 kg ha^{-1}) uptake in PE of pendimethalin 750 g followed by combined PoE application of quizalafop60g + oxyfluorfen 200g ha^{-1} at 35 DAS and Phosphorous (2.61 kg ha^{-1}) uptake in PoE of oxyfluorfen 200g + quizalofop 60gha^{-1} at 35 DAS. But maximum nitrogen, phosphorous and potassium (23.22, 2.68 and 50.42kg ha^{-1}) uptake by weed (table no. 2) were in weedy check treatment and lowest in weed free treatment.Among the herbicidal treatment minimum nutrient (nitrogen, phosphorous andpotassium) (1.86, 0.21 and 3.86 kg ha^{-1}) uptake in PE application of pendimethalin 750 g (PE) followed by combined PoE application of quizalafop 60g + oxyfluorfen 200g ha^{-1} at 35 DAS (Patel *et al.,* 2016).It might be due to the more dry-weight and nutrients content in BLWs as compared to grassy weeds. These results are in the conformity with the work of Azad and Singh (1997).

Yield attributes and yield

It is evident from the data presented in figure no. 1 the **c**rop dry matter accumulation was increased appreciably due to the different treatments as compared to the weedy check as all the growth stages of crop. As far as the treatment combinations were concerned, they showed higher dry matter accumulation as compared to application of single treatment, except some in which crop phytotoxicity was noticed.Combination of the treatment pendimethalin 1000 g (PE) *fb* clodinafop 60 g ha^{-1}(PoE) showed effective control of grassy as well as BLWs. However, in case of single herbicide *e.g.* pendimethalin or oxyfluorfen controlled both type of weed very effectively at early stage but weeds which emerged at later stages could compete with the crop and ultimately declined the crop dry weight and yield levels. There was no any significant difference of 100-seed weight (g) at harvest stage of chickpea this was might have suppressed less weeds during the critical period of crop weed competition and favoured better utilization of available resources, *viz*. nutrient, light, water and space. These results are in agreement with the findings of (Dungerwal*et al.*, 2002).Maximum reduction in grain and straw yield were recorded in PE application of pendimethalin 750g ha^{-1}*fb*combined PoE application of quizalofop-ethyl60g + oxyfluorfen 200gha^{-1} (PoE) (0.47 and 0.94tha^{-1}) at 35 DAS over weedy check (0.92 and1.80tha^{-1}) and significantly at par with PoE application of oxyfluorfen 200g + quizalofop-ethyl 60g ha^{-1} (0.48 and 0.96tha^{-1}) at 35 DAS and PoE application of oxyfluorfen 200g + clodinafop 60g ha^{-1} (PoE) (0.52and 1.00tha^{-1}), this is might be due to less reduction of weeds from field and phytotoxic effect of herbicides on crop plants. Pendimethalin as PE followed by mix PoE of quizalofop-ethyl 60g + oxyfluorfen were less effective and hindered during critical periodof growth. The grain yield is the fraction of the total biomass (total dry matter accumulation) that gets available in the form of economic yield (grain yield).Grain yield is the ultimate result of the bio-physiological processes and source-sink relationship.The grain yield is contributed by different yield attributes *e.g.* number of pods $plant^{-1}$, number of grains pod^{-1}, weight of grains pod^{-1} and 100-grain weight etc**.** As far as the stover yield was concerned, it is the resultant of growth attributes *e.g.* plant population, plant height, dry matter accumulation and leaf area index etc. These attributes directly influenced by the crop-weed competition phenomena. The treatments, in which weed control was effective, ultimately provided better environment to crop for their growth resulted, better yields of stover as well as grain. These results are in the confirming with the work of Singh *et al.*,(2003) and Ratnam

et al., (2011).The harvest index of chickpea crop appreciably. However, the maximum harvest index (37.4 %) was recorded with the application of pendimethalin 1000 g (PE) followed by imazethapyr 75 g ha^{-1}PoE followed by T_7: oxyfluorfen (PE) 200 g fb clodinafop 60 g ha-1 PoE (36.9 %). On the other hand, lowest value of harvest index (33.81 %) was recorded with weedy check.The similar results were also noticed by Singh *et al.,* (2003) and Ratnam *et al.,* (2011).

ECONOMICS

Maximum cost of cultivation incurred in weed free treatment (₹30072.90ha^{-1}) by registering cost of cultivation (₹26299.95ha^{-1}) in PE of pendimethalin 750g followed by combined PoE application of quizalafop 60g + oxyfluorfen 200gha^{-1}at 35 DAS found to be the next best treatment (figure no. 2) maximum gross monetary returns (₹79062.00 ha^{-1}) was recorded in weed free by registering gross monetary returns (₹77478.00ha^{-1}) in PE of pendimethalin 1000 g followed by PoE application of clodinafop 60gha^{-1} found to be besttreatment. Maximum net monetary returns (₹53588.05 ha^{-1}) and B:C ratio (2.24) were recorded in PE application of pendimethalin 1000g (PE) *fb* PoE application of clodinafop 60gha^{-1} at 35 DAS by registering net monetary returns (₹50448.05ha^{-}1) andB:C ratio (2.05)in PE application of pendimethalin 1000 g *fb*by PoE application of quizalofop-ethyl 60 gha^{-1}at 35 DAS, found to be the next best treatment and PE application of Pendimethalin 750 g followed by combined PoE application of quizalofop-ethyl 60g + oxyfluorfen 200gha^{-1}at 35 DAS and PoE combined application of oxyfluorfen 200g + quizalofop-ethyl 60gha^{-1} at 35 DAS, the net monetary returns and B: C ratio were in negative because of high cost of cultivation (Pedde *et al.,* 2013). These above results are in the conformity with the work of Meena *et al.,* (2011) and Ratnam *et al.,*(2011).

CONCLUSION

The higher number of nodules were produced by weed free as well as better weed control treatments e.g. follow up application of clodinafop or quizalofop at 60 g ha^{-1} each as PoE in the PE treatment of either pendimethalin 1000 g ha^{-1} or oxyfluorfen 200 g ha^{-1}, which were at par among each other significantly superior over rest of the treatments.The application of pendimethalin 1000 g ha^{-1} along with PoE application of clodinafop propargyl 60 g ha^{-1}or quizalofop ethyl 60 g ha^{-1} proved superior over rest of the treatments with respect to weed control efficiency, grain yield and economics of chickpea followed by oxyfluorfen 200 g ha^{-1} as PE along with PoE application of clodinafoppropargyl or quizalofop ethyl 60 g ha^{-1} each.

However, PoE application of tank mixed herbicides caused the phytotoxicity to the chickpea. Effective control of weeds provides better results of crop by providing suitable environment for the growth and development of crop as well as increase input use efficiency.

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Table1: Number of nodules per plant at different growth stages of chickpea in different weed control measures

Treatments	45 DAS	60 DAS	75 DAS	90 DAS
T_1: Pendimethalin 1000 g ha^{-1} (PE)	10.30	13.45	13.00	11.22
T_2 : Pendimethalin 1000 g(PE) fb quizalofop 60 g ha^{-1} (PoE)	12.10	16.32	13.38	10.85
T_3 : Pendimethalin 1000 g(PE) fb clodinafop 60 g ha^{-1} (PoE)	13.30	17.98	14.75	11.96
T_4 : Pendimethalin 750 g(PE) fb quizalofop 60 g + oxyfluorfen 200 g ha^{-1} (PoE)	8.49	11.91	11.41	9.25
T_5 : Oxyfluorfen 200 g ha^{-1} (PE)	9.10	10.53	10.10	9.00
T_6 : Oxyfluorfen 200 g (PE) fb quizalofop 60 g ha^{-1} (PoE)	10.70	13.16	10.80	8.75
T_7 : Oxyfluorfen 200 g (PE) fb clodinafop 60 g ha^{-1} (PoE)	11.10	14.46	11.86	9.62
T_8 : Oxyfluorfen 200 g + quizalofop 60 g ha^{-1} (PoE)	8.15	11.20	10.95	8.88
T_9 : Oxyfluorfen 200 g + fb clodinafop 60 g ha^{-1} (PoE)	8.14	10.86	10.55	8.75
T_{10} : Imazethapyr 75 g ha^{-1} (PoE)	9.60	13.37	11.95	9.80
T_{11} : Pendimethalin 1000 g (PE) fb imazethapyr 75 g ha^{-1} (PoE)	10.70	15.57	12.78	10.36
T_{12} : Pendimethalin 1000 g (PE) fb imazethapyr 75 g + quizalofop 60 g ha^{-1} (PoE)	8.26	12.20	11.10	9.00
T_{13} : Weed free	13.90	18.54	15.21	12.33
T_{14} : Weedy check	9.30	13.72	11.26	9.12
SEm±	0.52	0.87	0.68	0.49
CD at 5%	1.50	2.52	1.97	1.42

CD= Critical difference, SEm= standard error of mean

Table 2: N, P and K (kg ha^{-1}) uptake by crop and weeds in weed control treatments

Treatments	Uptake by crop			Uptake by weed		
	N	**P**	**K**	**N**	**P**	**K**
T_1: Pendimethalin 1000 g ha^{-1} (PE)	52.01	7.51	61.75	5.91	0.65	12.23
T_2 : Pendimethalin 1000 g(PE) fb quizalofop 60 g ha^{-1} (PoE)	60.82	8.57	72.32	3.99	0.46	8.55
T_3 : Pendimethalin 1000 g(PE) fb clodinafop 60 g ha^{-1} (PoE)	61.72	8.86	72.11	3.14	0.36	6.54
T_4 : Pendimethalin 750 g(PE) fb quizalofop 60 g + oxyfluorfen 200 g ha^{-1} (PoE)	18.71	2.63	22.63	1.86	0.21	3.86
T_5 : Oxyfluorfen 200 g ha^{-1} (PE)	48.91	6.95	58.14	6.23	0.70	13.17
T_6 : Oxyfluorfen 200 g (PE) fb quizalofop 60 g ha^{-1} (PoE)	57.35	8.23	68.18	4.57	0.50	9.52
T_7 : Oxyfluorfen 200 g (PE) fb clodinafop 60 g ha^{-1} (PoE)	58.56	8.30	69.26	3.63	0.40	7.61
T_8 : Oxyfluorfen 200 g + quizalofop 60 g ha^{-1} (PoE)	18.87	2.61	23.14	2.38	0.27	5.11
T_9 : Oxyfluorfen 200 g + fb clodinafop 60 g ha^{-1} (PoE)	20.13	2.85	24.56	2.76	0.31	5.63
T_{10} : Imazethapyr 75 g ha^{-1} (PoE)	46.16	6.54	54.66	6.04	0.69	12.67
T_{11} : Pendimethalin 1000 g (PE) fb imazethapyr 75 g ha^{-1} (PoE)	54.84	7.74	64.92	2.17	0.25	4.73
T_{12} : Pendimethalin 1000 g (PE) fb imazethapyr 75 g + quizalofop 60 g ha^{-1} (PoE)	38.75	5.44	46.39	1.18	0.13	2.50
T_{13} : Weed free	63.60	9.09	74.39	0.00	0.00	0.00
T_{14} : Weedy check	36.00	5.08	46.57	23.22	2.68	50.42
SEm±	**2.82**	**0.40**	**3.35**	0.28	0.03	0.59
CD at 5%	**8.20**	**1.16**	**9.74**	0.81	0.09	1.73

CD= Critical difference, SEm= standard error of mean

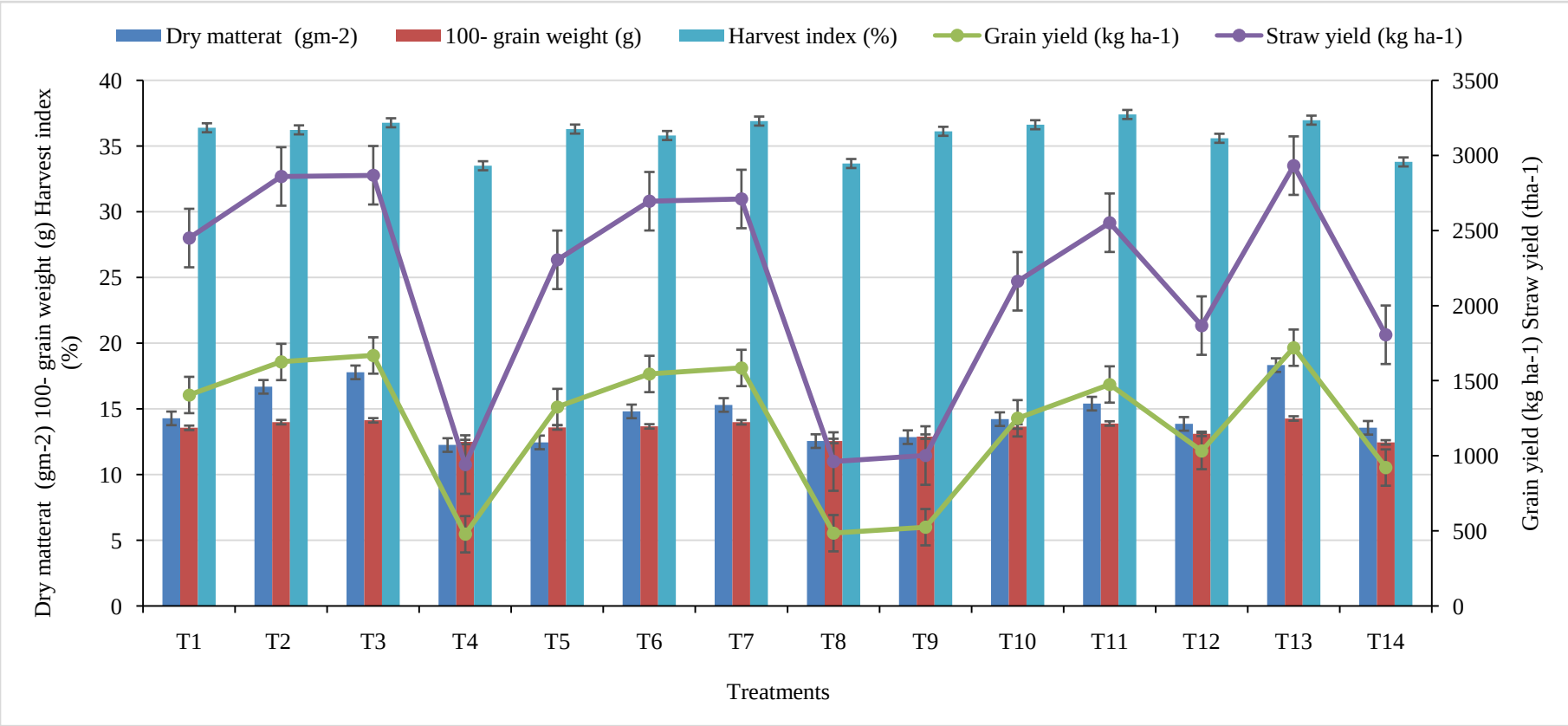

Figure no. 1: Effectof herbicides onDry matter(gm^{-2}), 100- grain weight (g), Harvest index (%),Grain yield (kg ha^{-1}) and Straw yield (tha^{-1}) ofchickpea

T1: Pendimethalin 1000 g ha-1 (PE), T2: 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), T5: Oxyfluorfen 200 g ha-1 (PE), T6: Oxyfluorfen 200 g (PE) fb quizalofop 60 g ha-1 (PoE), T7: Oxyfluorfen 200 g (PE) fb clodinafop 60 g ha-1 (PoE), T8: Oxyfluorfen 200 g + quizalofop 60 g ha-1 (PoE), T9: Oxyfluorfen 200 g + fb clodinafop 60 g ha-1 (PoE), T10: Imazethapyr 75 g ha-1 (PoE), T11: Pendimethalin 1000 g (PE) fb imazethapyr 75 g ha-1 (PoE), T12: Pendimethalin 1000 g (PE) fb imazethapyr 75 g + quizalofop 60 g ha-1 (PoE), T13: Weed free, T14: Weedy check.

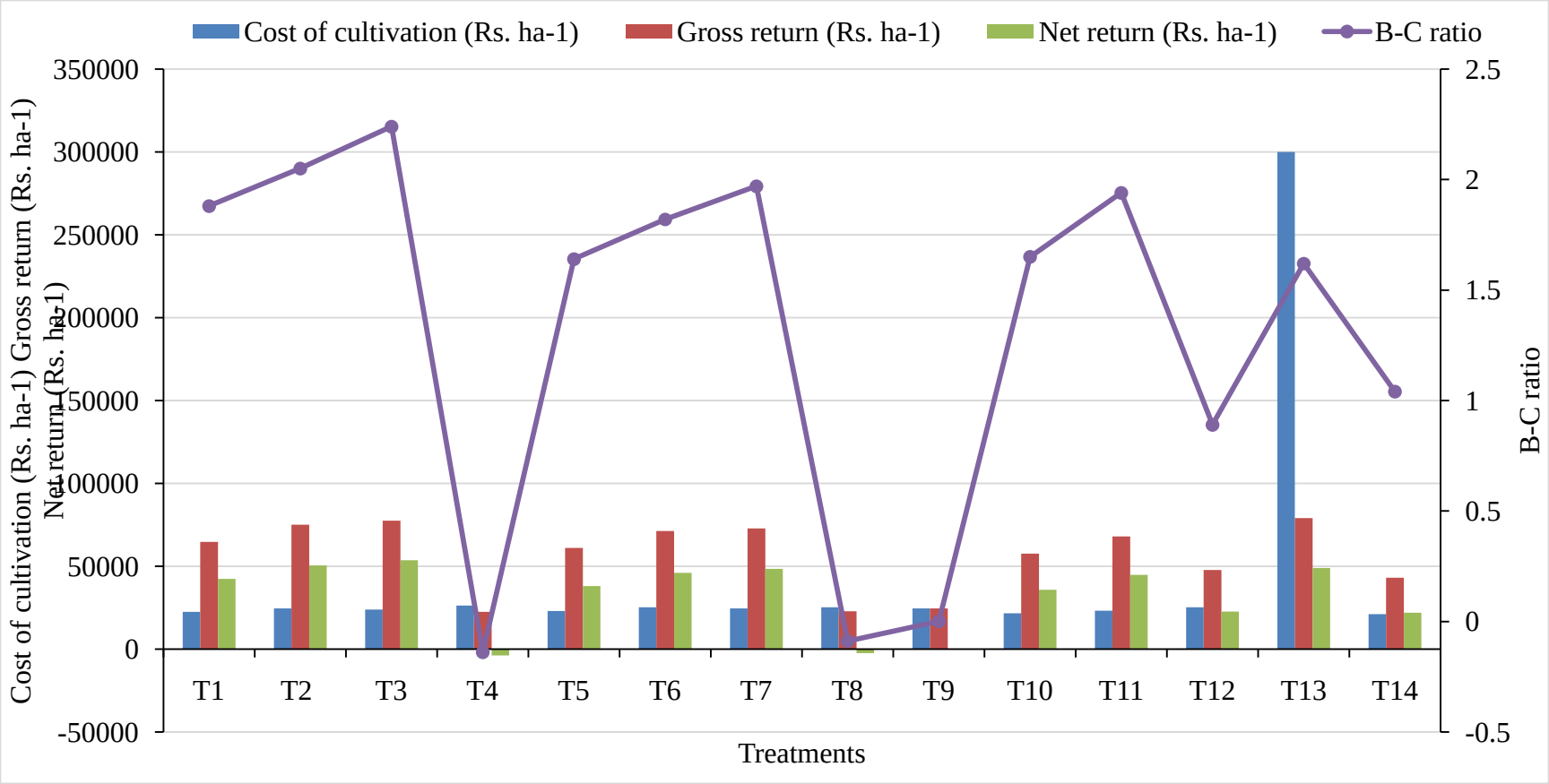

Figure no. 2: Effectof herbicides Cost of cultivation (Rs. ha^{-1}) Gross return (Rs. ha^{-1}) Net return (Rs. ha^{-1}) and B-C ratio ofchickpea

T1: Pendimethalin 1000 g ha-1 (PE), T2: 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), T5: Oxyfluorfen 200 g ha-1 (PE), T6: Oxyfluorfen 200 g (PE) fb quizalofop 60 g ha-1 (PoE), T7: Oxyfluorfen 200 g (PE) fb clodinafop 60 g ha-1 (PoE), T8: Oxyfluorfen 200 g + quizalofop 60 g ha-1 (PoE), T9: Oxyfluorfen 200 g + fb clodinafop 60 g ha-1 (PoE), T10: Imazethapyr 75 g ha-1 (PoE), T11: Pendimethalin 1000 g (PE) fb imazethapyr 75 g ha-1 (PoE), T12: Pendimethalin 1000 g (PE) fb imazethapyr 75 g + quizalofop 60 g ha-1 (PoE), T13: Weed free, T14: Weedy check.