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Pre-emergence Application of Imazethapyr for Weed Control in Soybean (*Glycine max* (L.) Merr.), Gezira State, Sudan

Suhaip A. M. Zain [1], Awadallah B. Dafaallah [2] and Mohamed S. Zaroug [2]

1 Weed Science Research Program, Integrated Agricultural Pest Management Research Center, ARC, Sudan.
2 Crop Protection Department, FAS, UofG, Sudan.
* E-mail address: awadna2020@gmail.com; awadna@uofg.edu.sd (Corresponding author)

***Abstract**: Soybean is one of the most important crops grown for the purpose of oil production in many countries of the world. In the State of Sudan, in recent years, the interest in the soybean crop has increased due to the increase in demand and the lack of supply for the crop in the local market, as well as the importance of the crop in many industries, especially food. Weeds are one of the factors that negatively affect the production and productivity of the soybean crop. The current study was conducted with the aim of assessing the pre-emergence application of the chemical imazethapyr in weed management of soybeans in Gezira State, Sudan. A field experiment was conducted at the farm of Gezira Research Station of the Agricultural Research Corporation in Wad Medani, Sudan during the 2018/19 agricultural season. Three doses (0.0375, 0.050, and 0.0625 kg ai ha^{-1}) of imazethapyr (Pursuit® 100 SL) were used as a pre-emergence treatment. For comparison, weeded and un-wedded treatments were used as a control. A randomized complete block designed was used and each treatment was replicated four times. Descriptive analysis and analysis of variance were performed to analyze data. Duncan's Multiple Range test was used for separation of the means. The results showed that all tested herbicide doses were effective in controlling weeds. The three doses significantly decreased weed infestation in comparison with un-weeded control and significantly increased the yield and different growth attributes of soybean compared un-weeded control treatment. Using of imazethapyr at the dose 0.0625 kg a.i. ha^{-1} significantly reduced weeds (grasses and broad leaf) in the crop. It was also the best in terms of growth and productivity. The highest yield of seed (1383.3 kg ha^{-1}) was obtained in the herbicide at the dose 0.0625 kg a.i. ha^{-1}. The results of chemical analysis for the detection of pesticide residues in soybean seeds showed that there were no residues of the tested pesticide. The study concluded that the use of imazethapyr at a dose of 0.0625 kg a.i. ha^{-1} as pre-emergence treatment is effective and safe in weed management in soybean crop.*

Keywords: *Glycine max*; Imazethapyr; Soybean; Weed Control

1. INTRODUCTION

Soybean, known with scientific name *Glycine max* (L.) Merr), belonging to the family Fabaceae, is undoubtedly of a great economic and social importance worldwide. The global production of soybeans is forecast to be 337 million tons in 2017–2018 [1]. The main countries growing soybeans in 2016 were the United States (35% of world total), Brazil (29%) and Argentina (18%) [2]. It provides approximately 60% of vegetable protein and 30% of vegetable oil in the world. The United States of America, Brazil, Argentina and the Republic of China are the main global soybean producers, producing 87.8% of the world's production. The highest soybean average yield is 2890 kg ha^{-1} in the USA and the world average yield is 2430 kg ha^{-1}. According to the statistic of FAO, soybean was grown on at an average of 1.26 million ha in Africa with an average production of 1.48 million tons in 2007 [3]. Its cost-effectiveness is ensured by biological nitrogen fixation and rotation with exhaustive crops like as maize and sorghum; helps regenerate and maintain soil fertility. It provides a large amount of edible vegetable oils, also soybean cake and meal which are high protein supplements in the livestock mixed feed rations.

Reference [4] reported that soybean contains 20 to 22% of essential amino acids, and 40% of protein. The study by [5] showed that soybean contains 18-22% oil which comprises of 85% cholesterol free unsaturated fatty acids in comparison to conventional vegetable and animal fats. Soybean also has several food and industrial uses. Soybeans food has been reported to provide protection versus heart disease, cancer and other diseases [6]. Owning to its nutritional value there is a growing demand for soybeans foods such as soy milk, many types of tofu, soybean sprouts, soy nuts, cottage cheese like soybean curd rich in protein, and various vitamins and minerals [6].

In Sudan, commercial production of soybeans began in the 1982/83 season when an estimated area of 1,260 to 2,100 hectares of soybean production was laid down by the Sudanese-Egyptian Integrated Agricultural Project in El Damazin. In Sudan, the first soybean experiments were conducted as early as 1925 at the Gezira Research Farm, where a poor yield of 500 kg ha^{-1} was obtained. Subsequent studies conducted in the period from 1931-1935 and in the season 1939/40 also failed due to the poor performance of the introduced varieties [7]. Since then, studies on soybean have been erratic and inconsistent, depending on the researchers' interest [8]. The interest in soybeans increased and the research work on soybeans was reactivated, due to the increased demand for soybeans as an industrial crop in Sudan [9].

Weed competition is one of the most important factors that reduce soybean production and productivity, as well as profits in soybean cultivation due to the bad influence of weeds, as

this leads to increased production costs, reduced net profit margins and reduced product quality [10]. Weeds decrease soybean yield by as much as 5% to 80% in several parts of the world [11] and [12]. Reference [13] reported a yield loss of soybean beans of up to 99% due to weed dominance in the Sudan Savanna region of Nigeria. In the early growth stages of soybean crop, the crop is considered a poor competitor with fast-growing weeds and if such weeds are not controlled [14]. Also, [15] reported that up to 80% of soybean yield loss may occur as a result of weed competition in many parts of the world. Reference [16] indicated that lack of weed control reduces soybean yield by up to 5%, depending on economic density and diversity, as the average yield loss of 5% expected in that study translates to a loss of 26.72 dollars per acre in 2011 crop prices. Uncontrolled weeds not only reduce soybean yield by competing for light, nutrients and moisture, but more than that, it can also severely reduce harvesting efficiency and grain quality as well as harboring insect pests and disease agents [17].

The application of herbicides is one of the methods developed to control weeds in crop production. It is more adaptable to large scale, crop production and labor saving. Another factor that makes chemical weed control more popular than manual weeding is to reduce the drudgery of chemical weed control, it protects crops from the harmful effects of early weed competition, that properly leads to economic losses in yield that need early weed control in the four weeks as this is the critical period for weed competition in soybean [18], [19] and [20].

Imazethapyr, pyridinecarboxylic acid, is a selective herbicide applied to manage the unwanted plants in soy, peas, groundnut and edible beans. Imazethapyr control wide range of annual broad leaf and grass weeds. It is applied as foliar or soil applied, pre-plant incorporated, pre-emergence or early post-emergence [21]. Imazethapyr is translocated herbicide that is absorbed either by roots or above-ground parts of plants and is circulated within the plant system to the meristematic tissues. It is known as amino acid synthesis inhibitor which acts on a specific enzyme to stop the synthesis of specific amino acids that are key building blocks for normal plant growth and development [22]. Toxicity symptoms include leaf chlorosis and necrosis caused by loss cell membrane integrity [23]. In Sudan, Imazethapyr was approved to be applied at any time before the weed seedlings emerge through the soil surface for weed management in many leguminous crops [24].

Therefore, the current study was conducted with the aim of assessing the pre-emergence application of the chemical imazethapyr in weed management of soybeans in Gezira State, Sudan.

2. MATERIALS AND METHODS

2.1. Location

A field trial was carried out at the experimental farm of Gezira Research Station, Agricultural Research Corporation (ARC) (14°24'N, 33°29'E), Sudan throughout season 2018/19. The farm's soil is highly fractured with clay contents of 55-58%. The soil pH is 8.1, total nitrogen content is 300-400 ppm and the total organic carbon is 0.5% [25].

2.2. The trial

The soil was a plowed, rammed, flat, ribbed 80 cm wide. Soybean cultivar (Sudan II) was planted on burrs at a distance of 80 cm and 4 cm between plants. The planting date is 12/7/2018. The crop was irrigated with an interval of 10-12 days. The chemical applied in this trial was imazethapyr that is known with the trade name Pursuit SL 100®, the manufacturer; American Cyanamide Corporation (One Cyanamide Plaza Wine, NJ 07470). The treatments of imazethapyr, i.e., the doses 0.0375, 0.05 and 0.0625 kg ai ha^{-1}, were applied instantly posterior sowing. (pre-emergence treatments). The chemical was used as an aqueous solution by a backpack sprayer adjusted to yield 240 l ha^{-1}. The size of plot was 33.2 m^2. For comparison, weed control and un-weeded control were used. Weeds were manually removed every two weeks after sowing throughout the season, while the un-weeded treatment remained throughout the season. A randomized complete block designed was used and each treatment was replicated four times.

2.3. Data collection

Phytotoxicity

The symptoms of the phytotoxic effect of Imazethapyr on the soybean crop was recorded periodically on the visual scale. The scale was 0, 1-2, 3-4, and 5 which indicating that the plant is healthy, slight, moderate and high phytotoxicity, respectively [26].

Count of weeds

The plots regarding un-weeded control were left with weed throughout the season. The effects of the different doses were evaluated by counting the total and individual weed species and the percentage of land covered in six fixed squares (25 × 40 cm) per plot at 4 and 8 weeks after sowing, hence indicating early and late weeds of season, respectively. The weed control scale was 0 – 49, 50 – 59, 60 – 69, 70 - 79 and ≤ 80% indicating poor, moderate, satisfactory, good and excellent control, respectively [27]. The percentage of control total weeds and broadleaf weeds compared to check weeds for each treatment was calculated as follows. The percentage control of broadleaf, grasses and total weeds compared with the weedy control for each treatment was calculated as follows.

$$Control\ \% = \frac{W_x - W_y}{W_x} \times 100$$

In the equation Wx and Wy refer to the number of weeds in un-weeded control and in herbicide treatment, respectively.

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To assess the percentage of individual dominant weeds following equation was used:

$$\text{Weed } \% = \frac{Wx}{Wy} \times 100$$

In the equation Wx and Wy refer to the number of individual and total number of weeds in the experimental site, respectively.

The percentage of weed ground cover was assessed in six fixed squares (25 × 40 cm) per plot at each of the four and eight weeks after sowing, i.e. 4 and 8WAS, respectively. During harvesting, weeds of 1 square meter per plot were cut, dried on air and weighed.

Yield and yield attributes

To assess the height of soybean plant, five plants were randomly chosen and the height per plant was determined from the ground level to the tip of the plant. The mean height of the five plants was then recorded. To assess the number of pods per soybean plant, five plants were randomly chosen and the numbers of pods per plant were determined. The mean number of the total pods per plant was recorded. To assess the plant population soybean crop, plant population in each plot (the harvested area was 6 m2) was recorded and transformed into plant ha^{-1}. To assess the grain yield soybean crop, the pods per plot (the harvested area was 6 m2) were gathered, threshed and the grain yield was weighed. The grain yields transformed into Kg ha^{-1} by calculation. To assess the hundred-seeds weight, 100 seeds randomly chosen and weighed. To assess the percentage weed ground cover was visually estimated in six fixed quadrates (25 x 40 cm) per plot at both the four and eight weeks after sowing, i.e. 4 and 8WAS, respectively. During harvesting, weeds of 1 square meter per plot were cut, dried on air and weighed.

2.4. Detection of imazethapyr residues

For the detection of imazethapyr residues in soybean crop, samples of soybean seeds were collected at harvest and subjected to chemical analysis using the TLC methodology that describe by references [19] and [20].

2.5. Data analysis

Descriptive analysis and analysis of variance were performed to analyze data. Duncan's Multiple Range test was used for separation of the means. Statistix8, a software, was used for the analysis.

3. RESULTS

3.1. Weeds flora of the location

The results showed that there were 21 species of weeds reported in the location through the critical period for weed competition and crops belonging to 11 families and they were mainly broadleaf and constituted 70% of the total weeds present (Table 1). However, the predominant weed species at the location were mostly broadleaf weeds and these include; Basil or *Ocimum basilicum*, *Digera muricata*, *Brachiaria eruciformis*, *Echinochoa colona* and *Phyllanthus maderaspatensis* out of the total number of weed species present at the location which was 519 weed species. The corresponding frequency of the predominant weed species was 16, 15, 12, 8 and 5%, respectively.

Table 1: Weed species recorded in the location

	Predominant species	Weed number	Frequency percentage
1.	*Ocimum basilicum*	83	16
2.	*Phyllanthus maderaspatensis*	78	15
3.	*Digera muricata*	62	12
4.	*Echinochoa colona*	42	8
5.	*Brachiaria eruciformis*	78	15
6.	Other species	176	34
	Total	519	100

3.2. Effects of imazethapyr on weeds

Effects of imazethapyr treatments on predominant weed species

The results revealed that imazethapyr at 0.0375 kg a.i. ha^{-1} showed excellent control versus *Digera muricata*, *Echinochoa colona*, good control versus *Phyllanthus maderaspatensis,* and poor control versus *Ocimum basilicum* and *Brachiaria eruciformis* (Table 2). Imazethapyr at 0.05 kg a.i. ha^{-1} showed excellent control *Ocimum basilicum*, *Phyllanthus maderaspatensis, Digera muricata*, moderate control versus *Echinochoa colona* and good control versus *Brachiaria eruciformis.* Imazethapyr at 0.0625 kg a.i. ha^{-1} gave excellent control *Ocimum basilicum, Phyllanthus maderaspatensis, Digera muricata*, poor control versus *Echinochoa colona* and satisfactory control versus Brachiaria *eruciformis* (Table 2).

Effect of imazethapyr treatments on weed control

Imazethapyr at 0.0375 kg a.i. ha^{-1} gave moderate control versus total weeds (53.9 control) at 4WAS and poor control (44.3% control) at 8WAS (Table 3 and 4). On grasses displayed poor control (30% control) at 4WAS and moderate control (59% control) at 8WAS. On broad leaved weeds showed satisfactory control (67.7% control) at 4WAS and poor control (28.9% control) at 8WAS.

Table 2: Effects of imazethapyr treatments on dominant weeds

Treatments	Imazethapyr dose (Kg a.i. ha^{-1})	Dominant weeds control (%)				
		Ocimum basilicum	*Phyllanthus maderaspatensis*	*Digera muricata*	*Echinochoa colona*	*Brachiaria eruciformis*
Imazethapyr	0.0375	30.5	72.2	97.1	92.8	4.7
Imazethapyr	0.0500	80.5	88.8	100	57.1	77.7
Imazethapyr	0.0625	88.8	100	100	14.2	66.6
Weeded Control	-	100	100	100	100	100
Un-Weeded Control	-	0	0	0	0	0

Table 3: Effects of imazethapyr treatments on total weed control

Treatments	Herbicide dose (Kg a.i. ha^{-1})	Weed control (%)	
		4WAS	8WAS
Imazethapyr	0.0375	53.9	44.3
Imazethapyr	0.0500	72.4	63.7
Imazethapyr	0.0625	69.6	66.4
Weeded Control	-	100	100
Un-Weeded Control	-	0	0

WAS = Week After Sowing.

Imazethapyr at 0.05 kg a.i. ha^{-1} displayed good control versus total weeds (72.4% control) satisfactory control (63.7% control) at 4 and 8WAS, respectively. On grasses displayed moderate control (53.3% control) and satisfactory control (66% control) at 4 and 8WAS, respectively. Control activity versus broadleaved weed species was excellent, it gave (83.06% control) at 4WAS and moderate control (56.5% control), 8WAS. Imazethapyr at 0.0625 kg a.i. ha^{-1} showed satisfactory control versus total weeds (69.6 and 66.4% control) at 4WAS and 8WAS, respectively. Versus grasses displayed excellent control (90% control) at 4WAS and moderate control (56% control) at 8WAS. On broad leaved weeds showed excellent control (93% control) at 4WAS and good control (76.3% control) at 8WAS (Table 3 and 4).

Effects of imazethapyr treatments on weed ground cover

The percentage weed ground cover was estimated visually. Imazethapyr displayed the lower percentage ground cover (5.0% - 13.75%) at 4WAS and (14.5% - 29.5%) 8WAS, compared to (45% - 70%) in the un-weeded treatment (Table 5).

Table 4: Effects of imazethapyr treatments on the control of annual grasses and broad leaved weeds

Treatment	Imazethapyr dose (Kg a.i. ha^{-1})	Control%			
		Grasses		Broadleaved	
		4WAS	8WAS	4WAS	8WAS
Imazethapyr	0.0375	30	59	67.7	28.9
Imazethapyr	0.0500	53.3	66	83.06	56.5
Imazethapyr	0.0625	90	56	93.5	76.3
Weeded Control	-	100	100	100	100
Un-Weeded Control	-	0	0	0	0

WAS = Week after sowing.

Table 5: Effects of imazethapyr treatments on ground cover and dry weight of weeds

Treatment	Imazethapyr dose (Kg a.i. ha^{-1})	Ground cover %		Dry weight (g m^{-2})
		4WAS	8WAS	
Imazethapyr	0.0375	13.75	29.5	357.50 b
Imazethapyr	0.0500	5.6	14.5	320.00 b
Imazethapyr	0.0625	5	17.7	217.50 c
Weeded Control	-	-	-	-
Un-Weeded Control	-	45	70	771.25 a
SE±				18.332
CV%				8.12

*****Means followed by the different letter(s) are significantly different according to Duncan's multiple range test (DMRT) at $P \leq 0.05$.

Effects of imazethapyr treatments on weed dry weight

The results showed that imazethapyr treatments significantly reduced the weed dry weight (Table 5). The highest reduction in the weed biomass was recorded in the highest dose of the herbicide, while the lowest reduction in the weed biomass was recorded in the lowest dose of the herbicide. Moreover, Herbicide treatments reduced weed dry weight significantly by (53.6% – 71.8% in comparison with to un-weeded control. Imazethapyr at the low dose (0.0375 kg a.i. ha^{-1}) and at the medium dose (0.05 kg a.i. ha^{-1}) displayed comparable weed dry weights, 357.50 and 320.50 g/m^2, respectively.

3.3. Effects of imazethapyr treatments on growth and yield

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Phytotoxic effects of imazethapyr

The results showed that there was no phytotoxic effect on soybean plants when imazethapyr applied at the tested doses as pre-emergence herbicide, no phytotoxic symptoms or signs appear on the crop and the plants appear healthy (Table 6).

Table 6: Effects of imazethapyr treatments on phytotoxicity in soybean

Treatments	Imazethapyr dose (kg a.i. ha^{-1})	Phytotoxicity scale
Imazethapyr	0.0375	0
Imazethapyr	0.0500	0
Imazethapyr	0.0625	0

Where; 0, 1-2, 3-4 and 5 indicating healthy plant, slight moderate, high phytotoxicity.

Effects of imazethapyr treatments on plant population

Leaving weeds without control significantly reduced the plant density of soybean (7%) compared to weeding (Table 7). There were significant differences in plant density between herbicide and weed control treatments.

Effect of herbicide treatments on plant height

Competition of weed in un-weeded control significantly, resulted in a 31.1% lower plant height compared to the weeded control in all treated plots (Table 7). The experiment revealed that there were no statistically significant differences in plant height between imazethapyr treatments. There were no adverse effects on soybean plant height due to all treatments of Imazethapyr.

Table 7: Effects of imazethapyr treatments on plant population and plant height of soybean

Treatments	Herbicides dose (kg a.i. ha^{-1})	Plant population (plant ha^{-1})	Plant height (cm)
Imazethapyr	0.0375	243750 ab	63.750 a
Imazethapyr	0.0500	241250 ab	64.000 a
Imazethapyr	0.0625	249166 a	63.750 a
Weeded Control		248333 a	65.500 a
Un-Weeded Control		230416 b	42.250 b
SE±		7173.2	1.6735
CV%		4.20	3.82

*****Means in the same column followed by the different letter(s) are significantly different according to Duncan's multiple range test (DMRT) at $P \leq 0.05$.

Effects of imazethapyr treatments on pod number

Growth of weeds without control, significantly decreased the number of pods per plant compared to the weeded control treatment (56%) (Table 8). Hand weeded control treatment showed the highest number of pods per plant (39.75). Imazethapyr treatments considerably raised the number of pods per plant (37.5% - 50.4%) compared to the un-weeded control treatment. Imazethapyr at the dose of 0.0625 kg a.i. ha^{-1} showed the higher numbers of pods per plant (35.25). Imazethapyr at the dose of 0.0375 and 0.050 kg a.i. ha^{-1} showed insignificant numbers of pods per plant.

Table 8: Effects of imazethapyr treatments on number of pods per plan, hundred seeds weight and grain yield

Treatments	Imazethapyr dose (kg a.i. ha^{-1})	Number of pods plant^{-1}	Hundred seeds weight (g)	Grain yield (kg ha^{-1})
Imazethapyr	0.0375	28.000 c	10.537 b	883.3 c
Imazethapyr	0.0500	29.250 c	10.485 b	979.1 c
Imazethapyr	0.0625	35.250 b	11.185 a	1383.3 b
Weeded Control		39.750 a	11.578 a	1645.8 a
Un-Weeded Control		17.500 d	7.835 c	487.5 d
SE±		1.9492	0.2769	54.062
CV%		8.98	3.56	7.15

*****Means in the same column followed by the different letter(s) are significantly different according to Duncan's multiple range test (DMRT) at $P \leq 0.05$.

Effects of imazethapyr treatments on hundred seeds weight

Growth of weeds without control, led to a significant decrease in the hundred seed weight of the crop (32%). Imazethapyr treatments significantly raised the hundred seed weight of soybean (25.3% - 30.0%) (Table 8). Imazethapyr at the dose of 0.0625 kg a.i. ha^{-1} showed a high number of hundred seed weight (11.185). Imazethapyr at the dose of 0.0375 and 0.050 kg a.i. ha^{-1} showed a similar 100 seed weight.

Effect of herbicide treatments on grain yield

Growth of weeds without control, significantly decreased the grain yield of soybean (70%) in comparison to weeded control (Table 8). imazethapyr treatments increased grain yield productivity (44.8% - 64.8% kg/ha) in comparison to un-weeded control treatment. Imazethapyr at the dose 0.0625 kg a.i. ha^{-1} showed a high grain yield (1383.3 kg ha^{-1}). There were no significant differences between the dose 0.0375 kg a.i. ha^{-1} and the dose 0.050 kg a.i. ha^{-1}. All imazethapyr treatments, grain yields were outperformed to un-weeded control treatment yield (487.5 kg ha^{-1}).

Residue analysis of imazethapyr in soybean grain yield

Using the thin layer chromatography method for the chemical analysis of soybean seeds revealed that there were no residues of the tested herbicide at harvest.

4. DISCUSSION

Up on the obtained results, the tested imazethapyr doses displayed effectiveness in controlling weeds. They were significantly decreased weed competition in comparison to un-weeded control. Imazethapyr doses significantly affected the yield and different growth attributes of soybean cover over un-weeded control treatment. Imazethapyr at dose 0.0625 kg a.i. ha^{-1} showed a higher seed yield. Other doses of Imazethapyr; 0.05 and 0.0375 kg a.i. ha^{-1} showed a similar amounts of the grain yield. This finding in agreement with [28], who observed that imazethapyr at the dose 75 g ha^{-1} could be used effectively for reducing the weed dry matter in soybean. Reference [29] also reported effective control of weeds with imazethapyr. The selective action of imazethapyr is the reason for the better control of grassy and broad leaf weeds [30].

The results are consistent with those reported by [31] who carried out a field experiment in order to assess the bio-efficacy of imazethapyr versus predominant weeds in soybean and the crop safety at different doses of imazethapyr. The predominant weed species in experimental field were *Echinochloa colona* (L.) Link, *Echinochloa crussgalli* (L.) Beauv, *Cyperus difformis* L., *Euphorbia hirta* L., *Croton sparsiflorus* Morong and *Digera arvensis* Forsk. The maximum suppression of all the weed density, weed biomass, and highest weed control efficiency *vis-a-vis* crop yield were obtained where twice hand weeding done at 20 and 40 days after sowing, and closely followed by the treatment with imazethapyr 150 g ha^{-1} and imazethapyr 0.125 kg ha^{-1}, respectively. Imazethapyr 0.150 kg ha^{-1} scored the highest herbicide efficiency index, however, displayed relatively lower yield than imazethapyr 0.125 kg ha^{-1} and also showed delayed ripening due to its toxic effect on soybean, while weedy check treatment displayed lowest yield of soybean among all the treatments.

Imazethapyr at 0.05 to 0.14 kg ai ha^{-1} applied pre-plant incorporated, pre-emergence and post-emergence was evaluated alone and with complementary herbicides in the field for weed control in soybean. Imazethapyr controlled 90% or more smooth pigweed regardless of application method or herbicide dose. Imazethapyr at 0.05 kg ha^{-1} controlled jimsonweed 30% better post-emergence compared to soil applications. Imazethapyr at 0.10 kg ha^{-1} controlled 90% or more velvetleaf regardless of application method. The addition of alachlor to soil-applied imazethapyr enhanced giant foxtail, jimsonweed, and velvetleaf control. Adding acifluorfen or bentazon to post-emergence imazethapyr antagonized weed control. Adding sethoxydim to post-emergence imazethapyr was not beneficial [32]. At harvest the residue of imazethapyr in soybean seeds was below detectable limits. Similar result reported by [33] who state that the residue of imazethapyr in soybean grains were below the detectable limits at harvest.

5. CONCLUSION

Application of Imazethapyr as pre-emergence treatment at the dose 0.0625 kg a.i. ha^{-1} controlled the grasses and broad leaf weeds likewise showed a higher grain of soybean yield with no chemical residues in the grain. Therefore, imazethapyr at a dose of 0.0625 kg a.i. ha^{-1} as pre-emergence treatment is effective and safe in weed management in soybean crop.

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