Indian Journal of Weed Science (2025) **57**(4): 461–465
http://dx.doi.org/10.5958/0974-8164.2025.00080.7

RESEARCH ARTICLE

Management of *Ipomoea* spp. infestation in sunn hemp (*Crotalaria juncea* L.) seed crop

Rajinder Pal[1], Tarundeep Kaur[2], Gurinder Singh[2], Manpreet Singh[2], M.S. Bhullar[2] and Simerjeet Kaur[2*]

Received: 19 August 2025 | Revised: 8 November 2025 | Accepted: 11 November 2025

ABSTRACT

Morning glories (*Ipomoea* spp.), whether annual or perennial, are aggressive broad-leaved weeds that frequently infest many *Kharif* season crops including sunn hemp (*Crotalaria juncea* L.). *Ipomoea* spp. competes with the sunn hemp for light, nutrients, and moisture but also complicate harvesting operations, ultimately lowering seed yields, if they are not controlled. A field experiment was conducted during the *Kharif* seasons of 2023 and 2024 at Regional Research Station, Kapurthala of Punjab Agricultural University with an objective to evaluate the efficacy of different herbicides to manage *Ipomoea* spp. in sunn hemp. A randomized complete block design with three replications was used. The pre-emergence application (PE) of pendimethalin 750-900 g/ha + imazethapyr 75 g/ha (tank-mix) or imazethapyr + pendimethalin 800 g/ha (pre-mix) recorded higher control efficiency (70-81%) of *Ipomoea* spp. with 83.2-93.5% higher seed yield over the weedy check in sunn hemp seed crop. These two treatments effectively controlled the *Ipomoea* spp. and other weeds at the establishment stage, gave satisfactory weed control and improved sunn hemp seed productivity.

Keywords: Imazethapyr, *Ipomoea*, Pendimethalin, Pyroxasulfone, Sunn hemp, Weed management

INTRODUCTION

Crotalaria juncea L. (sunn hemp) is an annual herbaceous plant, typically reaching 1.0-3.0 m in height, believed to have originated in the Indo-Pakistan subcontinent. It is widely cultivated in tropical regions as a green manure or cover crop and for seed production (Mosjidis and Wehtje 2011). It is utilized in various ways in Indian households and industries as India is the major producer of sunn hemp (Bhandari *et al.* 2022). As a member of the Leguminosae family and only cultivated species in the *Crotalarieae* tribe, it offers several economic and ecological benefits to farmers and the environment, respectively and its roots characteristically harbour nitrogen-fixing bacteria (*Rhizobium*), enhancing nitrogen in the soil. The rapid growth, abundant foliage, high biomass accumulation, and favourable C:N of *C. juncea* make it highly suitable as both a cover crop and a green manure crop. It thrives best in tropical and sub-tropical regions, performing well during summer and rainy seasons, but is sensitive to low temperatures and frost. When harvested at the vegetative stage, before seed formation, sun hemp can also serve as a valuable feedstock for cattle (Garzon *et al.* 2021). The strong weed-suppressing capacity of sunn hemp is largely a result of its rapid growth and dense canopy (Morris et al. 2015), although weeds such as *Ipomoea* spp. that emerge at the crop establishment stage, compete for space, light, water and nutrients, and intertwine with the crop. Furthermore, some *Ipomoea* species act as alternate hosts for pests and diseases and, may also release allelopathic substances, indirectly impacting sunn hemp health (Barroso *et al.* 2019). Controlling *Ipomoea* in sunn hemp continues to be a challenge to farmers as there is no label claim of herbicide for sun hemp.

In recent years, two invasive broad-leaved weeds, Japanese morning glory (*Ipomoea nil* (L.) Roth) and obscure morning glory (*Ipomoea obscura* (L.) Ker Gawl.) have been reported in northern part of India (Marimuthu *et al.* 2002). These species are now widespread and problematic in Punjab, where they also infest crops such as cotton, maize, soybean and various vegetables (Bhullar *et al.* 2012). Considering the limitations of current weed management practices in sunn hemp, where growers depend predominantly only on post-emergence

[1] PAU-Regional Research Station, Kapurthala 144601, Punjab, India

[2] Department of Agronomy, Punjab Agricultural University, Ludhiana-141004, Punjab, India

* Corresponding author email: simer@pau.edu

application (PoE) of herbicides, the integration of pre-emergence (PE) herbicides into the control strategy can offer an early advantage by lowering initial weed pressure, improving crop competitiveness, and ultimately increasing crop productivity. There are no reported herbicide options available for weed management in sun hemp in India. This study was undertaken to evaluate the efficacy of pre-emergence (standalone or tank-mix or pre-mix), post-emergence herbicides and their sequential applications in managing weeds and improve sunn hemp crop productivity.

MATERIALS AND METHODS

A field experiment under natural weed infestations in sunn hemp was carried out during *Kharif* 2023 and 2024 at Punjab Agricultural University (PAU), Regional Research Station, Kapurthala. The Kapurthala district of Punjab, India, is situated at 31°23'N and 75°25'E. During winter season, minimum temperature falls below 3°C while during summer season, sometimes temperature reaches 40°C and many a time touches 46°C. The soil of the experiment site was classified as a Typic Ustochrept, sandy loam in texture, with a pH of 7.2 and EC 0.18 dS/m. The fertility status of soil was medium in OC (0.44%), low in $KMnO_4$-N (241.3 kg/ha), high in Olsen P (31.9 kg/ha) and medium in NH_4OAc-K (195.4 kg/ha). The treatments in field experiment consisted of standalone, tank-mix, pre-mix and sequential application of PE and PoE herbicidal applications. Thirteen treatments were evaluated including: imazethapyr 75 g/ha PE, imazethapyr 75 g/ha PoE, sequential application of imazethapyr 75 g/ha PE followed by (*fb*) PoE, pyroxasulfone 127 g/ha PE, pyroxasulfone 127 g/ha PE *fb* imazethapyr 75 g/ha PoE, pendimethalin 750 g/ha PE, pendimethalin 750 g/ha PE *fb* imazethapyr 75 g/ha PoE, pendimethalin 750 g/ha PE *fb* pyroxasulfone 127 g/ha PoE, pendimethalin 900 g/ha + imazethapyr 75 g/ha (tank-mix) PE, pendimethalin 750 g/ha + imazethapyr 75 g/ha (tank-mix) PE, imazethapyr + pendimethalin 800 g/ha (pre-mix) PE, weedy control and hand weeding (at 3 weeks after sowing). A randomized complete block design (RCBD) with three replications was used. Sunn hemp cv. PAU 1691 was sown on June 14, 2023, and June 10, 2024, maintaining a row spacing of 45 cm and a seed rate of 25 kg/ha. Each plot measured 5.0 m × 3.6 m, covering an area of 18 m^2. A pre-sowing irrigation was applied across the experimental site. Standard agronomic practices were adopted for crop cultivation, excluding weed management interventions. The full dose of phosphorus at a rate of 40 kg/ha was applied as basal. Pre-emergence herbicide was applied within 2 days of sowing while PoE herbicides were applied 2-4 leaf stage of weeds, at 15-20 days after sowing (DAS) during both the years. Herbicide applications, both PE and PoE, were carried out on moist soil using a battery-operated knapsack sprayer equipped with a flood jet nozzle for PE spray (500 L/ha water volume) and a flat fan nozzle for PoE spray (375 L/ha water volume).

Weed data were recorded using a 50 cm × 50 cm quadrat placed at two randomly selected spots in each plot at 45 DAS and at crop harvest. Weeds were identified species-wise, counted and cut at the collar region. The collected samples were placed in separate brown paper bags and sun-dried for 3-5 days to remove excess moisture. Subsequently, the samples were oven-dried at 70 ± 2 °C for 72 hours until a constant weight was obtained, which was taken as the biomass of each weed species. For data analysis, the average values from the two quadrats were expressed as weed density (no./m^2) and weed biomass (g/m^2), respectively. Plant height at harvest and seed yield were recorded. Cost of herbicide application and hand weeding was computed to calculate returns over weedy check and hand weeding treatment.

The analysis of variance (ANOVA) was performed to evaluate different weed management practices against complex weed flora in *C. juncea*. Statistical analysis of the recorded data was performed using IBM SPSS Statistics 19 with weed control treatments as fixed effect. Results were interpreted at 5% level of significance (p=0.05) with the help of Fisher's least significant difference test (Cochran and Cox 1957). To normalize the variance, weed data was square transformed before analysis, wherever required.

RESULTS AND DISCUSSION

Weed density

The density of grasses and broad-leaved weeds at 45 DAS was significantly influenced by all the weed control treatments over the untreated control. At 45 DAS, imazethapyr 75 g/ha PE, sequential application of imazethapyr 75 g/ha PE and PoE, pendimethalin 750 g/ha *fb* imazethapyr 75 g/ha, pendimethalin 900 g/ha + imazethapyr 75 g/ha (tank-mix) PE, pendimethalin 750 g/ha + imazethapyr 75 g/ha (tank-mix) PE and of imazethapyr + pendimethalin (pre-mix) 800 g/ha PE recorded statistically at par density of *Ipomoea* and other broad-leaved weeds and were significantly lower over all other weed control treatments. Further, pendimethalin 750 g/ha *fb* pyroxasulfone 127 g/ha also recorded statistically at par density of *Ipomoea* at 45 DAS with all the above treatments. In case of grasses at 45 DAS, pendimethalin 750 g/ha PE, pendimethalin 750 g or 900 g/ha + imazethapyr 75 g/ha (tank-mix) PE and imazethapyr + pendimethalin 800 g/ha (pre-mix) PE resulted in significantly lower grass weed density as compared to all other weed control treatments (**Table 1**). This indicated that the growth of newly germinated weed seeds or seedlings may be inhibited with the application of tank-mix and pre-mix PE herbicides due to their synergistic effect of the two mechanisms of actions. Therefore, during the initial periods of crop growth, total weed density was significantly less. Mixing of pendimethalin with other herbicides also resulted in better residual weed control throughout the growing season over application of single herbicide. Pendimethalin is a member of the dinitroaniline family that disrupts microtubule synthesis, which is crucial for the formation of cell wall microfibrils. This disruption halts cell elongation and interferes with chromosome movement during mitosis in germinating seeds and young weed seedlings, thereby providing effective weed control and contributing to higher crop productivity. Imazethapyr acts by inhibiting the plastid enzyme acetolactate synthase (ALS), which catalyses the initial step in the biosynthesis of the essential branched-chain amino acids (valine, leucine, and isoleucine). In this study, weeds were effectively controlled by sequential application of herbicides.

Weed biomass

Imazethapyr 75 g/ha PE, pendimethalin 750 g or 900 g/ha + imazethapyr 75 g/ha (tank-mix) PE and imazethapyr + pendimethalin 800 g/ha (pre-mix) PE recorded 60.1%, 67.6%, 69.8% and 63.2% reduction of total weed biomass at 45 DAS over weedy control, respectively and was significantly lower as compared to all other weed control treatments. Significant reduction of grasses and broad-leaved weed biomass at crop harvest was observed when sequential application of pendimethalin 750 g/ha *fb* imazethapyr 75 g/ha, pendimethalin 750 g or 900 g/ha + imazethapyr 75 g/ha (tank-mix) PE and imazethapyr + pendimethalin as PE 800 g/ha (pre-mix) was applied (**Table 1**). Better control of weed density with tank-mix, pre-mix and sequential application of herbicides leads to a reduction in biomass of grasses and broad-leaved weeds. The soil colloids bind the PE herbicide applied to the soil surface, forming a thin protective layer that inhibits weed establishment. As weed seedlings emerge, absorb it, and subsequently exhibit phytotoxic symptoms, leading to suppressed growth and reduced biomass. This was mainly due to better control of weeds in critical period of crop-weed competition, resulting in lower weed biomass.

Weed control efficiency

Due to a significant reduction of weeds, higher weed control efficiency was observed with sequential application of pendimethalin 750 g/ha *fb* imazethapyr 75 g/ha, pendimethalin 750 g or 900 g/ha + imazethapyr 75 g/ha (tank-mix) PE and imazethapyr + pendimethalin 800 g/ha (pre-mix) PE over control

Table 1. Density and biomass of *Ipomoea* spp. and other weeds in sunn hemp as affected by weed management treatments (pooled data of two years)

Treatment	Weed density (no./m^2) at 45 DAS			Total weed biomass at 45 DAS (g/m^2)	Weed biomass (g/m^2) at harvest	
	Ipomoea spp.	Other broad-leaved weeds	Grasses		*Ipomoea* spp.	Other weeds
Imazethapyr 75 g/ha PE	1.6 (2)	1.4 (1)	1.6 (2)	144	600	589
Imazethapyr 75 g/ha PoE	1.9 (3)	2.3 (4)	1.8 (2)	243	608	578
Imazethapyr 75 g/ha PE and PoE	1.4 (1)	1.0 (0)	2.1 (4)	165	309	861
Pyroxasulfone 127 g/ha PE	2.0 (3)	1.7 (2)	2.1 (3)	231	592	533
Pyroxasulfone 127 g/ha PE *fb* imazethapyr 75 g/ha PoE	1.9 (3)	1.7 (2)	1.6 (2)	165	446	609
Pendimethalin 750 g/ha PE	2.0 (3)	2.2 (4)	1.3 (1)	242	472	567
Pendimethalin 750 g/ha PE *fb* imazethapyr 75 g/ha PoE	1.1 (0)	1.3 (1)	1.7 (2)	159	152	367
Pendimethalin 750 g/ha PE *fb* pyroxasulfone 127 g/ha PoE	1.5 (1)	1.8 (2)	1.4 (1)	224	517	552
Pendimethalin 900 g/ha + imazethapyr 75 g/ha (tank-mix) PE	1.0 (0)	1.0 (0)	1.0 (0)	109	87	405
Pendimethalin 750 g/ha + imazethapyr 75 g/ha (tank-mix) PE	1.1 (0)	1.4 (1)	1.0 (0)	117	98	418
Imazethapyr + pendimethalin 800 g/ha (pre-mix) PE	1.0 (0)	1.0 (0)	1.0 (0)	133	104	433
Weedy control	2.4 (5)	3.2 (10)	2.3 (4)	361	993	735
Hand weeding	2.2 (4)	2.8 (7)	2.0 (3)	280	463	546
LSD (p=0.05)	0.8	0.5	0.3	45	207	141

*Data is subjected to square root transformation ($\sqrt{x+1}$). Figures in parentheses are means of original values in round figures; DAS = days after seeding; PE = pre-emergence application PoE= post-emergence application; *fb* = followed by

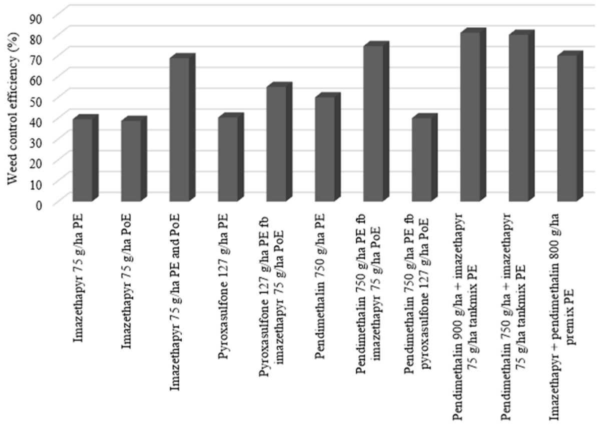

Figure 1. Weed control efficiency (%) of *Ipomoea* spp. in sunn hemp as affected by weed management treatments (pooled data of two years)

plot (**Figure 1**). The differences in weed control efficiency are closely linked to the corresponding weed biomass recorded under each treatment. The lower weed biomass accumulation in turn led to higher control efficiency (Yadav *et al.* 2021). The herbicide mixture strategy would not only offer broad-spectrum weed control but also help delay the evolution of herbicide resistance in weeds, manage existing herbicide resistance issues and contribute to the sustainability of *C. juncea* productivity.

Sunn hemp growth and seed yield

All weed control treatments registered a significant impact on the sunn hemp seed yield. However, the plant height of sunn hemp at harvest did not differ significantly among all weed control treatments. Sunn hemp seed yield in various herbicidal treatments ranged from 1.07 t/ha to 2.07 t/ha. Pendimethalin 900 g/ha + imazethapyr 75 g/ha (tank-mix) PE, pendimethalin 750 g/ha + imazethapyr 75 g/ha PE and of imazethapyr + pendimethalin 800 g/ha (pre-mix) PE recorded at par seed yield of sunn hemp with significantly 93.5%, 86.0% and 83.2%, respectively higher sunn hemp seed yield than weedy control (**Table 2**). There was slight phytotoxicity because of sequential application of pendimethalin and pyroxasulfone with imazethapyr in the crop as there was reduction in final plant height but the differences between different treatments were non-significant. The reduced crop-weed competition and marked increase in weed control efficiency with herbicide treatments resulted in better development of reproductive structures and translocation of photosynthates into the sink. By effectively suppressing weed growth at early stages, pre-emergence herbicides reduced competition for essential resources such as moisture, nutrients, space, and light, thereby promoting higher crop productivity. Mosjidis and Wehtje (2011) reported that pendimethalin 1120 g/ha PE alone provided consistent effective weed control and maximum sunn hemp biomass in U.S.A., but when yellow nutsedge was present, imazethapyr 70 g/ha was required for effective control and greater sunn hemp biomass. Contrary to our observations, Mosjidis and Wehtje (2011) reported that the combination of pendimethalin and imazethapyr at the same rate was detrimental to sunn hemp biomass yield.

Pendimethalin 900 g/ha + imazethapyr 75 g/ha (tank-mix) PE, pendimethalin 750 g/ha + imazethapyr 75 g/ha PE and of imazethapyr + pendimethalin 800 g/ha (pre-mix) PE resulted in more returns per hectare by Rs. 59550-67160 and 46370-53980 as compared to weedy check and hand weeding,

Table 2. Plant height, yield and economics of sunn hemp under different weed management treatments

Treatment	Final plant height (cm)	Seed yield (t/ha)			Cost of treatment (Rs./ha)	Returns (Rs./ha) over	
		2023	2024	Pooled		Weedy control	Hand weeding
Imazethapyr 75 g/ha PE	240.3	1.24	1.52	1.38	770	20930	7750
Imazethapyr 75 g/ha PoE	234.1	1.18	1.45	1.32	770	16730	3550
Imazethapyr 75 g/ha PE and PoE	240.4	1.29	1.53	1.41	1540	22260	9080
Pyroxasulfone 127 g/ha PE	248.0	1.16	1.38	1.27	3425	10575	-2605
Pyroxasulfone 127 g/ha PE *fb* imazethapyr 75 g/ha PoE	229.7	1.13	1.35	1.24	4195	7705	-5475
Pendimethalin 750 g/ha PE	239.5	1.32	1.54	1.43	2225	22975	9795
Pendimethalin 750 g/ha PE *fb* imazethapyr 75 g/ha PoE	231.9	1.34	1.56	1.45	2995	23605	10425
Pendimethalin 750 g/ha PE *fb* pyroxasulfone 127 g/ha PoE	238.4	1.35	1.56	1.46	5650	21650	8470
Pendimethalin 900 g/ha + imazethapyr 75 g/ha (tank-mix) PE	236.6	1.94	2.20	2.07	2840	67160	53980
Pendimethalin 750 g/ha + imazethapyr 75 g/ha (tank-mix) PE	232.4	1.88	2.10	1.99	2495	61905	48725
Imazethapyr + pendimethalin 800 g/ha (pre-mix) PE	231.0	1.84	2.07	1.96	2750	59550	46370
Weedy control	237.8	0.99	1.15	1.07	-	-	-
Hand weeding	235.1	1.27	1.54	1.40	9920	13180	-
LSD (p=0.05)	NS	0.33	0.41	0.38	-	-	-

*DAS = days after seeding; PE = pre-emergence application PoE= post-emergence application; *fb* = followed by

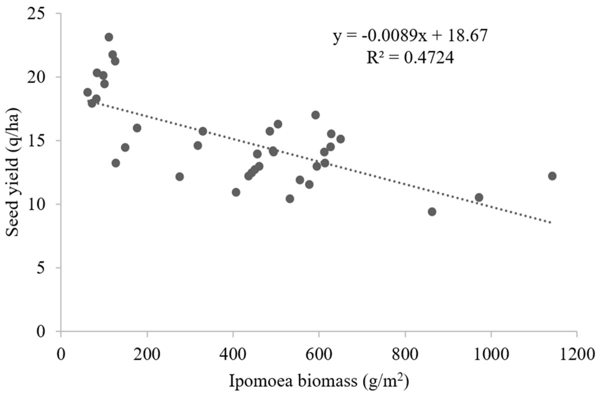

Figure 2. The relationship of seed yield of *sunn hemp* with *Ipomoea* spp. biomass (pooled data of two years) at harvest

respectively (**Table 2**). Pyroxasulfone 127 g/ha herbicide treatments resulted in the negative returns over hand weeding. Further, the linear regression analysis illustrates the strong negative linear correlation between *Ipomoea* biomass at harvest and sunn hemp seed yield (**Figure 2**). The coefficient of determination of 0.4724 indicates that *Ipomoea* biomass accounted for 47% of the sunn hemp yield variation. The findings highlight a significant influence of weed control treatments on both *Ipomoea* biomass and sunn hemp seed yield. As total *Ipomoea* biomass increased, sunn hemp seed yield decreased correspondingly.

It can be concluded that pre-emergence application of pendimethalin 750-900 g/ha + imazethapyr 75 g/ha (tank-mix) or imazethapyr + pendimethalin 800 g/ha (pre-mix) provided good control of the *Ipomoea* spp. and other associated weeds in sunn hemp with increased the sunn hemp productivity.

REFERENCES

Barroso AA, Ferreira PS and Martins D. 2019. Growth and development of *Ipomoea* weeds. *Planta Daninha* **6**(37): e019186421.

Bhandari HR, Shivakumar KV, Kar CS, Bera A and Meena JK. 2022. Sunnhemp: a climate-smart crop. In *Developing Climate Resilient Grain and Forage Legumes* pp. 277–296.

Bhullar MS, Walia US, Singh S, Singh M and Jhala AJ. 2012. Control of morningglories (*Ipomoea* spp.) in sugarcane (*Saccharum* spp.). *Weed Technology* **26**(1): 77–82.

Cochran WG and Cox GM. 1957. Experimental Design. 2nd Edition, John Wiley and Sons, New York, 615 p.

Garzon J, Vendramini JM, Silveira ML, Moriel P, da Silva HM, Dubeux Jr JC, Kaneko M, Carnelos CC and Mamede PA. 2021. Harvest management and genotype effects on sunnhemp forage characteristics. *Agronomy Journal* **113**(1): 298–307.

Marimuthu R, Ahmed SN and Grigharan S. 2002. Control of *Ipomoea* spp. in sugarcane. *Indian Sugar* **51**: 807–809.

Morris JB, Chase C, Treadwell D, Koenig R, Cho A, Morales-Payan JP, Murphy T, Antonious GF. 2015. Effect of sunn hemp (*Crotalaria juncea* L.) cutting date and planting density on weed suppression in Georgia, USA. *Journal of Environmental Science and Health,* Part B. **50**(8): 614–621.

Mosjidis JA and Wehtje G. 2011. Weed control in sunnhemp and its ability to suppress weed growth. *Crop Protection*. **30**(1): 70–73.

Yadav AL, Yadav RS and Kumawat A. 2021. Response of weeds to different herbicides and their time of application in clusterbean. *Indian Journal of Weed Science* **53**(2): 202–205.