Table 1. Important weeds of different crops with their severity of infestation.

Weed species	Severity*	Weed species	Severity*
Summer (*Aus*) rice		*Leptochloa chinensis*	++
Cynodon dactylon (L.) Pers.	+++	*Nymphaea* spp.	++
Cyperus difformis L.	++	*Oryza rufipogon* L.	+++
Cyperus iria L.	++	*Pistia stratioites* L.	+++
Cyperus rotundus L.	+++	*Sagittaria* spp.	++
Digitaria sanguinalis (L.) Scop.	+	*Salvinia natans* Hoffm.	++
Echinochloa colona (L.) Link	+++	**Wheat and barley**	
Echinochloa crus-galli (L.) P. Beauv	+++	*Amaranthus spinosus* L.	+
Eclipta prostrata (L.) L.	+	*Amaranthus viridis* L.	+
Eleusine indica (L.) Gaertn.	+++	*Bonnaya brachiata* Link & Otto	+
Fimbristylis littoralis Gaud.	++	*Chenopodium album* L.	+++
Murdania nudiflora (L.) Brenan	+	*Cynodon dactylon*	+++
Paspalum commersoni Lamk.	++	*Cyperus rotundus*	+++
Autumn (*Aman*) rice		*Eleusine indica*	++
Commelina benghalensis L.	++	*Gnaphalium luteo-album* L.	+++
Cyanotis axillaris R. & S.	+	*Oldenlandia corymbosa* L.	++
Cyperus diffusa Burn. f.	+	*Solanum nigrum* L.	+
Cyperus iria	+++	*Vicia hirsuta* (L.) S.F. Gray.	+
Echinochloa colona	+++	*Vicia sativa* L.	+
Fimbristylis miliacea (L.) Vahl.	+++	**Jute (*Capsularis*)**	+
Jussieua decurrens (Watt.) D.C.	+	*Alternanthera sesilis* (L) R. Br. & Roth.	+
Leersia hexandra Sw.	++	*Brachiaria reptans* (L.) Gard.	+
Leptochloa chinensis (L.) Nees.	++	*Cyanotis axillaris*	+
Ludwigia prostrata	++	*Cynodon dactylon*	++
Monochoria hastata (L.) Solms.	++	*Cyperus iria*	++
Murdania nudiflora	++	*Cyperus rotundus*	+++
Sagittaria guanensis H.B.K.	++	*Digitaria sanguinalis*	+
Scirpus mucronatus L.	+++	*Echinochloa colona*	++
Spring (Boro) rice		*Echinochloa crus-galli*	+++
Commelina benghalensis	++	*Eleusine indica*	++
Cyanotis axillaris	+	*Fimbristylis miliacea*	+++
Echinochloa crus-galli	+++	*Leersia hexandra*	+
Jussieua decurrens	++	*Panicum repens* L.	+
Leersia hexandra	++	**Jute (*Olitorius*)**	
Marsilea quadrifolia L.	+	*Amaranthus viridis*	++

Weed species	Severity*	Weed species	Severity*
Monochoria hastate	++	*Cynodon dactylon*	+++
Monochoria vaginalis (Burn. f.) Peral.	++	*Cyperus iria*	+++
Parapholis incurva L.	+	*Cyperus rotundus*	+++
Scirpus mucronatus	+++	*Dactyloctenium aegyptium* (L) P. Beauv.	++
Deep-water rice		*Echinochloa colona*	++
Alisma plantago L.	++	*Echinochloa crus-galli*	++
Alternanthera philoxeroides (Mart) Griseb.	++	*Eleusine indica*	++
Commelina benghalensis	++	*Lindernia* spp.	++
Cyanotis axillaris	++	**Sugarcane**	
Echinochloa crus-galli	++	*Amaranthus spinosus*	+++
Eichhornia crassipes Solms.	+++	*Cynodon dactylon*	+++
Hygroryza aristata (Retz.) Nees.	++	*Cyperus rotundus*	+++
Ipomoea aquatica Forsk.	++	*Imperata cylindrica* (L) P. Beauv.	+++
Leersia hexandra	+++	*Leucas aspera* Spreng.	++
Mimosa pudica L.	++	*Digitaria sanguinalis*	++
Saccharum spontaneum L.	++	*Echinochloa colona*	+
Solanum carolinense L.	++	*Eclipta prostrata*	++
Solanum nigrum	++	*Eleusine indica*	+++
Solanum torvum Swaritz.	++	*Portulaca oleracea* L.	++
Striga densiflora Benth.	++	**Pulses (chickpea and lentil)**	
Mustard		*Celosia argentea* L.	+
Bonnaya brachiata	+++	*Chenopodium album*	+++
Chenopodium album	+++	*Cynodon dactylon*	+++
Cynodon dactylon	++	*Cyperus rotundus*	+++
Cyperus rotundus	+++	*Dactyloctenium aegyptium*	+
Eleusine indica	+	*Eleusine indica*	++
Euphorbia hirta	+	*Gnaphalium luteo-album*	++
Gnaphalium luteo-album	++	*Parapholis incurva*	+
Oldenlandia corymbosa	+++	*Solanum torvum*	++
Orobanche indica Roxb.	+	*Vicia hirsuta*	+++
Physalis heterophylla Nees.	+	*Vicia sativa*	+++
Solanum nigrum	+	**Tea**	
Vicia hirsuta	++	*Bhumea spp.*	++
Vicia sativa	++	*Borreria hispidia* K. Shum.	+++

Weed species	Severity*	Weed species	Severity*
Potato		*Cyperus rotundus*	+++
Amaranthus spinosus	++	*Imperata cylindrica*	+++
Amaranthus viridis	++	*Mikania scandens* (L.) Willd.	+++
Chenopodium album	+++	*Mimosa pudica*	+++
Cynodon dactylon	++	*Scoparia dulcis* L.	++
Cyperus rotundus	+++		

* + = occurs as a component of weed flora but not a serious problem by itself, ++ = occurs as a weed of considerable importance, +++ = occurs as a serious weed at one or more locations [Karim et al. 1999].

This alien species, presumably invaded the country from the neighboring India [Karim 2008]. At present, more than 50% of the places (districts) in the country have been infested. This invasive species has been found infesting 19 crops including potato, tomato, onion, garlic, lentil, chili, pea, sugarcane, banana, etc. [Karim 2013; Illias et al. 2015]. Although this weed is widely spread along roadsides, it entered a good number of upland crop fields. Biswas et al. [2010] noted that the emergence of crop seedlings and their development are affected considerably by the allelopathic effects of parthenium debris mixed with soil in Bangladesh. The capacity of N uptake by parthenium was found greater than rice [Islam 2009]. In spite of wide spread in the country, no effective step has been taken by the government to control it.

Weed Control Practices

Prior to the decade of the 1960s, farmers used to grow local crop varieties and employed traditional cultural practices and manual weeding to reduce weed problems. The local varieties were more weed competitive due to their tall growth and droopy leaves especially in rice crop. The problem increased with the introduction of modern varieties of rice, wheat, potato and other crops which are susceptible to weed competition. The introduction of dwarf high yielding rice varieties during the 1970s exacerbated the weed problem considerably [Ahmed et al. 2011].

In Bangladesh, the main practice of weed management is manual weeding. In upland rice, hand-held hoe or *niri* (a local weeding tool) is generally used. In transplanted rice, Japanese rotary weeder, BARI weeder or BRRI weeder is used for inter-row weeding. Chemical weed control had been practiced mainly in tea since the 1960s. In the 1980s, herbicides have been introduced in rice. Currently, about 2 million ha are under herbicide-based weed control [Ahmed et al. 2011]. Most of the herbicides used in tea gardens are the non-selective ones, including glyphosate and paraquat. In field crops, selective herbicides belonging to different chemical families are used. The use of herbicides has been increasing at a fast pace [Karim 2008]. Research on selection of weed-competitive varieties and allelopathic rice varieties is also in progress [Karim et al. 2014a, b].

Development of Weeders

A power weeder (BARI Power Weeder) has been developed in 2006 by the Farm Machinery and Postharvest Processing Engineering division of BARI, Gazipur. This diesel-run weeder fitted with a rotary blade, gearbox and a hand clutch can be used to control weeds in wider-row crops such as maize sugarcane. It helps save weeding cost by 90%. The average field capacity of the weeder is 0.093 ha hr^{-1} with a weeding index of 0.75 [Hoque et al. 2011].

The Wheat Research Center at BARI has also developed a two-wheel tractor-operated boom sprayer to apply herbicides and other pesticides effectively and economically. This spray boom has 9 Tee jet nozzles, placed 50 cm apart. A DC motor is attached to the sprayer to pump the liquid. It is 4 m wide and moves at 5 km hr^{-1}. The effective field capacity of the sprayer is 1.6 ha hr^{-1}. It can be used in potato, oilseeds, pulses and other row crops [Hossain et al. 2011].

Weed Control by Intercropping

Maize is an important cereal crop after rice and wheat but weed infestation is a great problem in this crop cultivation. Maize-legume intercropping system is a vital intercropping system which has been practicing in many countries including Bangladesh in order to reduce weed problem and increase economic benefits. Effective reduction in weed growth depends on the choice of legume, and this ensures better crop yields. Adoption of maize-pea intercropping in winter or maize-mungbean intercropping in summer and following two rows of either legume between maize rows (spaced 75 cm x 25 cm), has been found to be weed-suppressive and high yielding. This system derived higher land equivalent ratio (1.80) and benefit:cost ratio (>2.0) [Nahar 2015].

Phytoremediation by Weeds

Some weed species have been found as scavengers of heavy metals, toxic compounds and organic substances. Roots of the annual sedge *Fimbristylis miliacea* (L.) Vahl was found to remove arsenic from the contaminated soil at 32.37 mg kg^{-1} [Zaman et al. 2006; Mitra et al. 2009].

Weed Science Education

There are 13 technical universities that offer courses in weed science in Bangladesh. These include Bangladesh Agricultural University, Sher-e-Bangla Agricultural University, Bangabandhu Sheikh Muzibur Rahman Agricultural University, Haji Danesh Science and Technology, Patuakhali Science and Technology University, Sylhet Agricultural University, Bangabandhu Sheikh Muzibur Rahman Science and Technology University, Noakhali Science and Technology University, Jessore University of Science and Technology, Khulna University, Rajshahi University, Bangladesh Open University and International University of Business Agriculture and Technology.

These universities devote 2-3% of the total credit hours to weed science courses (Table 2). The courses include both basic and applied aspects of weed science. Some of these include biology and ecology of weeds, weed survey and mapping, methods of weed management, crop-weed competition, allelopathy, herbicide-based weed management, etc. Advanced courses are offered to master's and doctoral degree students.

Table 2. Credits (hours) devoted to weed science at bachelor's level in different universities.

University[1]	Total	Weed science			% of Total credits
		Theory	Practical	Total	
BAU	185	2	2	4	2.16
SAU	182	2	2	4	2.20
BSMRAU	240	3	1.5	4.5	1.88
HDSTU	183	2	2	4	2.19
PSTU	180	3	1	4	2.22
RU	192	4	2	6	3.13

[1]BAU: Bangladesh Agricultural Univ. (BAU); SAU: Sher-e-Bangla Agricultural University; BSMRAU: Bangabandhu Sheikh Muzibur Rahman Agricultural Uni; HDSTU: Haji Danesh Science and Technology; PSTU: Patuakhali Science and Technology University; RU: Rajshahi University.

Weed Science Society

The Weed Science Society of Bangladesh (WSSB) was established in August 2008 when it was initiated by Dr. Karim of BAU. In the first executive committee, Dr. Ali, SAU was elected as President and Dr. Karim as general secretary. The objective of the society is to enhance the agricultural productivity through economically feasible and environmentally friendly weed management strategies. It provides a forum for exchange of accomplishments, ideas, etc. among weed scientists; to advise governments on control of noxious weeds; to maintain liaison with international weed science societies; to boost agricultural production, publication of journals, bulletins, monographs, books, fact sheets, etc. in weed science; and to identify outstanding weed scientists in the country and recognize their contributions; to recommend suitable and updated curriculum in weed science to the University Grant Commission, Text Book Boards, agricultural universities and colleges.

The society also organizes national seminars and conferences besides publishing Bangladesh Journal of Weed Science annually.

Future Research

There is a compelling need to determine weed research in the country. One other aspect is compiling a list of noxious, invasive and parasitic weeds. Special focus needs to be given for the control of parthenium which is now invading crop fields. There is an immediate need to establish weed science section or division in each of the national agricultural institutions devoted to research on rice, jute, sugarcane, tea, forestry and general agriculture.

Another requirement for the growth of weed science is establishment of a full-fledged central research centre to conduct weed research, train personnel, train farmers and develop sophisticated weeding tools and equipment. The national government needs to enact quarantine laws to prevent entry of invasive alien and noxious plant species into the country and establish guidelines in regard to genetically modified crops.

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