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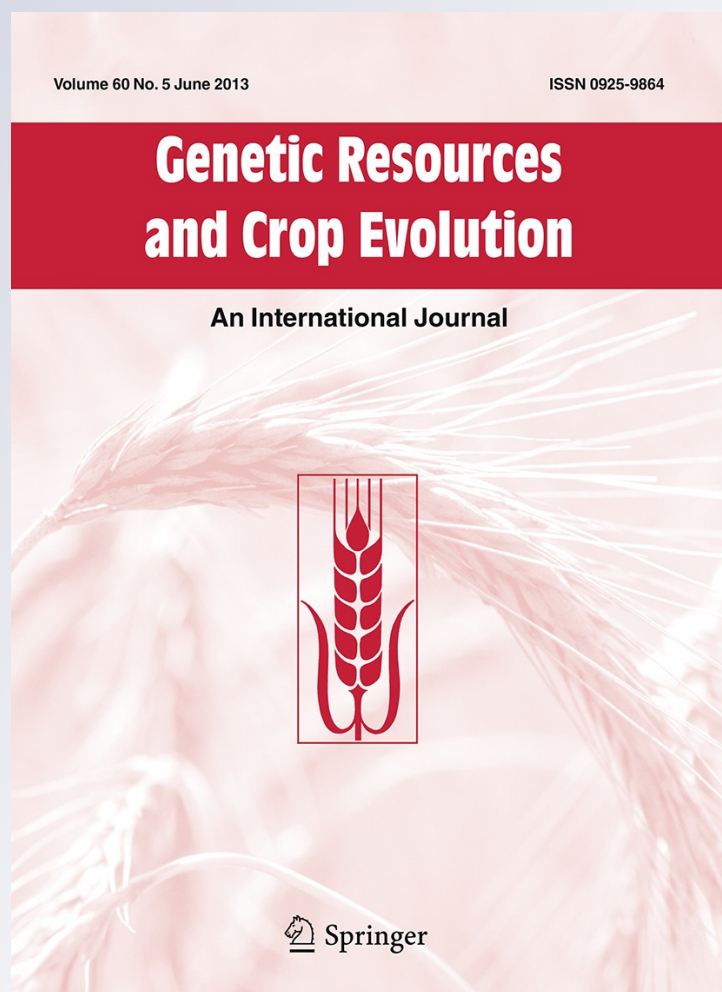
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Crop wild relatives from the Arabian Peninsula

N. Kameswara Rao

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Abstract The crop wild relatives constitute an important resource for improving agricultural production. An analysis of the floras from the Arabian Peninsula shows that there are over 400 wild relatives of some 70 food and forage crops. Because of their natural adaptation to the harsh environmental conditions, these species are expected to be extremely important sources of genes for the crop improvement programs targeting climate change and thus of potential value for global agriculture. However, these resources are under severe stress from both natural and anthropogenic factors. Considering that efforts for plant genetic resources conservation in the Arabian Peninsula are still meager, there is an urgent need to collect and conserve the crop wild relatives present in the region.

Keywords Arabian Peninsula · Climate change · Conservation · Crop improvement · Wild relatives

Introduction

The crop wild relatives (CWR) are wild plants related to socio-economically important species including food and forage crops, medicinal plants, ornamental and forestry species, as well as plants used for

industrial purposes, such as oils and fibers (Heywood et al. 2007). The wild relatives constitute an important resource for improving agricultural production and for maintaining sustainable agro-ecosystems. They are a critical source of genes for resistance to diseases, pests and stresses such as drought and extreme temperatures. It is not surprising that modern varieties of most major crops now contain genes from their wild relatives. For instance, the use of wild relatives has led to improved resistance to late blight in potato and to grassy stunt disease in rice (Hajjar and Hodgkin 2007). Wild relatives have been also used to improve tolerance of drought in wheat and acid sulphate soils in rice and to raise the nutritional value of some crops, including protein content in durum wheat, calcium content in potatoes and beta-carotene in tomato (Lane 2006). More recently, high levels of resistance against sclerotinia rot was introgressed into oilseed rape through hybridization with three wild crucifers viz. *Erucastrum cardaminoides*, *E. abyssinicum* and *Diplotaxis tenuisiliqua* (Garg et al. 2010). Wild species also provide other invaluable products such as animal fodder, building materials and medicines. With the advent of climate change and greater ecosystem instability, CWRs are likely to prove a critical resource in ensuring food security in future (Bioversity International 2006).

Despite their importance, the conservation of CWR, both *ex situ* and *in situ* has not received due attention. Not surprisingly, they remain underrepresented, accounting for only 2–4 % of the global *ex situ* germplasm collections of major food crops (Rao et al.

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2003; Maxted et al. 2007). The wild relatives of crops are themselves under threat from many of the same pressures which threaten global crop yields, such as climate change resultant ecosystem instability, natural habitat destruction, urbanization and infrastructure development and overgrazing. A study of the current and future geographical distribution of wild relatives of three important food crops—potato, peanut and cowpea, based on 19 climatic variables showed that by 2055, 18–25 % of all the species could become extinct and that most species could lose 50 % of the land area that is currently suited to them (Jarvis et al. 2008).

In the Arabian Peninsula, overgrazing by goats and camel is one of the principal threats to plant diversity including the CWR. Since majority of the CWR grow outside any form of protection, they are particularly vulnerable to loss. The problem is particularly acute in interior deserts where, because of the breakdown of traditional pastoral practices, stock often strays into the desert (Fisher et al. 1998; Miller and Cope 1996). The Arabian Peninsula is also threatened physically and biologically by the global warming phenomena. Climate change prediction for the Arabian Peninsula anticipate extreme weather events, both in terms of temperature and precipitation resulting in both more floods and drought (Kotwicki and Al Sulaimani 2009). More severe and harsh climatic conditions will also cause an increase in the formation of sand dunes, sand encroachment, and extreme dust storms, leading to further loss in plant diversity (Asem and Roy 2010). Despite the significant threat to their continued existence, limited attempts have been made in the past to develop inventories of the plant genetic resources from the countries of Arabian Peninsula. More recently, Hammer et al. (2009) provided a checklist of cultivated plants from Oman. Although wild relatives are not included, checklists such as these are a valuable tool for exploring and collecting the plant genetic resources. This paper presents an overview of the CWR from the Arabian Peninsula, their potential and possible approaches to future utilization. A checklist has also been provided in the appendix to help in developing national and/or regional strategies for conservation and sustainable use of these species.

Materials and methods

The Arabian floras and other related publications were used for compiling the list of CWR. The most important

among them are: An Illustrated Guide to the Flowers of Saudi Arabia (Collenette 1985), The Flora of the United Arab Emirates (Weston 1989), The Wild Flowering Plants of Bahrain (Cornes and Cornes 1989), An Annotated Catalogue of the Vascular Plants of Oman (Ghazanfar 1992), Flora of the Arabian Peninsula and Socotra (Miller and Cope 1996), A Handbook of the Yemen Flora (Wood 1997), Vegetation of Kuwait (Omar et al. 2000), Flora of the Kingdom of Saudi Arabia (Chaudhary 1999, 2000a, b, 2001a, b), The Comprehensive Guide to the Wild Flowers of the United Arab Emirates (Jongbloed et al. 2003), Flora of Sultanate of Oman (Ghazanfar 2003, 2007), An Illustrated Checklist of the Flora of Qatar (Norton et al. 2009), Phytogeography of Saudi Arabia (Al-Nafie 2008) and Oman at the cross-roads of inter-regional exchange of cultivated plants (Hammer et al. 2009).

In addition to the crops covered under the multi-lateral system of the International Treaty for Plant Genetic Resources for Food and Agriculture (FAO 2004), other plant species listed as crops by Tanji and Kielen (2002) and the World Programme for the Census of Agriculture 2010 (FAO 2005) formed the basis for compiling the checklist of related wild taxa. While any taxon belonging to the same genus as the crop is considered as a wild relative, different genera than the crop were also considered as related wild species if they are cross-compatible with the cultivated taxa (e.g. *Brassica* and allied genera).

Results and discussion

Inventory of CWR from the Arabian Peninsula

The list of crop wild relatives from the seven countries of Arabian Peninsula consisted of ca. 404 species belonging to some 70 food and forage crops (see Appendix). The highest number of species is found in Saudi Arabia (303 spp.), followed by Yemen (177 spp.), Oman (143 spp.), UAE (87 spp.), Qatar (69 spp.), Kuwait (64 spp.) and Bahrain (39) (Fig. 1). The majority of the species belong to the families Leguminosae (134 spp.), Gramineae (69 spp.), Chenopodiaceae (38 spp.), Cruciferae (34 spp.), Liliaceae (19 spp.) and Solanaceae (19 spp.). The largest genera are: *Astragalus* (27 spp.), *Indigofera* (23), *Crotalaria* (20 spp.), *Solanum* (18 spp.), *Salsola* (15 spp.), *Allium* (12 spp.), *Ipomoea*, *Lotus* and *Pennisetum* (11 spp. each)

(Table 1). While 195 species (ca. 49 %) are restricted in their distribution to only one country and 102 species to two countries, 14 species are found to be distributed across all seven countries of the Peninsula. These include *Amaranthus viridus*, *Astragalus tribuloides*, *Beta vulgaris* ssp. *maritima*, *Brassica tournefortii*, *Chenopodium murale*, *Ficus carica*, *Melilotus indica*, *Panicum antidotale*, *Panicum turgidum*, *Salsola cyclophylla*, *S. imbricata*, *Rumex vesicarius*, *Portulaca oleracea* and *Ziziphus spina-christi*.

Some of the important CWR found in the region are: *Abelmoschus manihot*, *B. vulgaris* var. *maritima*, *Carthamus oxyacanthus*, *Citrullus colocynthis*, *Gossypium stocksii*, *Hordeum murinum*, *Lens culinaris* subsp. *orientalis*, *Olea europaea* subsp. *cuspidata*, *Pistacia khinjuk*, *P. falcata*, and several species of *Allium*, (from Saudi Arabia), *Brassica* and allied genera, *Cucumis*, *Medicago*, *Pennisetum*, *Trifolium* and *Vigna*.

Potential of CWR from the Arabian Peninsula

The Arabian Peninsula is one of the driest regions in the world with very low and unreliable rainfall. It is also one of the hottest regions in the world with day temperatures in summer often exceeding 50 °C. The soils of the Arabian Peninsula reflect the aridity of the climate. Most are poorly developed, shallow and rich in lime, gypsum or salts. Due to the hot climate, the percentage of organic substance in the soil is very low (<1 %) to improve the physical properties and support proper plant growth. The high percentage of calcium carbonate leads to many other problems related to soil fertility, such as increasing soil buffering capacity and fixation of phosphorous and certain micronutrients. It is expected that the species found in the region contain some of the extreme adaptations that are going to be

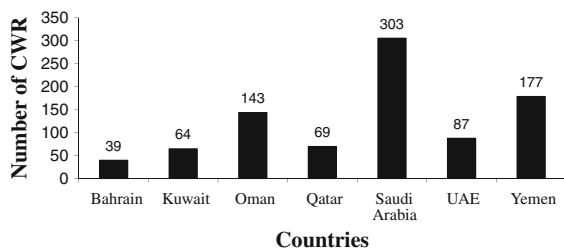


Fig. 1 Crop wild relatives reported from the seven countries of Arabian Peninsula

necessary to sustain agricultural productivity coping with climate change, such as resistance to intense heat, and tolerance to drought and salinity, which make them globally important for collecting and conservation (Fig. 2).

In the Arabian Peninsula as a whole, there are many protected areas in the IUCN-protected area management categories. However, these areas were created mainly for the protection and reintroduction of focal animal species and there is limited information on plant genetic resources and the status of their conservation in general (Fisher et al. 1998). Yemen and Oman have *ex situ* conservation programs for germplasm of widely cultivated crops, but they do not involve crop wild relatives (FAO 2010), thus showing the need for their targeted collecting and conservation.

Relationships between the cultivated and wild species

For effective utilization of the CWR in conventional breeding programs as well as for collecting and conservation when only limited resources are available, it may become necessary to focus on the priority species. This requires information about genetic relatedness or distance between the crop plants and their wild relatives. The most rigorous approach to defining the relationship between taxa is to use the Gene Pool concept proposed by Harlan and de Wet (1971) (See Hopkins and Maxted 2010). According to this concept, the crop itself and wild forms of the crop including those which grow as agricultural weeds and readily intercross with the cultigen to produce progenies that are fully or nearly fertile form Gene Pool 1A (GP 1a) and Gene Pool 1B (GP 1b), respectively. Species which are somewhat distant from the crop and hybridization using conventional breeding techniques is more difficult are grouped in Gene Pool 2 (GP2). Species that are related but where hybridization with the cultigen has not been possible or where hybrids have been completely sterile are grouped under Gene Pool 3 (GP3). However, prioritization of the species based on this concept requires information on cross compatibility between the crop and its wild relative. In the absence of such crossing data, Maxted et al. (2006) have proposed the Taxonomic Group (TG) concept, which uses the existing taxonomic hierarchy to assess the genetic relatedness or distance between taxa. The TG concept recognizes six groups: Taxon Group 1a

Table 1 Crop wild relatives reported from the Arabian Peninsula. The number of species in each genus is given parenthesis

Family	Genus
Amaranthaceae	<i>Amaranthus</i> (8)
Anacardiaceae	<i>Pistacia</i> (2)
Annonaceae	<i>Annona</i> (1)
Chenopodiaceae	<i>Atriplex</i> (9), <i>Beta</i> (1), <i>Chenopodium</i> (13), <i>Salsola</i> (15)
Compositae	<i>Carthamus</i> (4), <i>Cichorium</i> (3), <i>Lactuca</i> (4)
Convolvulaceae	<i>Ipomoea</i> (11)
Cruciferae	<i>Brassica</i> (3), <i>Crambe</i> (1), <i>Diplotaxis</i> (5), <i>Eruca</i> (2), <i>Erucastrum</i> (2), <i>Isatis</i> (1), <i>Lepidium</i> (9), <i>Raphanus</i> (1), <i>Rorippa</i> (1), <i>Sinapis</i> (2), <i>Sisymbrium</i> (7)
Cucurbitaceae	<i>Citrullus</i> (2), <i>Coccinea</i> (1), <i>Cucumis</i> (8), <i>Luffa</i> (1), <i>Momordica</i> (1)
Gramineae	<i>Aegilops</i> (5), <i>Andropogon</i> (6), <i>Avena</i> (6), <i>Cenchrus</i> (3), <i>Cymbopogon</i> (4), <i>Echinochloa</i> (3), <i>Eleusine</i> (3), <i>Festuca</i> (2), <i>Hordeum</i> (2), <i>Lolium</i> (4), <i>Panicum</i> (6), <i>Pennisetum</i> (11), <i>Saccharum</i> (3), <i>Setaria</i> (7), <i>Sorghum</i> (4)
Labiatae	<i>Mentha</i> (1)
Leguminosae	<i>Astragalus</i> (27), <i>Cicer</i> (1), <i>Crotalaria</i> (20), <i>Cyamopsis</i> (1), <i>Dolichos</i> (1), <i>Glycine</i> (1), <i>Indigofera</i> (23), <i>Lathyrus</i> (4), <i>Lens</i> (1), <i>Lotus</i> (11), <i>Macrotyloma</i> (1), <i>Medicago</i> (6), <i>Melilotus</i> (3), <i>Onobrychis</i> (1), <i>Pisum</i> (1), <i>Sesbania</i> (2), <i>Stylosanthes</i> (1), <i>Trifolium</i> (9), <i>Trigonella</i> (9), <i>Vicia</i> (5), <i>Vigna</i> (6)
Liliaceae	<i>Allium</i> (12), <i>Asparagus</i> (7)
Linaceae	<i>Linum</i> (5)
Malvaceae	<i>Abelmoschus</i> (1), <i>Gossypium</i> (1)
Moraceae	<i>Ficus</i> (3)
Moringaceae	<i>Moringa</i> (1)
Oleaceae	<i>Olea</i> (1)
Palmae	<i>Phoenix</i> (1)
Papaveraceae	<i>Papaver</i> (2)
Polygonaceae	<i>Rumex</i> (9)
Portulacaceae	<i>Portulaca</i> (3)
Rhamnaceae	<i>Ziziphus</i> (7)
Rosaceae	<i>Prunus</i> (2), <i>Rubus</i> (3)
Solanaceae	<i>Nicotiana</i> (1), <i>Solanum</i> (18)
Umbelliferae	<i>Anethum</i> (1), <i>Apium</i> (2), <i>Dacus</i> (2)

(TG 1a) = the crop; Taxon Group 1b (TG 1b) = same species as the crop but not domesticated; Taxon Group 2 (TG 2) = same series or section as the crop; Taxon Group 3 (TG 3) = other members of the same subgenus as the crop; Taxon Group 4 (TG 4) = other members of the same genus as the crop; and Taxon Group 5 (TG 5) = same tribe but different genus to the crop. While the Taxonomic Group concept may serve as a useful indicator of the degree of genetic relatedness, it will not be very helpful in genera which have not been divided into subgenera, series or sections. In some cases, even populations of the same species may not be always freely interfertile as with the three varietal groups (japonica, javanica and indica) of Asian rice *Oryza sativa*. On the other hand,

oil seed rape (*Brassica napus*) is capable of hybridizing with several wild species such as *Diplotaxis tenuisiliqua*, *Eruca vesicaria*, *Erucastrum abyssinicum*, *E. cardaminoides*, *Raphanus sativus*, *Sinapis alba*, *S. arvensis*, *Hirschfeldia incana*, *Moricandia arvensis* from seven other genera (Garg et al. 2010; Hopkins and Maxted 2010).

Heywood et al. (2007) suggested the combined use of gene pool and taxon group concepts as the best pragmatic means to determine whether a species is a closely or distantly related CWR and for prioritization in terms of conservation for use in improving crops. Thus, taxa which belong to GP1b or TG1b and TG2 may be considered as closely related CWRs of higher priority for conservation and those in the GP2 and GP3



Fig. 2 Some crop wild relatives found in the Arabian Peninsula. **A.** *Medicago laciniata*, **B.** *Lotus halophilus*, **C.** *Melilotus indica*, **D.** *Solanum incanum*, **E.** *Pennisetum divisum*, **F.** *Sinapis arvensis*

or TG3 and TG4 as more remote with lower priority. Heywood et al. (2007) although suggested exclusion of the taxa in TG5 from being considered as CWRs of that particular crop, the author thinks that they should also be targeted for conservation—considering that significant advances have been made in recent years, both in molecular technologies and hybridization procedures that allow for the transfer of genes even from distinctly related taxa. Furthermore, an examination of the hybridization results between crucifer species also illustrates that gene transfer is possible between remote genera with conventional breeding techniques even without recourse to genetic engineering.

Conclusions

The biodiversity of the Arabian Peninsula is under severe stress due to natural and anthropogenic factors. The region has several CWR with natural adaptation to the harsh growing environment, which are expected to be important sources of genes for crop improvement programs targeting climate change. Therefore, there is an urgent need to identify vulnerable species and initiate measures for *in situ* conservation through increase of protected areas and for *ex situ* conservation through seed storage and other means. If not, some of the most valuable resources that would be required to sustain future crop productivity could be lost forever.

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Appendix

Crop wild relatives from the Arabian Peninsula

Crop	Species	BHR	KWT	OMN	QAT	SAU	ARE	YEM
Alfalfa (<i>Medicago sativa</i> L.)	<i>Medicago laciniata</i> (L.) Mill.	x	x		x	x	x	
	<i>Medicago lupulina</i> L.					x		x
	<i>Medicago minima</i> (L.) L.					x		x
	<i>Medicago orbicularis</i> (L.) Bartal.					x		
	<i>Medicago polymorpha</i> L.		x	x	x	x	x	x
	<i>Medicago truncatula</i> Gaertn.					x		
Almond (<i>Prunus dulcis</i> (Mill.) D.A. Webb)	<i>Prunus arabica</i> (Oliv.) Meikle (Syn.: <i>Amygdalus arabicus</i> Oliv.)			x		x	x	
	<i>Prunus korshinskyi</i> Hand.-Mazz. (Syn.: <i>Amygdalus korshinskyi</i> (Hand.-Mazz.) Bornm.)					x		
Amaranth (<i>Amaranthus retroflexus</i> L.)	<i>Amaranthus albus</i> L.					x	x	
	<i>Amaranthus dubius</i> Mart. ex Thell.			x				
	<i>Amaranthus graecizans</i> L.	x	x	x	x	x	x	
	<i>Amaranthus hybridus</i> L.			x	x	x	x	
	<i>Amaranthus lividus</i> L. (Syn.: <i>A. blitum</i> subsp. <i>oleraceus</i> (L.) Costea)		x			x		
	<i>Amaranthus sparganicephalus</i> Thell.			x				x
Asparagus (<i>Asparagus officinalis</i> L.)	<i>Amaranthus spinosus</i> L.					x		x
	<i>Amaranthus viridis</i> L.	x	x	x	x	x	x	x
	<i>Asparagus africanus</i> Lam.					x		x
	<i>Asparagus falcatus</i> L.						x	x
	<i>Asparagus flagellaris</i> (Kunth) Baker					x		
	<i>Asparagus racemosus</i> Willd.							x
Barley (<i>Hordeum vulgare</i> L.)	<i>Asparagus setaceus</i> (Kunth) Jessop					x		
	<i>Asparagus stipularis</i> Forrsk. (Syn.: <i>A. horridus</i> L.)					x		
	<i>Asparagus virgatus</i> Baker							x
	<i>Hordeum marinum</i> Huds. subsp. <i>gussoneanum</i> (Parl.) Thell.		x					
Bitter gourd (<i>Momordica charantia</i> L.)	<i>Hordeum murinum</i> L. subsp. <i>glaucum</i> (Steud.) Tzvelev		x		x	x		
	<i>Momordica balsamina</i> L.					x		x
Blackberry, Raspberry (<i>Rubus</i> spp.)	<i>Rubus arisanensis</i> Hayata (Syn.: <i>R. corchorifolius</i> L. f.)					x		
	<i>Rubus canescens</i> DC. (Syn.: <i>R. tomentosus</i> Borkh. var. <i>canescens</i> (DC.) Wirtg.)					x		
	<i>Rubus sanctus</i> Schreb. (Syn.: <i>R. ulmifolius</i> Schott subsp. <i>sanctus</i> (Schreb.) Sudre					x		

continued

Crop	Species	BHR	KWT	OMN	QAT	SAU	ARE	YEM
Bluestem grass (<i>Andropogon gayanus</i> Kunth)	<i>Andropogon amethystinus</i> Steud.					x		x
	<i>Andropogon chinensis</i> (Nees) Merr.							x
	<i>Andropogon crossotus</i> T. Cope.							x
	<i>Andropogon distachyos</i> L.					x		x
	<i>Andropogon fastigiatus</i> Sw.							x
	<i>Andropogon greenwayi</i> Napper							x
Cabbage, Mustard, Rapeseed, Turnip, etc. (<i>Brassica</i> spp.)	<i>Brassica deflexa</i> Boiss.					x		
	<i>Brassica rapa</i> L.			x	x	x		
	<i>Brassica tournefortii</i> Gouan	x	x	x	x	x	x	x
	<i>Crambe orientalis</i> L.					x		
	<i>Diplotaxis acris</i> (Forssk.) Boiss.	x	x			x		x
	<i>Diplotaxis erucoides</i> (L.) DC.					x		x
	<i>Diplotaxis harra</i> (Forssk.) Boiss.	x	x	x		x	x	x
	<i>Diplotaxis kohlaanensis</i> A.G. Mill. et J.A. Nyberg							x
	<i>Diplotaxis tenuifolia</i> (L.) DC.							x
	<i>Eruca hispanica</i> (L.) Druce			x				
	<i>Eruca sativa</i> Mill. (Syn.: <i>E. vesicaria</i> (L.) Cav.)	x	x		x	x	x	x
	<i>Erucastrum abyssinicum</i> (A. Rich.) O.E. Schulz			x				x
	<i>Erucastrum arabicum</i> Fisch. et Mey. ex Boiss.			x		x		x
	<i>Isatis lusitanica</i> L.					x		
	<i>Lepidium africanum</i> (Burm.f.) DC.					x		
	<i>Lepidium armoracia</i> Fisch. et C.A. Mey.							x
	<i>Lepidium aucheri</i> Boiss.			x	x	x		
	<i>Lepidium bonariense</i> L.							x
	<i>Lepidium didymum</i> L.				x			
	<i>Lepidium draba</i> L.					x		
	<i>Lepidium latifolium</i> L.							x
	<i>Lepidium sativum</i> L.			x	x	x		x
	<i>Lepidium virginicum</i> L.					x		
	<i>Rorippa palustris</i> (L.) Besser							x
	<i>Sinapis alba</i> L.						x	
	<i>Sinapis arvensis</i> L.			x	x	x	x	x
	<i>Sisymbrium officinale</i> (L.) Scop.							x
	<i>Sisymbrium erysimoides</i> Desf.		x	x	x	x	x	x
	<i>Sisymbrium irio</i> L.		x	x	x	x	x	x
	<i>Sisymbrium loeselii</i> L.					x		
<i>Sisymbrium orientale</i> L.		x		x	x		x	
<i>Sisymbrium runcinatum</i> Lag. ex DC.					x			
<i>Sisymbrium septulatum</i> DC.		x				x		
Carrot (<i>Daucus carota</i> L.)	<i>Daucus durieua</i> Lange						x	
	<i>Daucus subsessilis</i> Boiss.						x	
Celery (<i>Apium</i> <i>graveolens</i> L.)	<i>Apium graveolens</i> L. ^a			x		x		
	<i>Apium nodiflorum</i> (L.) Lag.					x		
Chickpea (<i>Cicer</i> <i>arietinum</i> L.)	<i>Cicer cuneatum</i> A. Rich.					x		

continued

Crop	Species	BHR	KWT	OMN	QAT	SAU	ARE	YEM
Chicory (<i>Cichorium intybus</i> L.)	<i>Cichorium bottae</i> Deflers					x		x
	<i>Cichorium intybus</i> L. ^a			x		x	x	
	<i>Cichorium pumilum</i> Jacq. (Syn.: <i>C. endivia</i> subsp. <i>pumilum</i> (Jacq.) Cout.)					x		
Clover (<i>Trifolium</i> spp.)	<i>Trifolium alexandrinum</i> L.						x	
	<i>Trifolium arvense</i> L.					x		
	<i>Trifolium campestre</i> Schreb.					x		
	<i>Trifolium fragiferum</i> L.					x		x
	<i>Trifolium lappaceum</i> L.		x					
	<i>Trifolium resupinatum</i> L.		x		x		x	
	<i>Trifolium scabrum</i> L.					x		
	<i>Trifolium semipilosum</i> Fresen.					x		x
Clover, Sweet (<i>Melilotus</i> spp.)	<i>Melilotus alba</i> Medik. ^a	x		x	x	x	x	x
	<i>Melilotus indica</i> (L.) All.	x	x	x	x	x	x	x
	<i>Melilotus officinalis</i> (L.) Pal. ^a							x
Cotton (<i>Gossypium</i> spp.)	<i>Gossypium stocksii</i> Mast.			x				
Cowpea (<i>Vigna unguiculata</i> (L.) Walp.)	<i>Vigna aconitifolius</i> (Jacq.) Marechal					x		x
	<i>Vigna heterophylla</i> A. Rich.							x
	<i>Vigna luteola</i> (Jacq.) Benth.							x
	<i>Vigna macrorhyncha</i> (Harms) Milne-Redh.					x		
	<i>Vigna membranacea</i> A. Rich.					x		x
	<i>Vigna vexillata</i> (L.) A. Rich.							x
Cucumber (<i>Cucumis sativus</i> L.)	<i>Cucumis callosus</i> (Rottler) Cogn. (Syn.: <i>C. melo</i> L.)						x	
	<i>Cucumis canoxyi</i> Thulin et Al-Gifri			x				x
	<i>Cucumis dipsaceus</i> Ehrenb. ex Spach					x		x
	<i>Cucumis ficifolius</i>					x		x
	A. Rich. (Syn.: <i>C. fegarei</i> Delile ex Naudin)							
	<i>Cucumis melo</i> L. var. <i>agrestis</i> Naudin (Syn.: <i>C. melo</i> L.)					x		x
	<i>Cucumis metuliferus</i>							x
	E. Mey. ex Naudin							
	<i>Cucumis prophetarum</i> L.			x	x	x	x	x
	<i>Cucumis pustulatus</i> Naudin ex Hook.f.			x		x		
Custard apple (<i>Annona squamosa</i> L.)	<i>Annona muricata</i> L.			x				
Datepalm (<i>Phoenix dactylifera</i> L.)	<i>Phoenix caespitosa</i> Chiov.					x		
Dill (<i>Anethum graveolens</i> L.)	<i>Anethum graveolens</i> L. ^a			x			x	
Drumstick (<i>Moringa oleifera</i> Lam.)	<i>Moringa peregrina</i> (Forssk.) Fiori			x		x	x	x

continued

Crop	Species	BHR	KWT	OMN	QAT	SAU	ARE	YEM
Eggplant (<i>Solanum melongena</i> L.)	<i>Solanum albicaule</i> Kotschy ex Dunal					x		
	<i>Solanum anguivi</i> Lam.					x		
	<i>Solanum coagulans</i> Forssk.					x		
	<i>Solanum cordatum</i> Forssk. (Syn.: <i>S. pseudocapsicum</i> L.)			x		x		x
	<i>Solanum diflorum</i> Vell.					x		
	<i>Solanum elaeagnifolium</i> Cav.				x	x		
	<i>Solanum forskalii</i> Dunal					x		x
	<i>Solanum glabratum</i> Dunal					x		x
	<i>Solanum grossedentatum</i> A. Rich. (Syn.: <i>S. nigrum</i> var. <i>grossedentatum</i> (A. Rich.) De Wild.)							x
	<i>Solanum incanum</i> L.			x		x	x	x
	<i>Solanum macranthum</i> Dunal					x	x	
	<i>Solanum nigrum</i> L. (Syn.: <i>S. americanum</i> Mill.)		x	x		x	x	x
	<i>Solanum platananthum</i> Dunal							x
	<i>Solanum schimperianum</i> Hochst.					x		x
	<i>Solanum sepicula</i> Dunal					x		
	<i>Solanum surratense</i> Burm.f. (Syn.: <i>S. virginianum</i> L.)			x		x		x
	<i>Solanum terminale</i> Forssk.					x		x
<i>Solanum villosum</i> Mill.			x	x	x		x	
Fenugreek (<i>Trigonella foenum-graecum</i> L.)	<i>Trigonella anguina</i> Delile				x	x		x
	<i>Trigonella aurantiaca</i> Boiss. (Syn.: <i>Medicago phrygia</i> (Boiss. et Balansa) E. Small)					x		
	<i>Trigonella cylindracea</i> Desv.					x		
	<i>Trigonella glabra</i> Thunb. subsp. <i>uncata</i> (Boiss. et Noe) Lassen					x		
	<i>Trigonella hamosa</i> L. (Syn.: <i>T. glabra</i> Thunb.)	x	x	x	x	x	x	
	<i>Trigonella hamulosa</i> L.			x				
	<i>Trigonella monantha</i> C.A. Mey. (Syn.: <i>Medicago monantha</i> (C.A. Mey.) Trautv.)				x	x		
	<i>Trigonella monspeliaca</i> L. (Syn.: <i>Medicago monspeliaca</i> (L.) Trautv.)					x		
<i>Trigonella stellata</i> Forssk.	x	x	x	x	x	x		
Festue (<i>Festuca</i> spp.)	<i>Festuca cryptantha</i> Cope							x
	<i>Festuca obturbans</i> St.-Yves.							x
	<i>Ficus carica</i> L. ^a	x	x	x	x	x	x	x
Fig (<i>Ficus carica</i> L.)	<i>Ficus palmata</i> Forssk.			x		x		x
	<i>Ficus sycomorus</i> L.			x		x		x
Flax (<i>Linum usitatissimum</i> L.)	<i>Linum bienne</i> Mill.					x		
	<i>Linum corymbulosum</i> Rchb.			x		x		x
	<i>Linum strictum</i> L.				x			x
	<i>Linum trigynum</i> L.					x		x
Garden pea (<i>Pisum sativum</i> L.)	<i>Linum volkensisii</i> Engl.							x
	<i>Pisum sativum</i> L. var. <i>arvense</i> (L.) Asch. et Graebn. (Syn.: <i>P. sativum</i> subsp. <i>sativum</i> L.)					x		

continued

Crop	Species	BHR	KWT	OMN	QAT	SAU	ARE	YEM
Grasspea (<i>Lathyrus sativus</i> L.)	<i>Lathyrus aphaca</i> L.					x		x
	<i>Lathyrus cicera</i> L.					x		
	<i>Lathyrus pratensis</i> L.					x		x
	<i>Lathyrus saxatilis</i> (Vent.) Vis.					x		
Guar (<i>Cyamopsis tetragonoloba</i> (L.) Taubert)	<i>Cyamopsis senegalensis</i> Guill. et Perr.					x		
Horsegram (<i>Macrotyloma uniflorum</i> (Lam.) Verdc.)	<i>Macrotyloma axillare</i> (E. Mey.) Verdc.					x		x
Hyacinth bean (<i>Lablab purpureus</i> (L.) Sweet)	<i>Dolichos trilobus</i> L.					x		x
Indigo (<i>Indigofera tinctoria</i> L.)	<i>Indigofera cordifolia</i> Heyne ex Roth L.			x				
	<i>Indigofera colutea</i> (Burm.f.) Merr.			x		x	x	x
	<i>Indigofera amarphoides</i> Jaub. et Spach					x		
	<i>Indigofera arabica</i> Jaub. et Spach					x	x	x
	<i>Indigofera argentea</i> Burm.f.			x	x	x	x	x
	<i>Indigofera arrecta</i> A. Rich.					x		
	<i>Indigofera articulata</i> Gouan			x	x	x	x	x
	<i>Indigofera coerulea</i> Roxb.			x		x		x
	<i>Indigofera hochstetteri</i> Baker					x		x
	<i>Indigofera insularis</i> Chiov.					x		
	<i>Indigofera intricata</i> Bois Ts.			x	x	x	x	x
	<i>Indigofera linifolia</i> (L.f.) Retz.					x		
	<i>Indigofera nephrocarpa</i> Balf.f.			x				x
	<i>Indigofera oblongifolia</i> Forssk.			x		x		x
	<i>Indigofera schimperi</i> Jaub. et Spach					x		
	<i>Indigofera semitrijuga</i> Forssk.			x		x		x
	<i>Indigofera sessiliflora</i> DC.					x		
	<i>Indigofera spiniflora</i> Boiss					x		
	<i>Indigofera spinosa</i> Forssk.					x		
	<i>Indigofera tinctoria</i> L.					x		
<i>Indigofera trita</i> L.f.			x		x		x	
<i>Indigofera volkensis</i> Taubert			x		x		x	
<i>Indigofera rubromarginata</i> Thulin			x				x	
Ivy gourd (<i>Coccinia indica</i> Wight et Arn.)	<i>Coccinia grandis</i> (L.) Voigt					x		x
Jujube (<i>Ziziphus jujuba</i> Mill.)	<i>Ziziphus glabrata</i> Roxb.					x		
	<i>Ziziphus hajarensis</i> Duling, Ghaz. et Prend.			x				
	<i>Ziziphus leucodermis</i> (Baker) O. Schwartz			x				x
	<i>Ziziphus mauritania</i> Lam. (Syn.: <i>Z. abyssinica</i> Hochst. ex A.Rich.)			x				
	<i>Ziziphus mucronata</i> Willd.					x		
	<i>Ziziphus nummularia</i> (Burm. f.) Wight et Arn.	x		x	x	x		
<i>Ziziphus spina-christi</i> (L.) Willd.	x	x	x	x	x	x	x	

continued

Crop	Species	BHR	KWT	OMN	QAT	SAU	ARE	YEM
Lemongrass (<i>Cymbopogon citratus</i> (DC.) Stapf)	<i>Cymbopogon caesius</i> (Nees) Stapf							x
	<i>Cymbopogon commutatus</i> (Steud.) Stapf					x		x
	<i>Cymbopogon jwarancusa</i> (Jones) Schult.							x
	<i>Cymbopogon schoenanthus</i> (L.) Spreng.					x		x
Lentil (<i>Lens culinaris</i> Medik.)	<i>Lens orientalis</i> (Boiss.) Schmalh. (Syn.: <i>L. culinaris</i> subsp. <i>orientalis</i> (Boiss.) Ponert)					x		
Lettuce (<i>Lactuca sativa</i> L.)	<i>Lactuca inermis</i> Forssk.					x		x
	<i>Lactuca capensis</i> Thunb. (Syn.: <i>L. inermis</i> Forssk.)			x				
	<i>Lactuca dissecta</i> D. Don L.			x		x	x	
	<i>Lactuca serriola</i> L.					x		x
Milkvetch, Cicer (<i>Astragalus</i> spp.)	<i>Astragalus collenettiae</i> Hedge et Podlech					x		
	<i>Astragalus annularis</i> Forssk.	x	x		x	x		
	<i>Astragalus atropilosulus</i> (Hochst.) Bunge					x		x
	<i>Astragalus biabanensis</i> Sirj. et Rech.f. (Syn.: <i>A.</i> <i>squarrosus</i> Bunge)						x	
	<i>Astragalus bombycinus</i> Boiss.		x			x		
	<i>Astragalus caprinus</i> L.					x		
	<i>Astragalus corrugatus</i> Bertol.	x	x	x	x	x	x	
	<i>Astragalus dactylocarpus</i> Boiss.					x		
	<i>Astragalus echinus</i> DC. (Syn.: <i>Astracantha echinus</i> (DC.) Podlech)					x		
	<i>Astragalus eremophilus</i> Boiss.			x	x	x	x	
	<i>Astragalus fasciculifolius</i> Boiss. (Syn.: <i>Tragacantha fasciculifolia</i> (Boiss.) Kuntze)			x		x	x	
	<i>Astragalus fruticosus</i> Forssk.					x		
	<i>Astragalus hamosus</i> L.				x	x		
	<i>Astragalus hauarensis</i> Boiss.	x	x	x	x	x	x	
	<i>Astragalus intercedens</i> Rech.f.					x		
	<i>Astragalus kahiricus</i> DC.					x		
	<i>Astragalus mareoticus</i> Delile					x		
	<i>Astragalus schimperi</i> Boiss.	x	x	x	x	x		
	<i>Astragalus sieberi</i> DC.		x		x	x		x
	<i>Astragalus sinicus</i> L.					x		
<i>Astragalus sparsus</i> Decne.					x		x	
<i>Astragalus spinosus</i> (Forssk.) Muschl.		x			x			
<i>Astragalus squarrosus</i> Bunge							x	
<i>Astragalus termeanus</i> Maassoumi et Podlech				x				
<i>Astragalus trachoniticus</i> Post.						x		
<i>Astragalus tribuloides</i> Delile	x	x	x	x	x	x	x	
<i>Astragalus vogelii</i> (Webb) Bornm.				x		x		
Millet, Barnyard (<i>Echinochloa</i> <i>crusgalli</i> (L.) Beauv.)	<i>Echinochloa colona</i> (L.) Link			x		x		
	<i>Echinochloa frumentacea</i> Link					x		
	<i>Echinochloa pyramidalis</i> (Lam.) Hitchc. et Chase					x		

continued

Crop	Species	BHR	KWT	OMN	QAT	SAU	ARE	YEM
Millet, Broomcorn (<i>Panicum miliaceum</i> L.)	<i>Panicum antidotale</i> Retz.	x	x	x	x	x	x	x
	<i>Panicum atrosanguineum</i> Hochst. ex A. Rich.			x		x		
	<i>Panicum coloratum</i> L.			x		x		
	<i>Panicum repens</i> L.					x		
	<i>Panicum trichoides</i> Sw.			x				
	<i>Panicum turgidum</i> Forssk.	x	x	x	x	x	x	x
Millet, Finger (<i>Eleusine coracana</i> (L.) Gaertn.)	<i>Eleusine compressa</i> (Forssk.) Asch. et Schweinf. ex C. Chr. (Syn.: <i>Ochthochloa compressa</i> (Forssk.) Hilu)	x						
	<i>Eleusine floccifolia</i> Spreng.							x
	<i>Eleusine multiflora</i> Hochst. ex A. Rich.					x		x
Millet, Foxtail (<i>Setaria italica</i> (L.) P. Beauv.)	<i>Setaria intermedia</i> Roem. et Schult.			x				
	<i>Setaria plicatilis</i> (Lam.) T. Cooke					x		
	<i>Setaria pumila</i> (Poir.) Roem. et Schult.			x			x	x
	<i>Setaria sagittifolia</i> (A. Rich.) Walp.							x
	<i>Setaria sphacelata</i> (Schumach.) Stapf et C.E.Hubb. ex Moss							x
	<i>Setaria verticillata</i> (L.) P. Beauv.	x	x	x		x	x	x
Mint (<i>Mentha spicata</i> L.)	<i>Setaria viridis</i> (L.) P. Beauv.		x	x			x	
	<i>Mentha longifolia</i> (L.) L.			x		x		
Oat (<i>Avena sativa</i> L.)	<i>Avena abyssinica</i> Hochst.					x		x
	<i>Avena barbata</i> Pott ex Link		x	x			x	
	<i>Avena byzantina</i> K. Koch L.					x		
	<i>Avena fatua</i> L.			x		x	x	x
	<i>Avena sterilis</i> L.				x	x		x
	<i>Avena ventricosa</i> Balansa					x		
Okra (<i>Abelmoschus esculentus</i> (L.) Moench)	<i>Abelmoschus manihot</i> (L.) Medik.			x				
Olive (<i>Olea europaea</i> L.)	<i>Olea europaea</i> L. subsp. <i>cuspidata</i> (Wall. et G. Don) Cif.			x		x	x	
Onion, Garlic (<i>Allium</i> spp.)	<i>Allium alibile</i> A. Rich.					x		
	<i>Allium ampeloprasum</i> L.					x		
	<i>Allium asirensense</i> B. Mathew					x		
	<i>Allium atrovioleaceum</i> Boiss.					x		
	<i>Allium dictyoprasum</i> C.A. Mey. ex Kunth					x		
	<i>Allium pseudocalyptatum</i> Mouterde					x		
	<i>Allium rothii</i> Zucc.					x		
	<i>Allium sinaiticum</i> Boiss.					x		
	<i>Allium sindjarensense</i> Boiss. et Hausskn. ex Regel		x			x		
	<i>Allium sphaerocephalon</i> L.		x					
	<i>Allium stamineum</i> Boiss.					x		
<i>Allium venicolor</i> Wendelbo					x			

continued

Crop	Species	BHR	KWT	OMN	QAT	SAU	ARE	YEM
Pearl millet (<i>Pennisetum galucum</i> (L.) R. Br.	<i>Cenchrus ciliaris</i> L. (Syn.: <i>Pennisetum ciliare</i> (L.) Link)		x	x	x	x	x	x
	<i>Cenchrus pennisetiformis</i> Steud. (Syn.: <i>Pennisetum pennisetiforme</i> (Hochst. ex Steud.) Wipff)			x	x	x	x	x
	<i>Cenchrus setigerus</i> Vahl (Syn.: <i>Pennisetum ciliare</i> (L.) Link. var. <i>setigerum</i> (Vahl) Leeke)		x	x	x	x	x	x
	<i>Pennisetum divisum</i> (Forssk. ex J.F. Gmel.) Henrard	x		x	x	x	x	x
	<i>Pennisetum macrourum</i> Trin.					x		x
	<i>Pennisetum nubicum</i> (Hochst.) K. Schum. ex Engl.					x		
	<i>Pennisetum orientale</i> Rich.			x		x	x	
	<i>Pennisetum purpureum</i> Schumach.			x				
	<i>Pennisetum setaceum</i> (Forssk.) Chiov.			x	x	x	x	x
	<i>Pennisetum siberianum</i> (Schldtl.) Stapf et C.E. Hubb.						x	
	<i>Pennisetum stramineum</i> Peter							x
	<i>Pennisetum thunbergii</i> Kunth							x
	<i>Pennisetum unisetum</i> (Nees) Benth.							x
<i>Pennisetum villosum</i> Fresen.							x	
Pistachio (<i>Pistacia vera</i> L.)	<i>Pistacia falcata</i> Beccari ex Mart.					x		
	<i>Pistacia khinjuk</i> Stocks					x	x	
Poppy (<i>Papaver somniferum</i> L.)	<i>Papaver dubium</i> L. subsp. <i>laevigatum</i> (M. Bieb.) Kadereit			x		x		
	<i>Papaver decaisnei</i> Hochst. et Steud. ex Elkan			x			x	
Purselane (<i>Portulaca oleraceae</i> L.)	<i>Portulaca dhofarica</i> Gilbert			x		x		
	<i>Portulaca oleracea</i> L. ^a	x	x	x	x	x	x	x
	<i>Portulaca quadrifida</i> L.	x		x		x		x
Quinoa (<i>Chenopodium quinoa</i> L.)	<i>Chenopodium botrys</i> L.					x		x
	<i>Chenopodium carinatum</i> R. Br.					x		
	<i>Chenopodium fasciculosum</i> Aellen					x		x
	<i>Chenopodium ficifolium</i> Smith					x		
	<i>Chenopodium glaucum</i> L.	x	x			x		
	<i>Chenopodium opulifolium</i> Schrader ex W. Koch et Ziz		x			x		x
	<i>Chenopodium procerum</i> Hochst. ex Moq.							x
	<i>Chenopodium schraderianum</i> Schultes					x		x
	<i>Chenopodium album</i> L.		x	x		x		x
	<i>Chenopodium ambrosioides</i> L.					x		x
	<i>Chenopodium murale</i> L.	x	x	x	x	x	x	x
<i>Chenopodium pratericola</i> Rydb. (Syn.: <i>C. desiccatum</i> (Moq.) Standl. var. <i>leptophylloides</i> (Muirr.) Wahl)					x			
<i>Chenopodium vulvaria</i> L.			x		x		x	
Radish (<i>Raphanus sativus</i> L.)	<i>Raphanus raphanistrum</i> L.	x		x		x		x

continued

Crop	Species	BHR	KWT	OMN	QAT	SAU	ARE	YEM
Rigged gourd (<i>Luffa acutangula</i> (L.) Roxb.)	<i>Luffa forsskalii</i> Schweinf. ex Harms (Syn.: <i>L. acutangula</i> (L.) Roxb.)							x
Ryegrass (<i>Lolium perenne</i> L.)	<i>Lolium multiflorum</i> Lam.		x			x		x
	<i>Lolium persicum</i> Boiss. et Hohen.					x		
	<i>Lolium rigidum</i> Gaudich.		x			x	x	
	<i>Lolium temulentum</i> L.		x			x		x
Safflower (<i>Carthamus tinctorius</i> L.)	<i>Carthamus lanatus</i> L.					x		
	<i>Carthamus nitidus</i> Boiss.					x		
	<i>Carthamus oxyacanthus</i> M. Bieb.		x			x	x	
	<i>Carthamus persicus</i> Desf. ex Willd.					x		
Sainfoin (<i>Onobrychis viciifolia</i> Scop.)	<i>Onobrychis ptolemaica</i> (Delile) DC.					x		x
Salt bush (<i>Atriplex halimus</i> L.)	<i>Atriplex halimus</i> L. ^a					x		
	<i>Atriplex leucoclada</i> Boiss. var. <i>inamoena</i> (Allen) Zoh.	x	x	x		x	x	x
	<i>Atriplex leucoclada</i> var. <i>turcomanica</i> (Moq.) Zoh.	x	x		x	x	x	x
	<i>Atriplex semibaccata</i> R. Br.					x		
	<i>Atriplex suberecta</i> Verd.					x		
	<i>Atriplex dimorphostegia</i> Kar. et Kir.		x			x		
	<i>Atriplex farinosa</i> Forssk.			x		x		x
	<i>Atriplex stockii</i> Boiss.			x		x		x
	<i>Atriplex tatarica</i> L.					x	x	
Saltwort (<i>Salsola vermiculata</i> L.)	<i>Salsola arabica</i> Botsch.					x		
	<i>Salsola cyclophylla</i> Baker	x	x	x	x	x	x	x
	<i>Salsola drummondii</i> Ulbr.			x	x	x	x	
	<i>Salsola imbricata</i> Forssk.	x	x	x	x	x	x	x
	<i>Salsola inermis</i> Forssk.					x		
	<i>Salsola jordanicola</i> Eig		x			x		
	<i>Salsola kali</i> L.					x		x
	<i>Salsola lachnantha</i> (Botsch.) Botsch.					x		
	<i>Salsola omanensis</i> Boulos			x				
	<i>Salsola rubescens</i> Franchet			x			x	x
	<i>Salsola schweinfurthii</i> Solms-Laub.			x		x		
	<i>Salsola spinescens</i> Moq.			x	x	x		x
	<i>Salsola tetrandra</i> Forssk.					x		
	<i>Salsola villosa</i> Schultes				x	x		
	<i>Salsola volkensis</i> Asch. et Schweinf. (Syn: <i>S. incanescens</i> C.A. Mey.)					x		
Sesbania (<i>Sesbania sesban</i> (L.) Merr.)	<i>Sesbania leptocarpa</i> DC.					x		x
	<i>Sesbania pachycarpa</i> DC.							x
Sorghum (<i>Sorghum bicolor</i> (L.) Moench)	<i>Sorghum arundinaceum</i> (Desv.) Stapf				x			
	<i>Sorghum halepense</i> (L.) Pers.		x	x	x		x	
	<i>Sorghum versicolor</i> Andersson			x				
	<i>Sorghum 7x drummondii</i> (Steud.) Millsp. et Chase				x	x		

continued

Crop	Species	BHR	KWT	OMN	QAT	SAU	ARE	YEM
Sorrel (<i>Rumex acetosa</i> L.)	<i>Rumex conglomeratus</i> Murr.			x		x		
	<i>Rumex crispus</i> L.					x		
	<i>Rumex cyprius</i> Murb.				x	x		
	<i>Rumex dentatus</i> L.			x	x	x	x	x
	<i>Rumex limoniastrum</i> Jaub. et Spach			x				
	<i>Rumex nervosus</i> Vahl.					x		
	<i>Rumex pictus</i> Forssk.					x		
	<i>Rumex steudelii</i> Hochst. ex A. Rich.					x		
Soybean (<i>Glycine max</i> (L.) Merr.)	<i>Rumex vesicarius</i> L.	x	x	x	x	x	x	x
	<i>Glycine wightii</i> (Wight et Arn.) Verdc. subsp. <i>longicauda</i> Schweinf. Syn.: <i>Neonotonia wightii</i> subsp. <i>wightii</i> (Wight et Arn.) J.A. Lackey)					x		
Stylo (<i>Stylosanthes</i> spp.)	<i>Stylosanthes fruticosa</i> (Retz.) Alston					x		x
Sugar beet (<i>Beta vulgaris</i> L.)	<i>Beta vulgaris</i> L. subsp. <i>maritima</i> (L.) Arcang. (Syn.: <i>B. vulgaris</i> L.)	x	x	x	x	x	x	x
Sugarcane (<i>Saccharum officinarum</i> L.)	<i>Saccharum griffithii</i> Munro ex Benth.			x				
	<i>Saccharum ravennae</i> (L.) L.			x		x	x	x
	<i>Saccharum spontaneum</i> L.			x		x		x
Sunhemp (<i>Crotalaria juncea</i> L.)	<i>Crotalaria aegyptiaca</i> Benth.			x		x	x	x
	<i>Crotalaria deflersii</i> Schweinf.							x
	<i>Crotalaria emarginella</i> Vatke					x		x
	<i>Crotalaria impressa</i> Walp.							x
	<i>Crotalaria incana</i> L. (Syn.: <i>C. hirta</i> Lag.)					x		x
	<i>Crotalaria leptocarpa</i> Balf.f.			x		x		
	<i>Crotalaria medicagenia</i> Lam.			x				
	<i>Crotalaria microphylla</i> M. Vahl					x		x
	<i>Crotalaria mucronata</i> Desv.					x		
	<i>Crotalaria natalitia</i> Meissner							x
	<i>Crotalaria oocarpa</i> Baker							x
	<i>Crotalaria persica</i> (Burm.f.) Merr.			x		x		
	<i>Crotalaria plowdenii</i> Baker							x
	<i>Crotalaria pteropoda</i> Balf.f.			x				
	<i>Crotalaria pycnostachya</i> Benth.					x		x
	<i>Crotalaria quartiniana</i> A. Rich.					x		x
<i>Crotalaria retusa</i> L.			x		x		x	
<i>Crotalaria saltiana</i> Andrews			x					
<i>Crotalaria senegalensis</i> (Pers.) DC.					x		x	
<i>Crotalaria squamigera</i> Deflers							x	

continued

Crop	Species	BHR	KWT	OMN	QAT	SAU	ARE	YEM
Sweet potato (<i>Ipomoea batatas</i> (L.) Lam.)	<i>Ipomoea eriocarpa</i> R. Br.			x		x		
	<i>Ipomoea aitonii</i> Lindley			x				
	<i>Ipomoea aquatica</i> Forssk.			x		x		
	<i>Ipomoea cairica</i> (L.) Sweet			x				
	<i>Ipomoea hochstetteri</i> House						x	
	<i>Ipomoea nil</i> (L.) Roth L.			x				
	<i>Ipomoea obscura</i> (L.) Ker-Gawl.			x		x		
	<i>Ipomoea palmata</i> Forssk.			x				
	<i>Ipomoea pes-caprae</i> (L.) R. Br.			x				
	<i>Ipomoea sinensis</i> (Desr.) Choisy			x			x	
	<i>Ipomoea triflora</i> Forssk.						x	
Tobacco (<i>Nicotiana tabacum</i> L.)	<i>Nicotiana plumbaginifolia</i> Viv.							x
Trefoil (<i>Lotus</i> spp.)	<i>Lotus arabicus</i> L.						x	
	<i>Lotus corniculatus</i> L. var. <i>eremanthus</i> Chiov. (Syn.: <i>L. schoelleri</i> Schweinf.)						x	x
	<i>Lotus garcinii</i> DC.	x		x	x	x	x	
	<i>Lotus gebelia</i> Vent.						x	
	<i>Lotus glinoides</i> Delile	x			x	x	x	
	<i>Lotus goetzei</i> Harms						x	
	<i>Lotus halophilus</i> Boiss. et Spruner	x	x	x	x	x	x	
	<i>Lotus laticus</i> Rech.f.			x				x
	<i>Lotus platycarpus</i> Viv. (Syn.: <i>Lotononis platycarpa</i> (Viv.) Pic. Serm.)						x	
	<i>Lotus quinatus</i> (Forssk.) J.B. Gillett						x	x
	<i>Lotus schimperi</i> Steud. ex Boiss.			x		x		
Vetch, common (<i>Vicia sativa</i> L.)	<i>Vicia monantha</i> Retz.	x			x	x	x	
	<i>Vicia peregrina</i> L.					x		
	<i>Vicia sativa</i> L. ^a		x	x		x		
	<i>Vicia sativa</i> subsp. <i>nigra</i> (L.) Ehrh.					x		
	<i>Vicia villosa</i> Roth							x
Water melon (<i>Citrullus lanatus</i> (Thunb.) Matsum. et Nakai)	<i>Citrullus colocynthis</i> (L.) Schrad.		x	x	x	x	x	x
	<i>Citrullus lanatus</i> (Thunb.) Matsum. et Nakai			x		x		
Wheat (<i>Triticum aestivum</i> L.)	<i>Aegilops bicornis</i> (Forssk.) Jaub. et Spach		x					
	<i>Aegilops kotschy</i> Boiss.		x			x		
	<i>Aegilops peregrina</i> (Hack.) Maire et Weiller					x		
	<i>Aegilops triuncialis</i> L.		x					
	<i>Aegilops vavilovii</i> (Zhuk.) Chennav.					x		

BHR Bahrain, KWT Kuwait, OMN Oman, SAU Saudi Arabia, ARE United Arab Emirates, YEM Yemen

^a Weedy form or escape from cultivation

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