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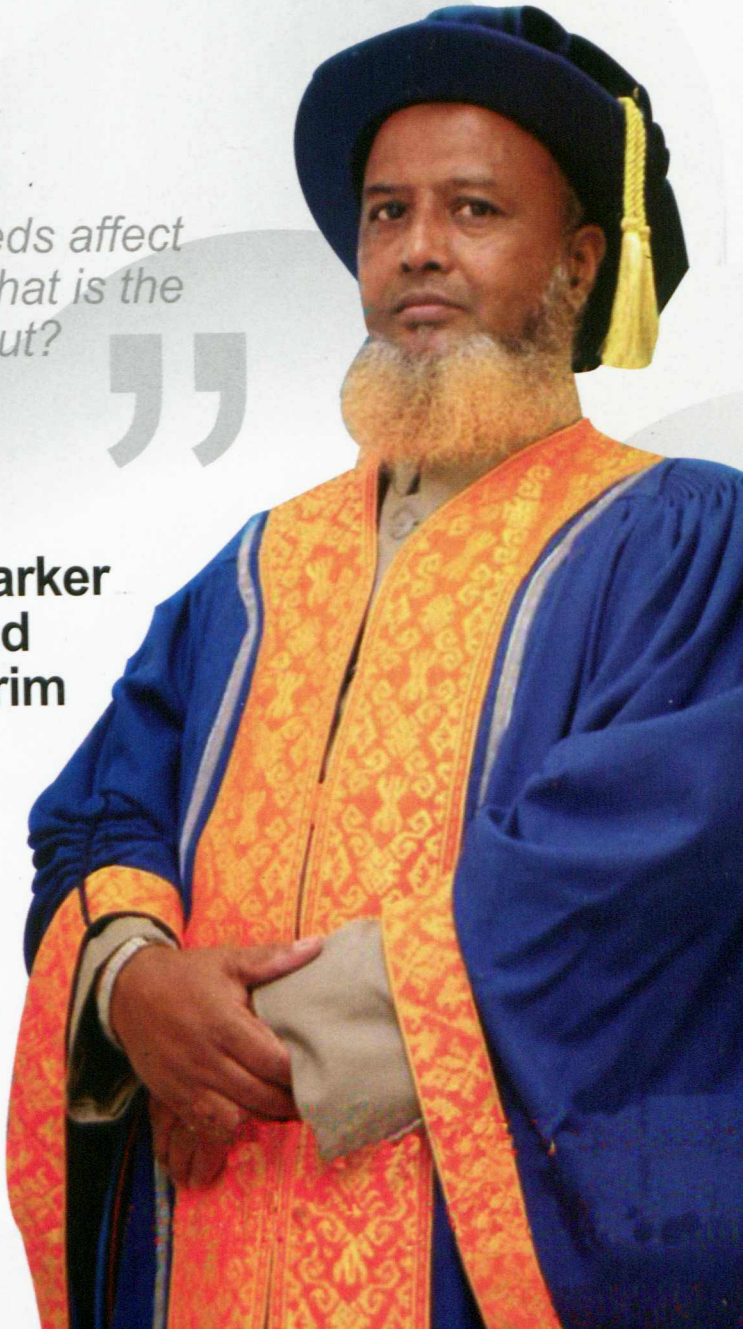
Prof. Dr. Sarker Mohammad Rezaul Karim



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Written by
S. M. Rezaul Karim

S. M. Rezaul Karim, *PhD*
Professor
Faculty of Agro-Based Industry
Universiti Malaysia Kelantan
Jeli Campus, Locked Bag 100
17600 Jeli, Kelantan

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Written by

S. M. Rezaul Karim, Faculty of Agro Based Industry, Universiti Malaysia Kelantan, Jeli Campus, Locked Bag 100, 17600 Jeli, Kelantan

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Preface

Weeds, the plants out of place, are of concern to everyone with respect to agriculture, environment or human and animal health. These plants must be managed effectively, economically and sustainably. In planning a proper weed management programme we should first be aware of the actual problems posed by weeds, their at tributes and characteristics in causing crop damage and impairment on environmental health, seed dispersal mechanisms and the approaches to confront and con them. In this book the ill impacts of different weeds and their management options are described. The weeds are categorised as per their severity of damages and difficulties in employing control measures. Special attention has been given on Parthenium weed invasion in Malaysia, which has recently been found infesting roadsides and wasteland in Batang Kali, Selangor, Malaysia. This weed may cause ecological disaster in Malaysia if the researchers, general public and policy makers are not aware of its presence and when no proper control measures are taken to eradicate it at its source. The role of policy makers especially in enacting the Weed Law and Weed Act in the country is also highlighted.

Ii is hoped that the information given in this book will be helpful for the students of agriculture, weed scientists and the decision makers of the country.

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S.M. Rezaul Karim

Faculty of Agro-Based Industry, Universiti Malaysia Kelantan, Jeli Campus, 17600 Jeli, Kelantan, Malaysia

Summary

Weeds, the unwanted plants, affect us in different ways. Many weeds being noxious and invasive species, are harmful to agricultural crops, human and animal health, water and surrounding environment; and impair the biodiversity of our natural vegetation. It creates problems during harvesting of crops, increase the cost of production, become barriers to navigation, increase wear and tear of machineries and equipments, create an ugly sight in recreational ground and landscaping, decrease the size of wildlife habitats, land value and the quality and quantity of crop produced. The damage to crop caused by weeds exceeds the damages caused by insect pests and diseases. A number of weeds such as poison ivy, tamarisk, 'mile-a-minute', witchweed, spotted knapweed, leafy spurge, parthenium weed, etc. are recalcitrant species causing remarkable distress to our environment through adding toxic chemicals to human and livestock, depleting available water resources or replacing native species.

Since weeds grow in nature unattended by any form of management and care, they struggle for existence through evolution of some special characteristics such as by possessing allelopathic potential, plasticity in adaptation, greater seed productivity, extended viability and longevity of seeds, easy dispersion of seeds, stress tolerance, etc. The existence of these characteristics in many weed species has made them difficult to be controlled.

On an average, 11% yield loss due to weeds occurred in developed temperate countries but in developing tropical countries, crop yields are lost by about 30 to 40%. In these countries, inspite of the adoption of some form of control measures in crop fields, 13% of crop yields are lost due to weed competition. Among the agricultural crops grown globally on a large scale such as rice, cotton, onion, maize, barley, wheat, soybean, are found to be more susceptible to weed damages. In Africa, grain production was badly affected by striga (a root parasitic weed) on 44 million hectares of land. Invasion of the alien weed species *Parthenium*, considered to be an environmental pollutant, is a dangerous threat for many countries including Malaysia. Recently, (early in September 2013), the weed has been identified infesting roadsides and wasteland in Batang Kali, Selangor, Malaysia.

The way out of the problem for these noxious weeds are employing cultural, physical/mechanical, chemical and biological approaches in weed control. Adequate land preparation, practicing appropriate crop planting methods, using competitive and allelopathic crop varieties, using recommended fertilizer rates and provision of irrigation, adopting appropriate broad-spectrum herbicides, introducing effective biocontrol agents are the practices which should be adopted to combat the menace. Integrated weed management approach is the best way for sustainable weed management.

The Weed Laws and Weed Acts for regulating the spread of weed propagules from one place to another should be established in the country. Quarantine regulation for weed control must be developed and practiced especially for the invasive recalcitrant weeds. Awareness campaign by the authorities through various media channels must be put in place to warn farmers and agricultural practioners the dangers posed by noxious and especially the alien invasive species such as the parthenium weed, which has reached the borders of the country. Eradication programmes must be organized to ensure that such a weed do not spread out to agriculture farms and encroach into plantations as this will bring about an ecological disaster in the country if the problem is not addressed at source.

1. WEEDS AND WEED PROBLEM

1.1 Weed – a nuisance!

Weed means "a plant out of place" or "a plant that interferes with the management objectives of a given area of land at a given point in time". A rice plant in a wheat field or a wheat plant in rice may also be a weed. A plant of good pasture crop growing in a well-managed lawn is also a weed. Similarly, a plant of medicinal value growing unwontedly on the roof of a building is a weed. Weeds are pollutants to our environment. They appear attractive, desirable, or harmless, but later it can be toxic, painful, or injurious to humans, and may cause water quality problems. It multiplies itself exponentially and can generate tons of biomass in a matter of months, spreads naturally in water, wind, or soil, also spread by wildlife and livestock. A number of weeds grow in terrestrial and aquatic conditions causing enormous losses to crops and the environment.

1.2. Category of Weeds

Three major categories of weeds are – environmental weeds, invasive weeds and noxious weeds.

Environmental weeds are the weeds that invade native ecosystems and adversely affect the survival of indigenous flora and fauna. It can be foreign plants, which were accidentally or intentionally introduced into the country, or they can be native plants that have become weedy due to inappropriate management, or because they are outside of their normal range. Environmental weeds may have significant economic and social impacts, as well as environmental impacts.

Invasive weed species are those weeds which are non-native, alien or exotic to the ecosystem under consideration and cause or are likely to cause economic or environmental harm or harm to human health. A species to become an invasive weed it must cross over some barriers as – large scale geographical barrier, survival barrier, establishment barriers, dispersal and spread barriers, and finally it must causes negative economic, environmental and human health impacts.

Noxious weeds are the weeds that can directly or indirectly cause damage to crops (including nursery stock or plant products), livestock, poultry or other interests of agriculture, irrigation, navigation, natural resources of the country, the public health, or the environment. In other words, noxious weeds mean any species of plant that are troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture or important native species, and difficult to control or eradicate. In most cases, noxious weeds are evolved in other countries where the pressures from the environment cause them to develop aggressive and invasive characteristics. The main differences between a common weed and a noxious weed are that the latter have an enormous capacity for destruction and are very difficult to control.

1.3. Why Noxious Weeds are of utmost Concern?

Noxious weeds are of utmost concern since they pose serious threats to our environment, biodiversity, livestock industry and socio-economic activities:

i. Increase the cost of crop production and processing
ii. Increase equipment wear, tear and fuel costs
iii. Increase cost for seed cleaning
iv. Reduce the quality of crop or crop produce

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v. Extra amount of water and nutrients are required for crop production
vi. Act as alternate hosts for pests and diseases
vii. Decrease the quality and quantity of animal production
viii. Decrease the value land holdings
ix. Affect human and animal health (allergies, poisonings)
x. Decrease the wildlife habitat
xi. Decrease the water quality and cause damage to watershed systems
xii. Impair recreational ground and opportunities
xiii. Displace native, threatened and endangered species of fauna and flora
xiv. Increase the danger of wild fire occurrence (Sharon, 2004; GYCC, 2013)

It can be mentioned that only about 10% of the earth's 33 billion acres are arable. If these lands are infested with non-productive weeds along with other crop-destroying pests, it will begin to decrease the land available for food production. Over the last 30 years the estimates for total losses due to weeds range from $6 to 18 billion per year. Currently, in the United States there are about 100 million acres infested with noxious weeds and this is increasing by at least 8% each year. In 1993, $3.6 to 5.4 billion was lost in direct costs (chemical costs, labour, equipment wear and tear) with an additional $1 billion in indirect costs to control the weeds. 'Leafy spurge alone is responsible for decreasing the carrying capacity of pasture (number of animals can graze in an area) by up to 50%. This weed contains a milky sap that may cause blisters in the mouths of cattle and wildlife. Garlic mustard, on the other hand, out competes valuable forest plants and creates large monocultures that have little or no value for forest ecosystems. It has been estimated that the economic impact of 'spotted knapweed' infested areas both directly and indirectly are $42 million (Beck, 1994; Sharon, 2004).

Noxious weeds produce large number of seeds per plant which make them sustain longer. In most of the cases of weed infestation they produce between 30,000 to 350,000 seeds/m^2 and 120 million to 1.4 billion seeds per acre. Even if only 2-10% of these seeds germinate every year a huge number of weeds can still emerge. Weed seeds also have a tendency to be able to survive in the soil for many years (for example bindweed 30 years or more). Most noxious weeds have traits that allow them to outcompete native vegetation such as faster growth rate, extensive root systems or higher seed production (Anon. 2012).

Noxious or invasive weeds alter the environment in several ways such as reducing the plant biodiversity, animals, insects and microorganisms. They can create monocultures, which then create undesirable habitat for the native plants, animals, insects and other microorganisms to prosper. *Imperata cylindrica* (Cogon grass) is an allelopathic noxious weed which excludes other surrounding plants surrounding it due to their allelopathic effects and colonizes its own plants. The resulting monoculture increases wind and water erosion, alters water movement in the soil

and changes nutrient cycling. These weeds alter the structure of ecosystems by altering soil properties, environmental and economic systems. Soils in weed-infested areas tend to have less organic matter due to increased erosion by both water and wind. This reduces water infiltration and availability to other plants. Nitrogen, phosphorus and potassium can be reduced by 40-90% in spotted knapweed infested areas (Beck, 1994, Sharon, 2004).

Noxious weeds have different growth habits and growth structures which can alter handling of wind, rain, etc. For example, in spotted knapweed areas, runoff is 1.5 times higher and sediment loss is 3 times higher than in uninfected areas. They also alter plant community composition for wildlife by reducing forage, altering thermal condition (due to reduced canopy) altering water flow and water availability to wildlife. They reduce territorial space available for wildlife survival. *Mimosa pigra* is a prickle-bearing noxious shrub weed which affects the biodiversity of the infested area. Magpie goose are disturbed due to creating of unsuitable nesting environment, *Orang Asli* is affected when collecting food from the forest, and tourism is also affected due to reduced area and access to tourism activities (Karim and Mashhor, 2013). Animal communities are also altered as preferred vegetation is reduced (Shanon, 2004; Anon. 2012).

Noxious weeds cause more extreme soil temperatures due to lower water levels, exposure of soil to sunlight (reduced canopy), poorer soil aggregation and organic material content. In lowland rice culture, noxious weed e.g. water hyacinth, water lettuce transpire a lot of water causing shortage of irrigation water. They may have root systems that take longer to decompose than the fibrous roots of grasses and sedges. Some weeds (e.g. Tamarisk) utilize more water thus reducing water available for wildlife, municipal and agricultural use.

Other ways in which weeds impact us are reducing product quality. Seeds of *Vicia hirsuta, Vicia sativa* etc. when mix with pulses and oilseeds causes odd odour to soups made from pulses and oils made from oil seeds. Milk and meat from cows that eat certain weeds (e.g. wild garlic, parthenium weed etc.) can develop an off taste and may not be sellable. Weeds also affect the health of many people and animals every year from allergies to poisonings. The best example of this kind is *Parthenium hysterophorus*, which causes skin dermatitis, eczema etc. when the plants come into contact to human body for considerable time. Land prices are also known to drop over 50% if the property is infested with a noxious weed.

Some weeds are allelopathic in effect. Litter and root exudation from allelopathic noxious weeds leach compounds that inhibit germination of other crop seeds. For example, tamarisk accumulates salt in the foliage, which falls to the ground, and the salt is leached into the ground making the soil too salty for most desirable seeds to germinate (Shanon, 2004; Anon. 2012). *Chromolaena odorata, Lantana camara, Polygonum hydropiper, Imperata cylindrica, Parthenium hysterophorus,*