

RISK ANALYSIS OF RUDERAL AND AGERASTAL WEEDS FROM SUPERASTERIDS GRADE IN UDHAM SINGH NAGAR, DISTRICT, UTTARAKHAND

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ABSTRACT

Invasive plant species are wreaking havoc on ecological and agricultural environments across the world. Early detection and mitigation of extremely dangerous introductions are crucial for reducing losses and enhancing benefits. From April 2022 to July 2023, 35 field sites were surveyed to understand the distribution and availability of various ruderal and agrestal weed flora in Udham Singh Nagar district. The Australian Weed risk assessment scoring methodology was used to generate a generalised weed risk score for superasterids grade of the APG-IV. The Weed risk assessment method has been a successful prediction work for forecasting naturalisations of weed species in 8 blocks of Udham Singh Nagar District in Uttarakhand. A research looked at 13 (*Alternanthera philoxeroides*, *Alternanthera sessilis*, *Amaranthus spinosus*, *Celosia argentea*, *Chenopodium strum murale*, *Digera muricata*, *Gomphrena serrata*, *Dysphania ambrosioides*, *Mirabilis jalapa*, *Opuntia elatior*, *Oureta lanata*, *Portulaca oleracea*, *Chenopodium album*) weed species in the superasterids grade of the APG-IV classification system. The study discovered that 54% of the reported weed species were of high risk rank, followed by 31% were of low rank, 8% in medium risk rank, and 7% were of extreme risk rank status. In our investigation, we discovered that *Chenopodium album* had the highest weed risk score (37), while *Dysphania ambrosioides* had the lowest weed risk score (0.96). A study found that 77% of the weed species were herbs, 15% as creeping herb and 8% as under shrub. Agrestal weeds (43%) were the most common, followed by ruderal weeds (38%) and (19%) in both categories. In terms of the origin of weed species, mostly weeds were from tropical America (46%). The study suggests a method for estimating weed species' risk rank status in different climates and agro-habitats, providing valuable insights for future research on troublesome weed species on the basis of risk rank information.

(Key words: APG-IV, superasterids, weed risk assessment, weeds)

INTRODUCTION

India imports seeds and planting materials from around the world, with many potential weeds. Assessment of invasiveness is crucial for selecting agricultural and non-agricultural species. Australian Weed Risk Assessment (WRA) provides accurate risk determination for most plant species. Plant species undergoes three stages to become a troublesome weed: entering new habitat, dispersing, and affecting the environment or human activities. Plant species undergoes three stages to become a troublesome weed: entering new habitat, dispersing, and affecting the environment or human activities. The risk analysis technique delivers an important framework for characterising the ecology of a route, detecting events that impact weed risk, and emphasising risk minimization or mitigation opportunities (Sreekanth *et al.*, 2022). Australia has used the Australian WRA as a fundamental component of its

federal regulatory framework for the introduction of new plants since 1997 (Weber *et al.*, 2009). Others have adopted or examined this WRA, frequently with minor changes to accommodate local situations. For example, the WRA system has gone through multiple levels of testing in Florida, U.S.A. (Gordon *et al.*, 2008), Hawaii, U.S.A. (Daehler and Carino, 2000). The danger associated with bringing new weed species to India is determined not only by the amount of weed seeds found in compromised imported grain, but also by the specific species compositions present and the possibility of their dispersion to an appropriate habitat for installation and spread (Nagaraju *et al.*, 2021; Sreekanth *et al.*, 2022). There are several ways for predicting weed potential (Mack, 1996) but a risk assessment methodology that is objective, accurate, and widely acknowledged is urgently needed to determine how weedy new plant introductions will be. Weeds are inadvertently seeded, annoying, difficult plants that thrive in undesirable locations

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(Sagar *et al.*, 2023). Weeds are typically the most severe danger to diminishing agricultural productivity, along with germs (parasites, bacteria, and so on.) insects, rats, nematodes, mites, birds, and other less important animal pests (Oerke, 2006). In India, weeds have caused in excess of eleven billion dollars in revenue losses in only ten crops (Gharde *et al.*, 2018). Ruderal are weed plants that thrive in dumps, urban wastelands, docks, footpaths, railways, roadsides, and other areas extensively influenced by human occupation, industry, and trade (Frenkel, 1977). Agrestals are a kind of plant that grows in agricultural grounds. Weeds are frequently considered as invasive, undesirable invaders in agriculture-related ecosystems that rival for resources, diminish yields, and need the adoption of demanding of labour interventions such as workers and advanced equipment to prevent crop losses (Dwari and Mondal, 2012).

Phosphorus in the soil aids in root growth, cell proliferation, and makes plants more drought resistant (Yadav and Verma, 2019). Weeds, with very few exceptions, generally have a short vegetative phase, a high reproduction rate, and the capacity to diminish agricultural yields (Ghaffoor, 2004). Weeds can have varying degrees of interference with a weed community based on their unique qualities (Arévalo *et al.*, 1977). The formation of soil seed banks (SSBs) is a weed technique that permits it to survive in farmed regions for decades. Several species generate a large number of seeds, which aids in the spread of the SSB and makes it more difficult to eliminate (Boguzas *et al.*, 2004). Weed is not evenly spread across the landscape, and stains or dense woody structures reflect the infestation's spatial heterogeneity (Izquierdo *et al.*, 2009; Iwara *et al.*, 2011).

MATERIALS AND METHODS

Study area

The district is located in Uttarakhand's Kumaun region. It is between latitudes 28°52'22" N and 29°23'22" N and longitudes 78°45'22" N and 80°08'22" N. The district boundaries link with the districts of Champawat and Nainital in Uttarakhand's north, Pilibhit, Moradabad, and Bareilly in the south, Bijnor in the west of Uttara Pradesh, and Nepal in the east.

Field survey and data collection

A total of 35 field sites (agricultural and non-agricultural) surveys were carried out from April 2022 to July 2023 to get understanding of the distribution as well as availability of the various ruderal and agrestal weed flora growing in the research area and to estimate the weed danger of different weeds in Udham Singh Nagar district by generating a generalised weed risk score of weeds from Superasterids Grade of the APG-IV using the Australian Weed danger Assessment scoring methodology. Data were collected from 35 different localities of 8 blocks, situated in the area of district. A score method that determines a weed plant's danger propensity as a ranking that can be contrasted to other weed species is a novel addition to this study and

the Global Risk Score of Weeds was just compared from the Global Compendium of Weeds by (Randall, 2017). The field study gathered detailed information on the location, habitat, behaviour, ecological specifications, and diagnostic declarations of every Superasterids Grade weed plant species. Invasive alien weed plant specimens gathered from the areas of study were recognised on-site, whereas unidentifiable plants were recognised using the documentation that was available, including Flora of the Upper Gangetic Plain and of the Adjacent Siwalik and sub-Himalayan Tracts (Duthie, 1903). Recorded weed species were arranged in different APG-IV families and APG-IV grades according to the modern system of classification, the APG-IV system for plant taxonomy (Chase *et al.*, 2016). Different fourteen categories in three phases (Table 1) were chosen from the plants database (Randall, 2016). The evaluation inside each stage is cumulative, with the three stages' subsequent scores multiplied. Weed Risk Score Analysis Equation = Entry (A+B+C+D+E) x Dispersal (F+G+H+I+J) x Impact (K+L+M+N).

RESULTS AND DISCUSSION

Grade Superasterids of APG-IV includes 30 APG-IV families, out of the above 30 families in our study, 13 weed species were recorded from the following 4 APG-IV families: *Amaranthaceae*, *Nyctaginaceae*, *Cactaceae* and *Portulacaceae*. The *Amaranthaceae* family has the most weed species, with 10, followed by *Cactaceae*, *Portulacaceae*, and *Nyctaginaceae*, each with one. Study reveals that *Alternanthera* was the dominant weed genera with two species among all the reported weed species. In this study, we found that 13 weed species were reported from the study site. In the phase of entry of weed species, there were 10 weed spp. in class-A, (4) spp. in class-B, (11) spp. in class-C, (2) spp. in class-D, (2) spp. in class-E. In the phase of dispersal, there were (12) weed spp. in class-F, (10) spp. in class-G, (10) spp. in class-H, (10) spp. in class-I, (8) spp. in class-J. In the phase of impact of weed species, there were (9) weed spp. in class-K, (9) spp. in class-L, 0 spp. in class-M and (13) weed spp. in class N. Data revealed numerous weed species in grain materials, with some significant agricultural weeds believed to have spread as contaminants (Chand *et al.*, 2005, 2014; Nagaraju *et al.*, 2021; Sreekanth *et al.*, 2022). Weed species and populations vary based on field and season, influenced by local conditions, agricultural practices, and weather (Singh *et al.*, 2022). All the reported weed species showed the following types of origin centres: 6 weed species (46%) were from Tropical America, followed by 2 weed species (15%) from Europe, 2 weed species (15%) from South America, 1 weed species (8%) from Tropical Africa, 1 weed species (8%) from Peru, 1 weed species (8%) from North America.

The current study represent that 7 weed species (54%) were recorded in the high risk rank on the basic of generic weed risk score analysis i.e. *Alternanthera philoxeroides*, *Alternanthera sessilis*, *Amaranthus spinosus*, *Celosia argentea*, *Chenopodia-strum murale*,

Table 1. The system categories, total species numbers, weed percentages and allocated values for each species

Sr.No.	Weed Name	Entry													Dispersal					Impact				Origin status	Risk Score	
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	W	X	Y	Z	AA	BB	CC	DD			
1.	<i>Alternanthera philoxeroides</i>	+	-	+	-	-	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	TAM	15.2
2.	<i>Alternanthera sessilis</i>	+	-	+	-	-	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	TAM	15.2
3.	<i>Amaranthus spinosus</i>	+	-	+	-	-	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	TAM	19.0
4.	<i>Celosia argentea</i>	+	+	-	-	-	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	TAF	20.0
5.	<i>Chenopodium album</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	EU	37.0
6.	<i>Chenopodium murale</i>	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	E	25.0
7.	<i>Digera muricata</i>	+	-	+	+	-	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	NAM	20.0
8.	<i>Dysphania ambrosioides</i>	-	-	+	-	-	-	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	SAM	0.96
9.	<i>Gomphrena serrata</i>	+	-	+	-	-	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	TAM	15.2
10.	<i>Mirabilis jalapa</i>	-	-	+	-	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	PU	1.08
11.	<i>Opuntia elatior</i>	-	-	+	-	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	TAM	1.08
12.	<i>Oure lanata</i>	+	+	+	-	-	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	TAM	3.72
13.	<i>Portulaca oleracea</i>	+	-	+	-	-	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	SAM	7.60

Origin: (SAM) = South America, (TAM) = Tropical America, (EU) = Europe, (TAF) = Tropical Africa, (NAM) = North America, (PU) = Peru

Table 2. Comparative representation of the current findings with the findings of global compendium of weeds

Sr.No.	Weed Name	APG-IV Families	Life forms	Weed's category		Generalize weed risk score				Weed Risk Rank Status	
				RW	AW	W	X	Y	Z	W	X
1.	<i>Alternanthera philoxeroides</i>	Amaranthaceae	H	RW	AW	44.8	15.2	15.2	15.2	15.2	High
2.	<i>Alternanthera sessilis</i>	Amaranthaceae	H	RW	AW	19.2	15.2	15.2	15.2	15.2	High
3.	<i>Amaranthus spinosus</i>	Amaranthaceae	H	RW	AW	19.2	19.0	19.0	19.0	19.0	High
4.	<i>Celosia argentea</i>	Amaranthaceae	H	-	AW	26.88	20.0	20.0	20.0	20.0	High
5.	<i>Chenopodium album</i>	Amaranthaceae	H	-	AW	44.8	37.0	37.0	37.0	37.0	Extreme
6.	<i>Chenopodium murale</i>	Amaranthaceae	H	-	AW	UNSCORED	25.0	25.0	25.0	25.0	High
7.	<i>Digera muricata</i>	Amaranthaceae	H	-	AW	16.00	20.0	20.0	20.0	20.0	High
8.	<i>Dysphania ambrosioides</i>	Amaranthaceae	H	RW	-	14.4	0.96	0.96	0.96	0.96	Low
9.	<i>Gomphrena serrata</i>	Amaranthaceae	CRH	RW	AW	9.12	15.2	15.2	15.2	15.2	High
10.	<i>Mirabilis jalapa</i>	Nyctaginaceae	H	RW	-	14.4	1.08	1.08	1.08	1.08	Low
11.	<i>Opuntia elatior</i>	Cactaceae	H	RW	-	14.4	1.08	1.08	1.08	1.08	Low
12.	<i>Oure lanata</i>	Amaranthaceae	US	RW	-	7.2	3.72	3.72	3.72	3.72	Low
13.	<i>Portulaca oleracea</i>	Portulacaceae	CRH	-	AW	44.8	7.60	7.60	7.60	7.60	Medium

Life Form: (H) = Herb, (CRH) = Creeping herb, (US) = Under shrub, (AW) = Agrestals weeds, (RW) = Ruderals weeds

Digera muricata, and *Gomphrena serrata*, followed by 4 weed species (31%) were recorded in the low risk rank i.e. *Dysphania ambrosioides*, *Mirabilis jalapa*, *Opuntia elatior*, and *Oureta lanata*; (1) weed species (8%) were recorded in the medium risk rank, i.e., *Portulaca oleracea*; and (1) weed species in the extreme risk rank status, i.e. *Chenopodium album*.

The current study reveals that 10 weed species (77%) were recorded as herbs, followed by creeping herb 2 weed species (15%) and under shrub 1 species (6%). There were two types of weed categories, and we found that 9 weed species (43%) were Ruderal weed species, followed by 8 Agrestal weed species (38%), and 4 weed species (19%) as above for both types of weed species categories. Comparative representation of the current study with the findings of the Global Compendium of Weeds reveals that there were 0 weed species in the low rank status of the Global Compendium, and we recorded 4 weed species out of 13 in low rank status. In our current study, we found that only 1 weed species were in medium risk rank status although 5 weed species were in the database of the Global Weed Compendium. In our work, we found that there were 7 weed species in the high and 1 weed species in extreme risk rank statuses, while there were 4 weed species in the high risk rank and 3 weed species in the extreme risk rank status. There was 1 weed species in un-scored status in the

compendium, and in our analysis, we found no species in un-scored status (Table 2), Findings of the Global Weed Compendium (Randall, 2017) weed species, i.e., *Alternanthera philoxeroides*, *Chenopodium album* and *Portulaca oleracea* were recorded in extreme status, but in our analysis, only *Chenopodium album* weed species were recorded in extreme risk rank status. In high risk rank status according to the compendium findings, there were *Alternanthera sessilis*, *Amaranthus spinosus*, *Celosia argentea* and *Digeramuricata*, but in our results we found that *Alternanthera philoxeroides*, *Alternanthera sessilis*, *Amaranthus spinosus*, *Celosia argentea*, *Chenopodium murale*, *Digera muricata* and *Gomphrena serrata* in high risk rank status. There were no weed species in the low risk rank of global compandium finding and we reported *Dysphania ambrosioides*, *Mirabilis jalapa*, *Opuntia elatior* and *Oureta lanata*. *Dysphania ambrosioides*, *Gomphren-aserrata*, *Mirabilis jalapa*, *Opuntia elatior* and *Oureta lanata* were enlisted in the medium risk rank of global compendium and we found that only *Portulaca oleracea* in medium risk rank status. The examination and monitoring of weed seeds during import ensures compliance with import rules (Nagaraju *et al.*, 2021). The desire for decorative species is frequently motivated by fashion, promotion, and pricing, resulting in countless successful plant invasions caused by human error (Dehnen-Schmutz *et al.*, 2007).

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