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Effect of weed control treatments on weed control efficiency and weed index in chickpea

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Abstract
The investigation was conducted at Agronomy Research Farm, Acharya Narendra Deva University of Agriculture and Technology. Kumarganj, Ayodhya (U.P.) during *Rabi* season of year 2017-18 and 2018-19. The experiment was laid out in Randomized Block Design with three replication. The experiment was carried out with 12 treatments *viz.*: T_1- Imazethapyr + imazamox (PRE), T_2- Imazethapyr+ imazamox (POE) at 3-4 leaf stage, T_3- Imazethapyr (POE) at 3-4 leaf stage, T_4- Quizalofop ethyl (POE) at 3-4 leaf stage, T_5- Clodinofop (POE) at 3-4 leaf stage, T_6- Pendamethalin (PE), T_7- Pendamethalin (PE)+ Imazethapyr (POE), T_8- Oxyfluorfen (PE), T_9- Oxyfluorfen (PE)+ Quizalofop (POE), T_{10}- 1 Hand Weeding at 35-40 DAS, T_{11}- Weed Free and T_{12}- Weedy Check respectively. The objective of the study was to study the bio-efficacy of herbicides and cultural practices on weed control. On the basis of the experiment it may be concluded that pre-emergence application of pendimethalin 1000 g ha^{-1} along with post-emergence application of either Imazethapyr proved superior over rest of the treatments with respect to weed control efficiency. Weed control efficiency was recorded highest with pendimethalin 1000 g and oxyfluorfen 200 g ha-1 as PE when supplemented with the sequential application of Quizalofop or imazethapyr g ha-1 as PoE each in both of the pre-emergence herbicides (T6 & T7/T8 & T9) over single application of either pendimethalin 1000 g or oxyfluorfen 200 g ha-1 as PE.

Keywords: Imazamox, pendimethalin, Clodinafop

Introduction
Pulses are an important commodity group of crops that provide high quality protein complementing cereal proteins for pre-dominantly substantial vegetarian population of the country. Although, being the largest pulse crop cultivating country in the world, the cultivation of pulses builds-up a mechanism to fix atmospheric nitrogen in their root nodules and thus meet their nitrogen requirements to a great extent.

Pulses are an integral part of Indian agriculture. Chickpea (*Cicer arietinum* L.) commonly known as gram or Bengal gram is one of the most important *rabi* season pulse crop grown in India, which account for 47 per cent of total pulse production and 33 per cent of total pulse area. The major chickpea growing states are Madhya Pradesh, Rajasthan, Uttar Pradesh, Haryana, Maharashtra and Karnataka, which together contribute 60 per cent area and 90 per cent production in the country. In India, the area under chickpea during 2015-16 was 8.35 million hectare with total production of 9.38 million tonnes and average productivity of 859 kg per hectare (Directorate of Economics & Statistics, DAC& FW, 2018). Besides being rich source of highly digestible dietary protein (19.5 per cent), chickpea is also a rich source of calcium, iron, niacin, vitamin B and C. It also provides 396 kcal energy from 100 grams of seeds.

Introduction of herbicides has made it possible to control a wide spectrum of weeds in pulses effectively at a remunerative cost. Application of pendimethalin as pre-emergence at 1.0 kg ha^{-1} (Tewari *et al*., 2003 and Vaishya *et al*., 2005) [6, 7], imazethapyr as post-emergence at 0.1 kg ha^{-1} (Singh *et al*., 2003) [5], clodinafop-propargyl (Topic 15 WP) as post-emergence at 0.03 kg ha^{-1} (Marwat *et al*., 2004) [2] and oxyfluorfen (600 g ha^{-1}) as weed control treatment (Yousefi *et al*., 2007) [8] provided effective control of annual broad leaved and grassy weeds in chickpea field as reported by many research workers from the various parts of the country.

In the legumes especially in case of chickpea pendimethalin at 1.0 kg ha^{-1} applied as pre-emergence is a very common herbicide which is used to take care of all type of weeds, but there is no herbicide available to be applied as post-emergence to control the emerging BLWs effectively. Even if pre-emergence application of herbicide is missed due to any reason in that case post-emergence 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 post-emergence in pulses and more specifically in chickpea. However, manual weeding has been found very efficient but availability of labours in time and at cheaper rate 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 these molecules are used in a combination may be more effective to control the wide spectrum of weeds.

Materials and Methods

The field experiment was conducted during rabi season of the year 2017-18 and 2018-19 at Agronomy Research Farm of Acharya Narenra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) India. To find out the effect of weed control treatments on crop and associated weeds, to study the efficacy of pendimethalin and oxyfluorfen as pre-emergence in combination with post-emergence herbicides. The experiment was carried out with 12 treatments *viz.*: T_1- Imazethapyr + imazamox (PRE), T_2- Imazethapyr+ imazamox (POE) at 3-4 leaf stage, T_3- Imazethapyr (POE) at 3-4 leaf stage, T_4- Quizalofop ethyl (POE) at 3-4 leaf stage, T_5- Clodinofop (POE) at 3-4 leaf stage, T_6- Pendamethalin (PE), T_7- Pendamethalin (PE)+ Imazethapyr (POE), T_8- Oxyfluorfen (PE), T_9- Oxyfluorfen (PE)+ Quizalofop (POE), T_{10}- 1 Hand Weeding at 35-40 DAS, T_{11}- Weed Free and T_{12}- Weedy Check respectively. The experiment was laid out in Randomized Block Design (RBD) with three replications.

Result and Discussion

The major weeds noted in the experimental field in the control plot were *Chenopodium album*, *Anagallis arvensis*, *Phalaris minor*, *Cynodon dactylon* and other weeds included *Melilotus alba*, *Convolvulus arvensis* and *Avena fatua* and few plant of *Cyperus rotundus*. Although, *Chenopodium album* was most predominant weeds recorded in the experiment. Similar type of weed flora in chickpea under normal conditions have also been reported by a number of workers working in different agro-climatic zones of the country (Buttar *et al.*, 2008 and Sharma *et al.*, 2009) [1, 4].

The species wise density of weeds recorded at various stages of crop growth revealed that the chickpea crop was infested mainly with non-grassy as well as grassy weeds. All the weed control treatments decreased the weed density per unit area over weedy check at various growth stages. At 30th, 60th, 90th days and at harvest stage of crop growth, all the weed control treatments reduced the weed density significantly. The similar type of response was reported by Sharma *et al*. 2009 [4] and Punia *et al*. 2009 [3]. However, the response of Pendamethalin (PE) + Imazethapyr (POE) (T_7) also declined the density of different weed species appreciably and proved superior over imazethapyr 75 g ha^{-1} as PoE alone.

The data given in Table 1 and fig. 1 revealed that WCE was also affected due to various weed control treatments. The highest weed control efficiency was recorded in T6: pendimethalin 1000g as PE along with Imazethapyr (94.11 and 94.41%) along with T9: oxyfluorfen 200g as PE along with quizalofop 60 g ha-1 PoE (91.55 and 92.42%), T1: Imazethapyr + imazamox (PRE) (79.67 and 81.18%) and lowest was found with T4: Quizalofop ethyl (POE) (71.78 and 74.07%), T5: Clodinofop (POE) (73.79 and 75.95%) and T3: Imazethapyr (POE) (77.37 and 79.37%), respectively both the year. Imazethapyr applied as post emergence controlled the BLWs only, while pendimethalin and oxyfluorfen both of these herbicides applied as pre-emergence used to control BLWs and grassy both type of weeds in the early stages. In the experimental field, density of narrow leaved weeds was comparatively less as compared to broad leaved weeds. So, this might be a main reason to show the lower W.C.E. over rest of the herbicidal treatments. After all, the pendimethalin 1000 g (PE) along with Imazethapyr (POE) was found much effective to control the both type of weeds and resultant to this gave higher value of W.C.E. %. It is because of the fact that pendimethalin + Imazethapyr (POE) controlled the BLWs as well as grassy weeds and recorded the lowest value of weed index (2.87 and 3.25%) FB T6: pendimethalin 1000 g (PE) alone (8.05 and 7.69%). It means maximum reduction in grain yield was recorded with T4: Quizalofop ethyl, however, highest grain yield was recorded with weed free and lowest with weedy check treatments as there was no competition and 100% competition between crops and weeds, respectively. However, maximum WCE was noticed in the treatments e.g. T5, T3, T1 and T2, which was not due to bio efficacy of treatments but caused by phytotoxicity to weeds as well crop plants and it was reflected by the low values of weed index in the respective treatments.

Data on weed index as affected by different weed control treatment are presented in Table 2 and Fig. 2. Weed control treatments during both the years sequential spray of pendimethalin (POE) recorded the lowest value of weed index (2.87 and 3.25%) in respective years. Which was followed by Oxyfluorfen (PE) FB. Oxyfluorfen (PE) + Quizalofop (POE) (14.08 and 14.53%) Imazethapyr+ imazamox (POE) at 3-4 leaf stage followed by Imazethapyr + imazamox (PRE) (8.04 and 7.69%) in respective year. Among the single herbicide applied either pre or post emergence, pendimethalin @ 1.0 l a.i. (PE) recorded the lowest values of weed index (12.35% and 12.36% which was followed by Oxyfluorfen (PE) (17.16 and 17.66%). the highest values of weed index (46.26 and 16.32% was requested under weed check treatment. Two hand weeding resulted in lowest value (14.08 and 14.52%) as compared to single herbicides applied treatments either post emergence except pendimethalin applied as pre – emergence which was found significantly effective as resulted the lowest weed index (12.35 and 12.36% in respective years.

Among all the weed control treatments, T_7: Pendamethalin (PE) + Imazethapyr (POE) followed by T_9: Oxyfluorfen (PE) + Quizalofop (POE). Being at par recorded significantly lower values of N, P & K uptake by weeds over rest of the treatments, except the tank mixed treatments during both the year.

Table 1: Effect of weed control treatments on weed control efficiency (%) at harvest stage of chickpea.

Treatments	Weed control efficiency	
	2017-18	2018-2019
Imazethapyr+ imazamox (PRE)	79.67	81.18
Imazethapyr+ imazamox (POE) at 3-4 leaf stage	81.03	82.41
Imazethapyr (POE) at 3-4 leaf stage	77.37	79.37
Quizalofop ethyl (POE) at 3-4 leaf stage	71.78	74.07
Clodinofop (POE) at 3-4 leaf stage	73.79	75.95
Pendamethalin (PE)	93.05	93.30
Pendamethalin (PE) + Imazethapyr (POE)	94.11	94.41
Oxyfluorfen (PE)	89.90	89.72
Oxyfluorfen (PE)+ Quizalofop (POE)	91.55	92.42
1 Hand Weeding at 35-40 DAS	91.64	92.01
Weed Free	100.00	100.00
Weedy Check	0.00	0.00
S.Em±	-	-
C.D. at 5%	-	-

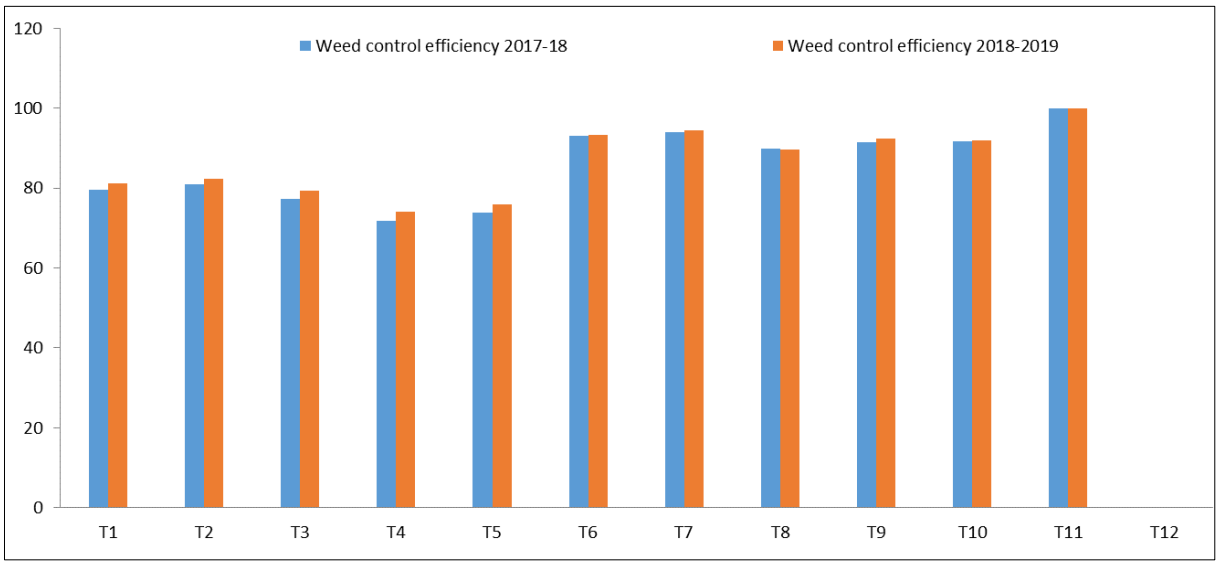

Fig 1: Effect of weed control treatments on weed control efficiency (%) at harvest stage of chickpea.

Table 2: Effect of weed control treatments on weed index (%) at harvest stage of chickpea.

Treatments	Weed index	
	2017-18	2018-2019
Imazethapyr+ imazamox (PRE)	18.97	19.32
Imazethapyr+ imazamox (POE) at 3-4 leaf stage	17.82	17.66
Imazethapyr (POE) at 3-4 leaf stage	20.40	20.46
Quizalofop ethyl (POE) at 3-4 leaf stage	24.71	24.22
Clodinofop (POE) at 3-4 leaf stage	21.26	21.37
Pendamethalin (PE)	8.05	7.69
Pendamethalin (PE)+ Imazethapyr (POE)	2.87	3.25
Oxyfluorfen (PE)	14.08	14.53
Oxyfluorfen (PE)+ Quizalofop (POE)	12.07	11.97
1 Hand Weeding at 35-40 DAS	12.36	12.36
Weed Free	0.00	0.00
Weedy Check	46.26	46.32
S.Em±	-	-
C.D. at 5%	-	-

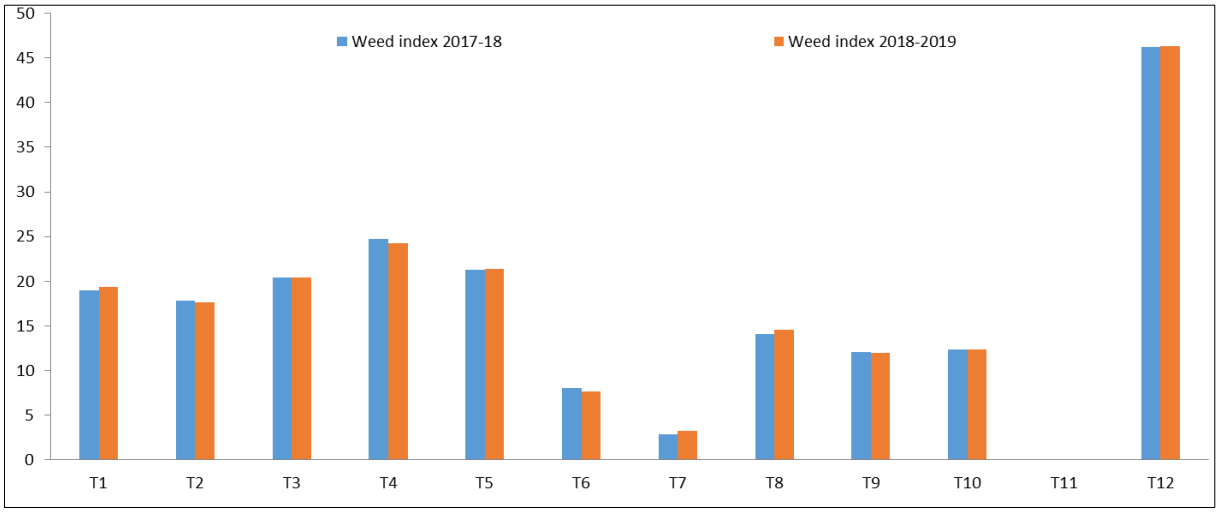

Fig 2: Effect of weed control treatments on weed index (%) at harvest stage of chickpea.

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