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The potential benefits of weeds: A comparative study: A review

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Abstract
A weed in a general sense is a plant, usually wild or feral, that is commonly considered to be a nuisance in a garden, lawn, or other agri-cultural development. More specifically the term is often used to describe plants that grow and reproduce aggressively. Weeds may be unwanted because they are unsightly, or because they limit the growth of other plants by blocking light or using up nutrients from the soil. The term weed in its general sense is a subjective one, without any classification value, since a plant or herb is not a weed when growing where it belongs or is wanted. Despite of being harmful some weeds are called, beneficial plants or herbs as they are edible, use for food or herbal medicine. Other advantage of such beneficial herbs may be the keeping away of some insect pests of crops. Many researchers have pointed out that there is scarce evidence to prove that pests move from the alternative host in sufficient numbers to cause significant crop damage, even in the case of pests such as some of the aphids which are obliged to alternate between hosts to complete their life cycle.

Keywords: Weed, harmful, beneficial effect, alternate host

Introduction
Weeds are defined as any plants that are growing in unwanted areas or plants growing in everlastingly human-disturbed environments but do not depend on human interference for reproduction and survival. These plants may be found growing on agricultural fields and gardens or as ruderal plants (Ngugi *et al.* 1978; Stephen 1982; Casas *et al.*1996) [1, 85, 3]. Weeds are usually seen to have adverse effects not only in agricultural lands but also in natural wild ecosystems. In terms of agriculture these plants compete against crop plants for available resources, lower the quality of agricultural produce, lower quality of pastures. Despite of these some are poisonous, increase costs of production, harbor pests, while some block irrigation after growing immeasurably (Ngugi *et al.* 1978; Klingman *et al.* 1982; Ivens 1989; Cousens & Mortimer1995) [1, 4, 5, 6]. In concern to biodiversity conservation considerations weed and other aggressive species are often supposed to act as "plant pests" (Miller 1999), one of the two major threats to biodiversity, second to habitat damage (Heywood 1995; Mungoro & Tezoo 1999) [8, 9]. This may be especially so when weed species are lack natural enemies, grow faster than native plant species and are able to produce plenty of seeds (Richardson *et al.* 1992) [10]. The species which grow on their own, without human efforts can be termed as weeds. They are in general harmful to the crops and can dominate the vegetation if not cared for. The weeds are of no use as they are harmful to crop. They are generally controlled from crop fields and destroyed. Many of the weeds are found to be medicinally important. Such weeds can be collected from crop fields and used for curing the diseases.

Losses caused by weed
The losses caused by weeds exceed the losses from any other category of agricultural pests, such as insects, nematodes and rodents. Among the total annual losses of agricultural product from various pest, weeds account for 45%, insects for 30%, diseases 20% and other pest 5% as shown in Figure 1 (Rao 2000) [81]

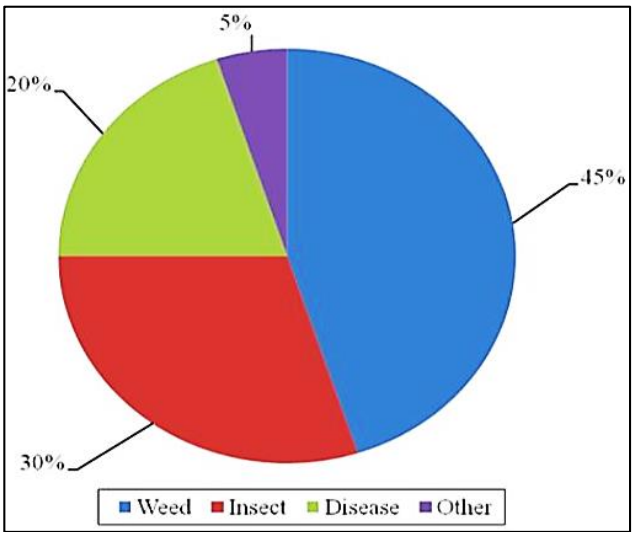

Fig 1: Losses caused by different pests and weeds

Losses caused by weeds to medicinal plants:

1. Nutrient losses caused by weeds by competition for essential nutrients.
2. Reduces the yield contributing character by creating space competition on the above and below the ground surface.
3. Loss in soil moisture.
4. Reduces the quality of medicinal plants by adulteration/ mixing of weeds during post-harvest processing. The root of kans grass (*Cyperus rotundus*) also reduces the quality of root crops like *Asparagus, Chlorophytum*, etc.
5. Weed drastically reduces the yield of medicinal plant as well as farm income.
6. High intensity of weed leads to slow germination and initial growth, wider row spacing and slow lateral spread, which causes tremendous loss in productivity as well as quality.

Uses

Domestic and Edible Weeds

There are only about 250 plant species which are sufficiently troublesome universally to be regarded as weeds (Altieri and Liebman, 1988) [36] and agriculture has been a major factor influencing their evolution. World-wide exchanges of planting material of major crop plants has been a factor allowing the introduction of many of these weeds into all cultivated areas of the world which have the required ecological conditions. Some have been cultivated in the past as crops and others are progenitors of, or closely related to, wild progenitors of crop plants. Some are sufficiently close genetically to their crop relatives that introgression is common and contributes to the diversity of the crop species population, while selection for uniformity in crop species results in a loss of genes, and the consequent increasing instability of agroecosystems. Weed relatives of crop species may remain as a reservoir of genes and should be conserved as they may be needed in the future (Harlan, 1965) [24]. In western Kenya the agricultural system of Bungoma is dominated by maize cultivation, yet one study revealed that at least 100 different species of vegetable and fruit were consumed which were drawn from 70 genera belonging to 35 families (Juma, 1989) [25]. Although most of the weeds commonly found in cultivated land are introduced species, there are few which do not have culinary, medicinal or other domestic uses (Table 1). Rahmato (1988) [26] noted that wild foods are an important component of peasant survival in Ethiopia.

Among other wild plants, the weed species *Portulacca oleracea* and *Amaranthus spp.* were important in helping the people of Wollo to cope with the 1984 drought. Although in most cases where weed species are used for human consumption their use is concerned to periods of food shortage, this is by no means always the case. Some species are highly prized as green leafy vegetables and grains and some are more productive than their crop equivalents. For instance the grain yield obtained from the wild grass *Panicum laetum*, (known as fonio) in the valley of the *Malian Gourma*, is higher than that from the local millets (Maiga *et al*., 1991) [27]. One study in Tanzania recorded that wild plants appeared in 32% of all meals consumed by villagers (Fleuret, 1979) [28]. *Bidens spp*. are among the most common early colonisers of cultivated land in Africa and the leaves are widely consumed. Although regarded as a famine food due to its rather aromatic flavor, Ogle and Grivetti (1985a) [29] reported that in Swaziland, Bidens was the most frequently consumed wild leaf vegetable and eaten by more than 70% of the adult population. Other weeds such as Commelina and *Sonchus oleraceus* were also important (Ogle and Grivetti, 1985b) [30]. Bush plants and edible weed often play an important role in maintaining the nutritional status of rural communities (Ogle and Grivetti, 1985c; Grivetti, 1987) [31, 32]. Huss-Ashmore and Curry (1989) [33] reported that the transition to more intensive farming with more cash crops and increased use of herbicides was marked by the virtual disappearance of *Bidens pilosa* and *Corchorus spp*. They attributed poorer nutritional status of the villagers in part to the elimination of these species as a source of wild food.

In Ethiopia also, it has been recorded that wild foods are an important component of peasant survival strategies and it is mainly the women who are particularly knowledgeable about the most useful species (Rahmato, 1988) [26]. Zmarlicki *et al*. (1984) [84] analysed the nutrient composition of some of the wild plants used for human consumption in the Transkei of South Africa. They found many potentially useful plants among the weed flora and suggested that the cultivation of weeds such as *Sonchus asper*, *Chenopodium album*, *Amaranthus spp*. And *Galinsoga parviflora* could be encouraged in multiple crop farming systems. The weed species *Gynandropsis gynandra*, *Solanum nigrum* and *Celosia argentea* contained high levels of protein. Ogle and Grivetti (1985c) [31] found that the protein content of edible wild plants ranged from 1.3% to 7.5% of fresh weight and in Swaziland, wild vegetables were eaten with maize porridge in 39% of all meals. As these leaves were high in lysine which is deficient in maize, they represent an important supplement to a diet based on maize. *Bidens pilosa*, *Amaranthus spp*. and *Corchorus spp*. all had a higher content of protein, calcium and iron than spinach.

Table 1: Different edible and other useful weeds.

Weed species	Domestic use
Ageratum conyzoides	Medicinal ± leaves pounded to treat wounds. Popular with the Luo in Kenya as a haemostatic. Also known as a remedy for stomach pains.
Amaranthus spp.	Food ± Leaves of several species of Amaranthus eaten as a relish throughout E. Africa, often mixed with salt and groundnut paste. Seed can be roasted and pounded to produce flour used in preparation of bread and biscuits. *A. caudatus* in Ethiopia is mixed with flour of Tef to make injera. Other uses ± A. hybrids can be used to make a red dye.
Argemone mexicana	Other uses ± Seeds are narcotic and used in Tanzania to make traditional beer more intoxicating. Seeds have insecticidal properties. Can be poisonous to livestock.
Bidens pilosa	Food ± leaves and shoots are edible. It is one of the weeds most widely used as a famine food due its abundance, rather than its taste which is rather aromatic. Medicinal ± Leaves can be made into a poultice to treat wounds and the juice used to treat eye complaints. Roots and stem used to treat diarrhea and abdominal pains.
Boerhavia diffusa	Medicinal ± Occasionally, leaves pounded and used medicinally.
Celosia spp.	Food ± leaves and inflorescence used as a vegetable and in soups and stews.
Chenopodium spp.	Medicinal ± C. ambosioides leaves applied to face to treat convulsions in Zimbabwe. Also powdered leaf mixed with oil and applied to skin to treat ringworm. Other uses ± Believed in some parts of Malawi to repel snakes.
Cleome monophilla	Food ± Said to be edible when leaves and flowers are cooked and pounded with groundnut and tomato but is bitter and not much liked.
Commelina spp.	Food ± in times of famine leaves and young shoots used either fresh or boiled as a vegetable. Rhizome can also be eaten. Medicine ± *C. africana* used to treat leprosy, eye problems and colds.
Corchorus spp.	Food ± One of the most valuable local vegetables in hot, arid regions. Often cooked with potash. In Senegal the leaf is used with steamed millet to prepare `m'boum'. Eaten by women, children and invalids in many parts of Africa. Medicinal ± *C. olitorius* used as a tonic and to treat toothache, stomach and bladder complaints. Other uses ± fibers can be woven to make course cloth.
Crotalaria spp.	Food ± leaves and flowers of some species can be cooked and eaten as a relish but it is often mixed with groundnut to make it more palatable.
Cynodon dactylon	Medicinal ± known in Malawi as a remedy for indigestion and heartburn. Other uses ± pasture grass.
Cyprus esculentus	Food ± Tubers are rich in starch and oil and it is a good source of phosphorous and iron, although protein content is relatively low, it is twice as high as in cassava. Tubers eaten raw or can be roasted to make coffee, in Zambia and Zimbabwe used to make porridge.
Datura stramonium	Medicine ± In Zimbabwe leaves burned and smoke inhaled as a treatment for asthma. Leaves and seed contain the alkaloids hyoscine and atropine and are crushed and mixed with ghee to make an ointment for treatment of ringworm. Crushed leaves used as insect repellent. Other uses ± in Malawi it is believed that the leaves sprinkled around the house repel cockroaches. *Datura spp.* used as a rat poison in stored grain.
Eleusine indica	Food ± seed can be pounded into flour; eaten as a famine food in Zambia and Ethiopia. Other uses ± straw used for bedding. Medicinal ± reputed in Malawi to be effective as a remedy for coughs and blood complaints.
Euphorbia heterophylla	Medicinal ± an infusion of leaves and root used as a remedy for headache.
Euphorbia hirta	Medicinal ± Used to treat wounds by covering with fresh leaves. Common name of asthma weed but this may be because it is believed to induce asthma. The latex is sometimes used in Malawi to treat eye complaints such as conjunctivitis.
Galinsoga parviflora	Food ± leaves eaten as a relish in some areas. Medicinal ± Stem=leaves pounded and juice squeezed into wound.
Gynandra gynandropsis	Food ± One of the most popular sources of relish in E. Africa. The young shoot and leaves are cooked and often mixed with pounded groundnut. Medicinal ± leaves are reputed to be a remedy for pneumonia in Malawi.
Hibiscus cannabinus	Food ± in times of famine may be eaten as a relish; the leaves have to be pounded with potash.
Imperata cylindrica	Medicinal ± known in Malawi as a treatment for digestive complaints.
Leucas martinensis	Medicinal ± leaves and bracts boiled in salt water and the infusion drunk to cure throat infections.
Ocimum spp.	Medicinal ± widely use as medicinal plants to remedy fevers and the whole plant of infusion of the leaves is used as a mosquito repellent.
Oxygonum sinnuatum	Food ± occasionally cooked with potash to make a relish. Medicinal ± widely used as a medicine. Leaves crushed and rubbed into the eye to treat eye complaints. Infusions of the root can be drunk to treat menstrual problems.
Physalis angulata	Food ± fruit can be consumed and is rich in vitamin A and C. Medicinal ± to improve female fertility.
Potulacca olerecea	Food ± contains high levels of oxalic acid. May be eaten in salads and soups particularly in Mozambique and Malawi. Large leaved types cooked as a vegetable. Medicinal ± as a snake bite remedy.
Schkuhria pinnata	Medicinal ± Leaf decoction taken orally in Zimbabwe to treat gonorrhea.
Solanum nigrum	Food ± the unripe fruit are poisonous but in many parts of Africa the leaves are cooked as a relish. Medicinal ± Juice from the fruit has antibacterial and antifungal properties and is used to treat skin infections including ringworm.
Tagetes minuta	Medicinal ± crushed in oil and applied to skin to treat wound maggots.
Tribulus terrestris	Food ± leaves, shoots and fruits rich in calcium, iron and vitamin C. Leaves used as salad and seed can be pounded to make flour. Fruits may be gathered in times of severe food shortage.
Trichodesma zeylanicum	Medicinal ± powdered tuber of *T. physaloides* Fengl. Said to have aphrodisiac properties. An infusion of the roots and leaves is used to treat intestinal worms.
Tridax procumbens	Medicinal ± the leaves are mixed with other herbs to treat coughs and chest complaints.
Triumfetta spp.	Medicinal ± in Zimbabwe, *T. weliwitschii* (Mat.) powdered root used to prevent abortion. *T. rhomboidea* used in

	Zimbabwe to treat circumcision wounds by squeezing juice from the root into the wound.
Vernonia spp.	Medicinal ± leaves contain alkaloids and can be used to treat wounds. In Zimbabwe infusions prepared from the root used to combat infertility. Leaves rubbed on body as insect repellent and to protect against body lice.

Sources: Banda and Morris (1986) [45], FAO (1988) [46], Kokwaro (1976) [47], Fox and Norwood-Young (1982) [48], Drummond (1984) [49], Ivens (1967) [50], Johns *et al*. (1990) [51], Johns and Kokwaro (1991) [52].

Medicinal Use

In the last decade herbal products have gained increasing popularity, and are now used by approximately 20% of the population. Herbal products are complex mixtures of organic chemicals that may come from any raw or processed part of a plant, including leaves, stems, flowers, roots, and seeds. (Bent, 2008) [86]. The Ayurveda system of medicine was first taught and practiced by the ancient Sages of India over 4000 years ago. It is a highly effective and advanced method of treatment with a deep insight to the root causes of ailments and its value or the effectiveness has not diminished with the time (Ediriweera 2007) [83].

Weeds as a source of bio pesticides

The production by plants of bioactive secondary metabolites is usually an evolutionary response to the threat posed to the species by herbivores, many of them insects. So it is not surprising that some of these compounds have been shown to be insecticidal. About 2000 plant species are reported to contain compounds with pest control properties (Secoy and Smith, 1983; see also Grange and Ahmed, 1988) [63, 75]. Some of the more effective compounds such as nicotine, derris and pyrethrum have long been exploited commercially as agricultural and household insecticides. There are many others which are used traditionally in Africa but their use is rarely universal with particular plants being used as insect repellents in one area but neglected in another (Chimbe and Galley, 1996) [70]. Although the efficacy of extracts from most of these plants is poor compared to commercial synthetic pesticides, they can still contribute substantially to pest control when their use is integrated with other measures and often have the advantage of low human toxicity. Some of the plant extracts which are active against insect pests are also active against fungal and bacterial pathogens. *Datura stramonium* has been shown to provide some control of both Alternaria leaf spot (*Alternaria macrospora*) and bacterial blight (*Xanthomonas campestris* pv. *malvacearum*) on cotton (Bambawale *et al*., 1995) [65]. *Nicandra physaloides* is a common weed in both the old and new worlds and is known to contain an antifeedant compound, nicandrenone. Its use as a household fly repellent is common in Peru (Bettolo, 1983) [66] and its use for this purpose has been recorded in Africa. Secoy and Smith (1983) [75] listed 664 plant species with pest control properties, some of which are common weeds. Most of the uses reported for these weeds, including *N. physaloides*, were as repellents against insects attacking the human body, *Datura spp*. are also used as rat poison in stored grain. Two noxious weeds which produce large quantities of biomass which could be exploited for pest control are the water hyacinth (*Eichornia crassipes* L) which decreased populations of plant parasitic nematodes when incorporated into soil (Siddiqi and Alam, 1989) [68] and *Lantana camara* which produces an antimicrobial compound, (Sharma *et al*., 1988) [87].

Storage pests are a major problem to smallholders in Africa where as much as 10% of their crop may be destroyed during storage (Schulten, 1975) [69]. In Malawi where maize is the dominant food crop, about 85% of production is stored on-farm in traditional granaries (Chimbe and Galley, 1996) [70]. Losses in store to insect pests, diseases and rodents are expensive to control with conventional pesticides and resistance in the target population has been known to develop towards some of the more commonly used insecticides such as malathion (Champ and Dyte, 1976) [71]. For these reasons and because compounds used on stored products must be of low human toxicity, storage pests are a particularly good target for natural pesticides. Natural products have shown some activity against two common pests of stored grain, *Sitophilum spp.* and *Prostephanus truncatus* (Chimbe and Galley, 1996; Abdallah *et al*., 1990; Tiertoniber, 1994) [70, 72, 74]. Fruits from *Datura spp.* or whole plants of *Leonotis africana* Briq or *Ocimum canem* Sims are placed in the traditional store to protect the crop from pests (Secoy and Smith, 1983) [75]. Extracts from the leaves of *O. kilimanscharicum* were also shown to be insecticidal against common stored product pests (Jembere *et al*., 1995) [76]. Weaver *et al*. (1991) [77] reported that linalol extracted from freshly milled *O. canem* was effective against stored product pests, protecting beans against *Zabrotes subfasciatus* in Rwanda. Another species of *Ocimum, O. suare* Willd. Protected stored maize from maize weevils (*Sitophilus zeamais* Motchusky), the lesser grain borer (*Rhyzopertha dominica* Fabricus) and the grain moth (*Sitotroga cerealella* Oliver). Dried or ground leaves and essential oil extract was repellent to all three pests but particularly to *S. zeamais* (Hassanali *et al*. 1990; Bellele *et al*., 1996) [78, 73]. Marigolds (*Tagetes spp.*) have long been known to produce root exudates with nematicidal properties (e.g. Daulton and Curtis, 1963) [79] and floral and root extract of the common weed species in east Africa *T. minuta*, showed insecticidal activity against the adult Mexican bean weevils (*Epilachnai spp.*) (Weaver *et al*., 1994) [80].

Nematodes

Many of the common plant parasitic nematodes have wide host ranges and can invade and reproduce on crop and weed species (Table 2). Common weed species growing on farm land can serve as indicator hosts for nematodes which might affect the crop growing there or which may be grown there in the future (Hogger and Bird, 1976) [41]. The root-knot nematodes (Meloidogyne spp.) are the most damaging nematodes in tropical legume and vegetable crops. Several common weeds associated with their cultivation in Malawi, such as *Ageratum conyzoides, Galinsoga parvi¯ora, Crotalaria spp., Nicandra physaloides* and *Corchorus olitorius* are also hosts for Meloidogyne javanica (Hillocks *et al*., 1995) [45]. Among these weed species, *A. conyzoides* was found to be a particularly good host for the population of *M. javanica* tested (Hillocks, *et al*., 1995) [45] which appears to be the case also in Zimbabwe (Martin, 1959) [43] and in Nigeria (Salawu *et al*., 1991) [44].

Table 2: Different species of weeds and their parasitic nematodes.

Weeds species	Nematode or Plant Pathogens
Acanthospermum hispidum	*Meloidogyne javanica* (Hillocks *et al*., 1995) [45]
Ageratum conyzoides	*M. javanica* (Hillocks *et al*. 1995; Madulu and Trudgill, 1993) [45,, 53] *Verticillium dahliae* Hillocks, unpublished), *P. solanacearum* (Kelman, 1953) [54]
Amaranthus hybridus	*Pratylenchus zeae* (Jones and Hillocks, 1995) [56], *M. javanica* (Hillocks *et al*., 1995) [45]
Amaranthus spinosus	*Rotylenchulus reniformis* (Inserra *et al*., 1989) [55]
Bidens pilosa	*M. javanica* (Saka and Siddiqi, 1979), *R. reniformis* (Inserra *et al*., 1989) [55]
Bidens schiperi	*M. javanica* (Martin, 1959) [43]
Chenopodium murale	*M. incognita* (Meyer and van Wyk, 1989) [58]
Commelina benghalensis	*Pratylenchus zeae* (Jones and Hillocks, 1995) [56], *P. godeyi* (Gowen, unpublished)
Commelina diffusa	*R. reniformis* (Inserra *et al*., 1989) [55]
Corchorus olitorius	*M. javanica* (Hillocks *et al*., 1995; Madulu and Trudgill, 1993) [45, 53]
Crotalaria incana	*P. zeae* (Jones and Hillocks, 1995) [56], Bean common mosaic virus (Spence and Walkey, 1995)
Cynodon dactylon	*Sporisorium sorghi* (Marley, 1995) [84]
Digitaria spp.	*P. zeae* (Jones and Hillocks, 1995) [56]
Eleusine indica	*P. zeae* (Jones and Hillocks, 1995) [56]
Euphorbia heteropylla	*R. reniformis* (Inserra *et al*., 1989) [55]
Euphorbia hirta	*R. reniformis* (Inserra *et al*., 1989) [55]
Galinsoga ciliata	*R. reniformis* (Inserra *et al*., 1989) [55]
Galinsoga parviflora	*M. javanica* (Hillocks *et al*., 1995; Madulu and Trudgill, 1993) [45, 53]
Gisekia spp.	*M. javanica* (Madulu and Trudgill, 1993) [53]
Nicandra physaloides	*M. javanica* (Hillocks *et al*., 1995) [42]
Oxygonoum sinuatum	*M. javanica* (Madulu and Trudgill, 1993) [53]
Portulacca oleracea	*P. solanacearum* (Quimio and Chan, 1979), *R. reniformis* (Inserra *et al*., 1989) [55]
Ricardia scabra	*M. javanica* (Madulu and Trudgill, 1993) [53]
Rottboellia exalta	*P. zeae* (Jones and Hillocks, 1995) [56]
Sida acuta	*M. javanica* (Madulu and Trudgill, 1993) [53]
Xanthium pungens	*Verticillium dahliae* (Evans, 1971) [61]

Conclusion

As it is well known that weeds are harmful to the main crops all the time but in context to use them as food and any other useful product like bio-pesticides. In India many of the weeds are in used as food and for the medicinal purpose like Bathua and Chirchita in Ayurveda. Many of the Tribal peoples still using various weeds to consume for the source of nutrients. Consequently; in the future as there will be need of extra food availability for the raising population of India and world there is the requirement of scientific research regarding weed as useful source for the human being. Therefore, agriculturists and weediologist should pay special attention to identify beneficial weeds. They should take care to promote beneficial weeds and to preserve and propagate them, which are valuable as medicinal and for other uses. It is determined that weeds are valuable in the form of edible, medicinal and for other uses thus these weeds should be protected.

Reference

1. Ngugi D, Karau PK, Nguyo W. East African Agriculture. Macmillan London, 1978, 282.
2. Stephen RJ. Theory and practice of weed control. The Mac Millan Press, London, 215.
3. Casas A, Vazquez MD, Viveros JL, Caballero J. Plant management among the Nahua and the Mixtec in the Balsas river basin, Mexico: An Ethnobotanical approach to the study of plant domestication. Human Ecology 1996; 24:455-478.
4. Klingman GC, Ashton FM, Noordhoff LJ. Weed Science: Principles and practices. John Wiley & Sons New York, 1982, 431.
5. Ivens GW. East African weeds and their control. Oxford University Press, Nairobi, 1989.
6. Cousens R, M Mortimer. Dynamics of weed populations. Cambridge University press, Melborne, 1995.
7. Miller, S. Invasive species in East Africa: Introductory comments. Invasive species in Eastern Africa: Proceedings of a workshop held at ICIPE (Nairobi, Kenya), 1999.
8. Heywood VH. Global biodiversity assessment. Cambridge University Press, Cambridge, 1995.
9. Mungoro Y, Tezoo V. Control of alien invasive species in Mauritus. Invasive species in East Africa: Introductory comments. Invasive species in Eastern Africa: Proceedings of a workshop held at ICIPE (Nairobi, Kenya), 1999.
10. Richardson DM, Macdonald I, Holmes PM, Cowling RM. Plant and animal invasions. In Cowling (Ed.) The ecology of Fynbols-Nutrients, Fire and Diversity. Oxford University Press Southern Africa, Cape Town, 1992.
11. Altieri MA. Biodiversity and Pest Management in agroecosystems. Food Productions Press, New York, 1994.
12. Wood D, JM Lenne. Agrobiodiversity Characterisation, Utillisation and Management. CABI, Wallington. 1999.
13. Gladis T. Unkrauter als Generessourcen. Z. Pflkrankh. Pflschultz, Sonderh. 1996; XV:39-43.
14. Erhss Ediriweera. A Review on Medicinal uses of Weeds in Sri Lanka. Tropical Agricultural Research & Extension, 2007, 10.
15. Kothari SK, Ram P, Singh K. Studies on intercropping autumn planted sugarcane with bergamot, pepper and spearmint in Tarai area of Uttar Pradesh. Indian Journal of Agronomy. 1987; 32(4):406-410.
16. Upadhyay RK, Hari Baksh, Patra DD, Tewari SK, Sharma SK, Katiyar RS. Integrated weed management of medicinal plants in India. International Journal of Medicinal and Aromatic Plants. 2011; 1(2):51-56.
17. Naik VN. Flora of Marathwada Amrut Publications, Aurangabad (M. S.) India, 1998, I(II).

18. Mali YP, Bhadane VV. Ethno-medical wisdom of tribals of Aurangabad district (M.S.), India. Indian J. of Natural Products and Resources. 2011; 2(1):102-109.
19. Mohmmad Nafees Iqbal, Suradkar SS. Ethnobotanical and Ethnomedicinal Study of some medicinal plants of Barshitakli Tahsil District Akola (MS) India. Bioscience Discovery. 2011; 2(2):236-239.
20. Lal HS, Singh S. Study of Plant Biodiversity of Hajaribag District, Jharkhand, India and its Medicinal Uses. Bioscience Discovery. 2012; 3(1):91-96.
21. Nag K, Zia-Ul-Hasan. Study of some rare medicinal wild herbs from gardens of Bhopal city, Madhya Pradesh (India), International Journal of Pharmacy & Life Science. 2013; 3:2437-2439.
22. Muley JR, Sharma PP. Plants used in Treatment of Jaundice by Folklore of Ahmednagar district, Maharashtra, India. Science Research Reporter, 2013; 3(2):216-222.
23. Altieri MA, Liebman M. Weed Management in Agroecosystems: Ecological Approaches. CRC Press, Boulder, Colorado, 1988.
24. Harlan JR. The possible role of weeds in the evolution of agriculture; plants. Euphytica. 1965; 14:173-6.
25. Juma, C. Biological diversity and innovation; Conserving and utilizing genetic resources in Kenya. African Centre for Technology studies, Nairobi, Kenya. 1989.
26. Rahmato D. Peasant survival strategies in Ethiopia. Disasters. 1988; 12:326-44.
27. Maiga A, De Leeuw P, Diarra L, Hiernaux P. The harvesting of wild growing grain crops in the Gourma Region of Mali. IIED Drylands Issues Paper 27, IIED, London, 1991.
28. Fleuret A. The role of wild foliage plants in the diet: a case study for Lusotho, Tanzania. Ecology of Food & Nutrition. 1979; 8:87-92.
29. Ogle BM, Grivetti LE. Legacy of the chameleon; edible wild plants in the Kingdom of Swaziland. A cultural, ecological and nutritive study. Part II ± Demographics, species availability and dietry use, analysis by ecological zone. Ecology of Food and Nutrition. 1985a; 17:1-30.
30. Ogle BM, Grivetti LE. Part I Introduction, objectives, methods, Swazi culture, landscape and diet. Ecology of food and Nutrition. 1985b; 16:193-208.
31. Ogle BM, Grivetti LE. Part IV ± Nutritional analysis and conclusions. Ecology of food and Nutrition. 1985c; 17:41-64.
32. Grivetti LE. Bush foods and edible weeds of agriculture Perspectives on dietry use of wild plants in Africa, their role in maintaining human nutritional status and implications for agricultural development. In R. Akhar (ed.), Health and disease in Tropical Africa: Geographical and Medical Viewpoints, Harwood, London. 1987; 51-81.
33. Huss-Ashmore R, Curry J. Diet, nutrition and agricultural development in Swaziland 1. Agricultural ecology and nutritional status. Ecology of Food and Nutrition. 1989; 23:189-209.
34. Zmarlicki C, Wehmeyer AS, Rose EF. Important indigenous plants used in the Transkei as food supplements. Ecology of Food and Nutrition. 1984; 14:242-54.
35. Bendixen LE, Horn DJ. An Annotated Bibliography of Weeds as Resevoirs of Organisms Affecting Crops. Ohio Res. & Dev Centre, Wooster, 1981, 117.
36. Andow DA. Management of weeds for insect manipulation in Agroecosystems. In M.A. Altieri and M. Liebman (eds) Weed management in Agroecosystems: Ecological Approaches. CRC Press, Boca Raton, Florida, 1988, 265-301.
37. Gebre-Amlak A. Development of maize stalk borer *Busseola fusca* Fuller in wild host plants in Ethiopian Journal of Applied Entomology. 1988; 106:390-5.
38. Nyambo BT. Significance of host-plant phenology in the dynamics and pest incidence of the cotton bollworm, *Heliothis armigera* (Lepidoptera: Noctuidae) in western Tanzania. Crop Prot. 1988; 7:161-7.
39. Nyambo BT. Effect of natural enemies on the cotton bollworm *Heliothis armigera* (Lepidoptera: Noctuidae) in western Tanzania. Tropical Pest Management. 1990; 36:50-8.
40. Page W, Richards R. Agricultural pest control by community action: the case study of variegated grasshopper in southern Nigeria. African Environment. 1977; 2:127-41.
41. Hogger CH, Bird GW. Weed and indicator hosts for plant parasitic nematodes in Georgia cotton and soybean fields. Plant Disease Reporter. 1976; 60:223-6.
42. Hillocks RJ, Stokes S, Jones M. Reproduction of the potential benefits of weeds with reference to small holder agriculture in Africa 165 *Meloidogyne javanica* on legume crops and some weeds associated with their cultivation in Malawi. Nematologica. 1995; 41:505-15.
43. Martin GC. Plants attacked by root-knot nematodes in the Federation of Rhodesia and Nyasaland. Rhodesia Agricultural Journal. 1959; 56:162-75.
44. Salawu EO, Ambursa AS, Manga YB. Weed and crop hosts of root-knot nematode, *Meloidogyne javanica* in North West Nigeria. Pakistan Journal of Nematology. 1991; 9:109-17.
45. Banda EAK, Morris B. Common Weeds of Malawi. University of Malawi, Zomba, 1986, 176.
46. FAO. Traditional food plants. FAO Food and Nutrition Paper No 42. FAO, Rome, 1988, 593.
47. Kokwaro J. Medicinal plants of East Africa. East Africa Literature Bureau. General Printers, Nairobi, 1976, 141.
48. Fox FW, Norwood-Young ME. Food from the Veldt; Edible Wild Plants of South Africa. South African Institute for Medical Research, Johannesburg, S. Africa. 1982, 273.
49. Drummond RB. Arable Weeds of Zimbabaw. Department of Research & Specialist Services, Harare, Zimbabwe, 1984, 164.
50. Ivens GW. African Weeds and Their Control. Oxford University Press, Nairobi, 1967, 269.
51. Johns T, Kokwaro JO, Kimanani EK. Herbal remedies of the Luo of Siaya District Kenya; establishing quantitative criteria for consensus. Economic Botany. 1990; 39:369-81.
52. Johns T, Kokwaro JO. Food plants of the Luo of Siaya District Kenya. Economic Botany. 1991; 45:103-13.
53. Madulu J, Trudgill DL. Weed hosts for *Meloidogyne javanica* in Tanzanian tobacco fields. Pakistan Journal of Nematology. 1993; 11:61-4.
54. Kelman A. The bacterial wilt caused by *Pseudomonas solanacearum*. A literature review and bibliography. North Carolina Agricultural experimental Station Technical Bulletin. 1953; 99:1-194.
55. Inserra RN, Dunn RAM, Sorley R, Langdow KR, Richmer AY. Weed hosts of *Rotylenchulus reniformis* in

ornamental nurseries of S. Florida. Weed Abstracts. 1989; 39:444.
56. Jones ML, Hillocks RJ. Host status for *Pratylenchus zeae* of food crops and associated weed species in Malawi. Afro-Asian Journal of Nematology. 1995; 5:20-6.
57. Saka V, Siddiqi MA. Plant parasitic nematodes associated with plants in Malawi. Plant Disease Reporter. 1979; 63:945-8.
58. Meyer JC, Van Wyk RJ. Susceptibility of rotation crops and weeds in tobacco field Meloidogyne species and host races. Phytophylactica. 1989; 21:205-7.
59. Spence NJ, Walkey DGA. Variation for pathogenicity among isolates of bean common mosaic virus in Africa and a reinterpretation of the genetic relationship between cultivars of *Phaseolus vulgaris* and pathotypes of BCMV. Plant Pathology. 1995; 44:537-46.
60. Quimio AJ, Chan HH. Survival of *Pseudomonas solanacearum* in the rhizosphere of some weeds and economic plant species. Philippine Phytopathology. 1979; 15:108-21.
61. Evans G. Influence of weed hosts on the ecology of *Verticillium dahliae* in the newly cultivated areas of the Namoi Vally, New South Wales. Annals of Applied Biology. 1971; 67:169-75.
62. Secoy DM, Smith AE. Use of plants in control of agricultural and domestic pests. Economic Botany. 1983; 37:28-57.
63. Grange M, Ahmed S. Handbook of Plants with Pest Control Properties. John Wiley & Sons, New York, 1988.
64. Chimbe CM, Galley DJ. Evaluation of material from plants of medicinal importance in Malawi as protectants of stored grain insects. Crop Protection. 1996; 15:289-94.
65. Bambawale OM, Mohan P, Chakrabotry M. Efficacy of some medicinal plants against cotton pathogens. Advances in Plant Science. 1995; 8:224-9.
66. Bettolo GBM. The role of natural products in plant insect and plant ± fungi interactions. In D.L. Whitehead and W.S. Bowers (eds) Natural crops. III Insects Products for Environmental Pest Management. Pergamon Press, Oxford. 1983; 187-220.
67. Secoy DM, Smith, AE. Use of plants in control of agricultural and domestic pests. Economic Botan. 1983; 37:28-57.
68. Siddiqi MA, Alam, MM. Possible utilization of anoxious weed in nematode control. Biological Wastes. 1989; 28:181-8.
69. Schulten GGM. Losses in stored maize in Malawi and work undertaken to prevent them. EPPO Bulletin. 1975; 5:113-20.
70. Chimbe CM, Galley DJ. Evaluation of material from plants of medicinal importance in Malawi as protectants of stored grain insects. Crop Protection. 1996; 15:289-94.
71. Champ BR, Dyte CE. Report of the FAO global survey of pesticide susceptibility in stored grain pests. FAO Plant Production and Protection. 1976; 5:297.
72. Abdallah MD, Kandil, MA Farag AA. Bioactivity of plant extracts against *Sitophilum granarius* L. and *Triboium castaneum* Host. Bulletin Entomological Society of Egypt. 1990; 15:199-205. I
73. Bellele AJ, Obeng-ofori D, Hassanali A. Evaluation of *Ocimum suare* (Willd.) as a source of repellents, toxicants and protectants against three stored product insect pests, 1996.
74. Tiertoniber B. The ability of powders and slurries from 10 plant species to protect stored grain from attack by *Piostephanus truncatus* (Horn) (Coleoptera: Bostrichidae) and *Sitophilus oryzae* L. (Coleoptera: Curculilonidae. Journal of Stored Products Research. 1994; 30:297-301.
75. Secoy DM, Smith AE. Use of plants in control of agricultural and domestic pests. Economic Botany. 1983; 37:28-57.
76. Jembere B, Obeng-Ofori D, Hassanali A. Products derived from leaves of *Ocimum kilimanscharicum* as postharvest grain protectants against the infestation of major stored product insect pests. Bulletin of Entomological Research. 1995; 85:361-7.
77. Weaver DK, Dunkel FV, Ntezupubamza L, Jackson LC, Stock DT. The efficacy of linalool, a major component of freshly milled *Ocimum canem* for protection against stored product coleoptera. Journal of Stored Product Research. 1991; 27:213-20.
78. Hassanali A, Lwande W, Ole-sitayo N, Moreka L, Nokoe S, Chapaya A. Weevil repellent constituents of *Ocimum suare* and *Eugenia caryophyllata* cloves used as grain protectants in parts of eastern Africa. Discovery and Innovation. 1990; 2:91-5.
79. Daulton RAC, Curtis RF. The effect of *Tagetes spp*. On *Meloidogyne javanica* in Southern Rhodesia. Nematologica. 1963; 9:357-362.0.
80. Weaver DK, Wells CD, Dunkel FV, Bertsch W, Sing, SE, Sriharlan S. Insecticidal activity of floral, foliar and root extracts of *Tagetes minuta* against mexican bean weevils. Journal of Economic Entomology. 1994; 87:1718-25.
81. Rao VS. Principles of weed Science. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, 2000, 427-436.
82. Katyayan A. Fundamental of Agriculture. Jain Brothers, 2007, 105-116.
83. Ediriweera ERHSS.). A Review on Medicinal uses of Weeds in Sri Lanka. Tropical Agricultural Research & Extension, 2007, 11-16.
84. Marley PS. *Cynodon dactylon*: An alternative host for *Sporisorium sorghi*, the causal organism for sorghum covered smut. Crop Protection. 1995; 14:491-493.
85. Stephen RJ. Theory and practice of weed control. The MacMillan Press, London, 1982.
86. Bent S. Herbal medicine in the United States: review of efficacy, safety, and regulation: grand rounds at University of California, San Francisco Medical Center. Journal of General Internal Medicine. 2008; 23(6):854-859. Doi: 10.1007/s11606-008-0632-y.
87. Sharma OP, Makkar HPS, Dawra RK. A review of the noxious plant Lantana camara. Toxicon. 1988; 26:975-13.