第17卷第4期 生 态 学 报 Vol. 17, No. 4
1997年7月 ACTA ECOLOGICA SINICA Jul., 1997

中国 C_4 植物的地理分布与生态学研究*

Ⅰ. 中国 C_4 植物及其与气候环境的关系

殷立娟[1] 李美荣[2]
([1]东北师范大学,国家草地生态工程实验室,长春,130024)
([2]Department of Botany, University of Toronto, Toronto, Ontario, Canada, M5S 3B2)

摘要 通过调查记录了中国533种40变种和3亚种具有 C_4 光合作用的植物和8种 C_3～C_4 中间植物。它们隶属于160属24科,其中46属97种、8变种和1亚种隶属于双子叶植物,114属436种、32变种和2亚种隶属于单子叶植物。C_4 植物主要属于禾本科(96属324种、32变种和2亚种),莎草科(14属108种),藜科(13属37种、7变种和1亚种)和苋科(3属16种1亚种)。根据中国的湿度气候(寒温带,冷温带,中湿带,暖湿带,亚热带和边缘热带)和大气水分状况(极干旱,干旱,半干旱,半湿润,季节性干旱和湿润)将中国除了南海诸岛以外的地理区域划为7个区和12个亚区,并总结出中国 C_4 种的地理与气候分布区。C_4 植物种数(尤其是禾本科和莎草科)随着大气温度与水分增高而增加。然而,藜科的 C_4 植物种数随着大气温度与水分增高而减少。调查结果表明中国 C_4 植物具有广阔的地理分布特点,在寒温带也有一定数量的分布。

关键词:C_4 光合作用,地理分布,温度,降水,生态学。

A STUDY ON THE GEOGRAPHIC DISTRIBUTION AND ECOLOGY OF C_4 PLANTS IN CHINA

Ⅰ. C_4 PLANT DISTRIBUTION IN CHINA AND THEIR RELATION WITH REGIONAL CLIMATIC CONDITION

Yin Lijuan[1] Li Meirong[2]
([1]National Laboratory of Grassland Engineering, Northeast Normal University, Changchun, 130024, China)
([2]Department of Botany, University of Toronto, Toronto, Ontario, Canada, M5S 3B2)

Abstract In this report, a survey is presented of plants with C_4 photosyntnesis in China. We have recorded 533 C_4 species, 40 varieties, 3 subspecies and 8 C_3～C_4 intermediate species. These species belong to 160 genera and 24 families. Among them, 97 species, 8 varieties and 1 subspecies in 46 genera are from the Dicotyledoneae and 436 species, 32 varieties and 2 subspecies in 114 genera from the Monocotyledoneae. Most of C_4 plants belong to Poaceae (96 genera, 324 species, 32 varieties and 2 subspecies), Cyperaceae (14 genera

* 本文为国家自然科学基金资助项目(NO. 39270506)。
承蒙 Dr. Mike Jones (Department of Botany, Trinity College Dublin, Dublin 2, Ireland)审阅,谨此深表谢意。
收稿日期:1994-08-30,修改稿收到日期:1996-06-10。

and 108 species), Chenopodiaceae (13 genera, 37 species, 7 varieties and 1 subspecies) and Amaranthaceae (3 genera, 16 species and 1 subspecies). We divide the geographic regions of China, except small islands in the South China Sea, into seven regions and fourteen subregions according to the temperature conditions (frigid temperate, cold temperate, cool temperate, warm temperate, subtropical and marginally tropical) and the atmospheric water (very arid, arid, semi-arid, semi-humid, seasonal arid and humid). The number of C_4 species increases with the increase of atmospheric temperature and humidity, especially in Poaceae and Cyperaceae. However, the number of C_4 species in Chenopodiaceae decreases with increase of atmospheric temperature and humidity. The results of the survey show a wide geographic distribution of C_4 plants and demonstrated the distribution of some C_4 species in arid and frigid temperate regions in China.

Key words: C_4 photosynthesis, ecology, geographic distribution, precipitation, temperature.

中国具有 960 万 km^2 的面积，覆盖了亚洲的四分之一，具有丰富的自然资源，其中草原植物就有约 4000 种[1]。C_4 植物因其高光效、高生物产量而被人们视为重要的开发资源[2]。目前，据已有的报告，世界上已经发现了约 1700 种 C_4 光合作用植物，隶属于 290 属 22 科，并发现在 30 多种植物中具有 C_3～C_4 中间型[3~4]。关于中国的 C_4 植物也有报告。林植芳和郭俊彦[5]发现了 123 种分布在广东省的 C_4 光合作用植物。殷立娟和祝玲[6,7]鉴定了 55 种发生在东北草原区的 C_4 植物。最近作者进一步对东北草原植物中的光合作用途径作了全面调查[8]。然而，就全国而言这些仅仅是初步的研究。到目前为止，中国究竟拥有多少种 C_4 光合作用植物，仍然是一个未知数。当代科学的发展不仅在于了解多少种和哪些种具有 C_4 光合作用途径，还要求进一步探讨它们的分布与生态学意义。通过 C_3 和 C_4 植物的比较，例如对于北美洲[9]、澳大利亚[10]、日本[11]和阿根廷[12]的禾本科植物的比较，表明温度是决定 C_4 光合作用途径是否发生的关键气候变量。对欧洲和北美洲的 C_3 和 C_4 莎草植物的研究[13,14]也表明同一趋势。Takeda[15]曾经对于印度次大陆的 C_4 禾本科植物的地理分布作了研究，认为 C_4 禾本科植物分布与水分条件也有密切关系。本文的目的是比较全面地了解目前已经报告的中国植物中哪些具有 C_4 光合作用途径，并且分析这些种的地理分布及其与中国温度和大气水分条件的关系。

中国位于欧亚大陆东部，太平洋西岸，季风气候特征显著，气候资源丰富。中国疆域辽阔，南北跨纬度约 50°，东西跨经度约 62°。其间由北向南依温度变化有寒温带，中温带，暖温带，亚热带和热带之分；由东南向西北按水分条件又有湿润，亚湿润，季节性干旱，半干旱和干旱之别[16]。这些气候资源是对于 C_4 光合作用的地理分布特点作全面分析的有利条件。此研究试图为发掘中国植物资源和深入研究光合作用生理生态提供依据。

1 材料与方法

收集迄今已发表的中国植物志，地方植物志，以及地方植物调查名录，参照已经报告的 C_4 植物名录进行一一核对，从而编出分布在中国的 C_4 植物的名录。然后对每一种 C_4 植物的行政区域分布进行调查。在此基础上，根据中国的大气温度和水分条件，对每一种 C_4 植物的地理分布及其所处的气候分区进行分析与鉴定。以大气的温度和水分变化为基础，将中国除了南海诸岛以外的地理区域划分为 7 个区和 12 个亚区，进而分析中国气候分区与 C_4 光合作用植物分布的关系。因为 C_4 植物分布在不同的分类群中，还着重分析包含 C_4 植物较多的禾本科，莎草科和藜科。对于这些科中的 C_4 植物在各地区中的分布数量与大气温度(年平均气温和年生长积温)和大气水分(年降水量和年干燥度)之间的关系进行比较分析。收集的数据用统计软件包 Microsoft Excel v. 5. 0 (Microsoft Corp.)作统计分析，然后输入绘图软件包 Cricket Graphics v. 1. 3. 2 (Cricket Software)作图。

2 结果与讨论

2.1 中国的气候与地理分析

温度和水分是影响植物的生长和地理分布的两个最重要的生态因子。中国南北温度相差值较大，在东半部大致自南向北随着纬度增加，其年平均温度逐渐降低。参考侯学煜[17]，盛承禹[18]和赵国藏[16]的论述，本文将中国除了南海诸岛之外的温度气候划分为寒温带，冷温带，中温带，暖温带，亚热带和南亚热带及边缘热带等6个区域(表1)。中国的大气水分状况因距离海岸远近不同而发生变化。根据中国各地的降水量，结合各季节分配的情况，并且参考中国年干燥度的状况[16]，将中国自西北向东南顺序划分为极干旱，干旱，半干旱，半湿润，季节性干旱和湿润等6个区域(表2)。综合中国的温度和水分状况的特点(表1和表2)，将中国除了南海诸岛以外的地理区域划分为7个区和12个亚区(表3)。黑龙江北部，内蒙古北部，西藏，青海和川西属于最寒冷区。天山山脉以北的新疆北部为冷温带；温度变化的代表带在东经110～125°之间，由东北往南温度逐渐升高。海南岛，广东南部，广西南部，云南南部，台湾南部和闽南是最热最湿润的地区。中国水分状况变化的代表带在北纬35～45°之间。新疆西部和南部，西藏北部，青海北部，内蒙古南部和甘肃北部则属于极干旱区域；由此向东干旱程度逐渐减弱。

表1 中国温度区域的地理分布

Table 1 Geographic distribution of temperature in China

温度带(编号) Temperature zone(code)	地理分布 Geographic distribution	年生长积温(>10℃) Annual sum temperature	年均温(℃) Annual average temperature
寒温带(T1)	大兴安岭北部，	1100～1700	−2.2～−5.5
	北纬27～40°的青藏高原。	1000～1500	−4.0～0
冷温带(T2)	新疆北部(天山山脉以北)。	1000～2000	0～4
中温带(T3)	沈阳以北的松辽平原和东北南部，	1600～3200	2～8
	燕山山脉和阴山山脉以北的内蒙古高原。		
暖温带(T4)	辽东半岛，华北平原，黄土高原，	3200～4500	8～14
	河西走廊，以及南疆一带。		
亚热带(T5)	从北回归线以北到北纬35°，	4500～6500	14～21
	包括南岭以北到秦岭淮河以南一带。		
南亚热带及	南岭山脉以南，包括滇，桂，粤，	6500～9000	20～26
边缘热带(T6)	闽，台的南部以及海南和西藏的东南缘。	或>9000	

表2 按年降水量和干燥度划分的水分区域的地理分布

Table 2 Geographic distribution of humidity zones according to annual precipitation and aridity

水分区域(编号) Humidity zone(code)	地理分布 Geographic distribution	年降水量(mm) Annual precipitation	年干燥度 Annual aridity
极干旱区(H1)	塔里木盆地，东疆，柴达木盆地	20～150	>16.0
	以及昆仑山北坡的西藏西北一带。		
干旱区(H2)	阿拉善及其东部，河西走廊东部，	100～250	4.0～16.0
	和准葛尔盆地，西藏中部和北部。		
半干旱区(H3)	内蒙古西北部，鄂尔多斯黄土高原，	200～450	2.0～4.0
	西北部，青藏高原中部，羌塘高原。		
半湿润区(H4)	东北平原，内蒙古高原东部，	400～750	1.0～1.5
	黄土高原东南部及青藏高原东部和中部。		
季节性干旱(H5)	东北东部，华北，云南高原，	500～1000	1.0～1.5
	和川西高原。		
湿润区(H6)	长江中下游，四川盆地，江南丘陵，	1000～2000	<1.0
	浙闽山地，粤，桂，台和海南。		

2.2 中国 C_4 植物及其分布

本文收集了迄今为止已经发表的资料，结合近年来作者的鉴定工作，总结出全国各地的具有 C_4 光合作用的植物共533种40变种和3亚种，和 C_3～C_4 中间植物8种，隶属于160属24科(表4)。其中双子叶植物46属97种8变种和1亚种，单子叶植物114属436种32变种和2亚种。C_4 植物主要分布在禾本科(96属324种32变种和2亚种)，莎草科(14属108种)，藜科(13属37种7变种和1亚种)和苋科(3属16种1亚种)。表4列出了每一个 C_4 种所处的分布区域，其中有33种分布于全国各区。C_4 种的分布数量从中国的西北向东南，自干冷往湿热，平行于中国东海岸线呈递增趋势。自半湿润区(H4)到湿润区(H5和H6)，随着温度升高(T1～T6)，C_4 种分布数量增加3倍以上。自暖温带区(T4)到南亚热带区(T6)，随着水分增加(H1～H6)，C_4 种分布数量增加近2倍。气候区的面积大小对 C_4 植物分布的影响不显著，中国的寒冷和干旱气候区(T1H4，T2H5，T4H1，T4H2)面积较大，主要包括中国北部及西藏地区，其 C_4 种数为76～121(表3)，而中国的温湿气候区(T5H5，T6H6)面积相对较小，主要包括中国的南部，其 C_4 种数为327～354(表3)。所以，大气温度和水分条件是影响中国 C_4 植物分布的重要因子。禾本科和莎草科的 C_4 植物在不同区域的分布数量和中国总的 C_4 植物种数之间有显著的正相关(图1)，表明这两科的 C_4 植物分布能反映中国总的 C_4 植物的生态分布特点。

2.3 C_4 植物分布的生态学意义

中国的 C_4 植物有13.3%～14.3%分布在寒温带(T1)区，从冷到热 C_4 植物分布种数随着温度的增加而增加(表3)。在中亚热带区(T5H5)的 C_4 植物数量最多，占全国 C_4 植物总数的61.1%，而发生在南亚热带或边缘热带[16](T6H6)区的 C_4 植物减少为56.8%(表3)，这表明中亚热带的温度气候可能最适合于 C_4 植物的生长。分析还表明禾本科和莎草科中的 C_4 植物种数在中国各地的分布与大气温度之间极为密切(图2)，随着大气温度上升而增加，该结果与他人报告的在澳大利亚[10]、日本[11]、欧洲[13]和北美洲[14,15,9]的工作相一致。大气水分状况对 C_4 植物的分布也有影响。例如，在暖温带区(T4)，C_4 植物的发生在极干旱(H1)，干旱区(H2)，半干旱区(H3)和半湿润区(H4)的数量分别占全国总数的21.2%，20.2%，26.3%和30.7%。禾本科和莎草科中的 C_4 种分布百分比随着大气水分增加而相应上升(图3)。该结果与Takeda[15]报告的在印度次大陆的 C_4 禾草分布百分比与年降水量呈显著负相关的结论不一致。这可能是由于中国土地广阔而且地理环境变化较大，涉及多个温度带和不同的水分区域，因而气候变化较复杂。藜科的 C_4 植物分布百分比则随着大气温度和水分增加而呈减少趋势(图2和图3)。由此看来，C_4 藜科植物在干旱和低温条件下比 C_4 禾本科和莎草科植物在地理分布方面都具有优势。

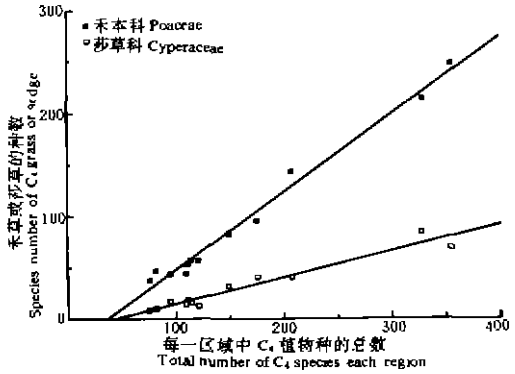

图1　在各气候亚区中的禾本科和莎草科 C_4 植物种数与各亚区中 C_4 植物总数的关系

其直线方程分别为：y(禾本科 C_4 植物数)$=-27.97+0.756x$(全部 C_4 植物种数)($r=0.985$)和 y(莎草科 C_4 植物种数)$=-11.91+0.26x$(全部 C_4 植物种数)($r=0.945$)

Fig 1　The relationships between the numer of C_4 species in grass and sedge families and total number of C_4 species in each climatic subregion

The formulas for the linear relationships are: y(C_4 grass species)$=-27.97+0.756x$(total C_4 species) ($r=0.985$) and y(C_4 sedge species)$=-11.91+0.261x$(total C_4 species)($r=0.945$)

C_4 植物具有比 C_3 植物高的水分利用效率(叶片在日间每蒸腾一摩尔水所同化的二氧化碳毫摩尔数)和氮素利用效率(单位面积或质量叶片每摩尔氮每秒钟所同化的二氧化碳微摩尔数)。这是它们具有广泛生态分布的生理学基础[13,20～23]。无论从种类还是从数量看，中国是 C_4 植物资源最为丰富的国家之一[2]。这可能是由于我国自然条件变化范围大和生态类型较复杂[16～18]。有些 C_4 植物不仅能分布在非常干旱的H1和H2区，并且也能分布在极为寒冷的T1和T2区(表

3和表4)。例如,有14.3%的C_4植物分布在高寒的青藏高原,有13.3%的C_4植物分布在东北平原北部,19.2%的C_4植物分布在新疆的北部。这类植物资源不仅能用于研究植物抗性和生态进化,也是人们进行植物资源开发和利用的可贵材料。

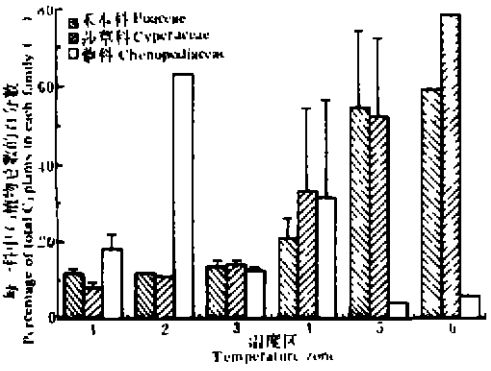

图2 温度(T)对于禾本科、莎草科和藜科中C_4植物在各区中分布的影响
(竖线分别表示在不同地理区域中同一温度带中的C_4植物(表3)平均数的标准离差)

Fig. 2 The effect of temperature (T) on the distribution of C_4 plants in Poaceae, Cyperaceae and Chenopodiaceae
(The vertical lines represent the standard deviations, see Table 3 for details)

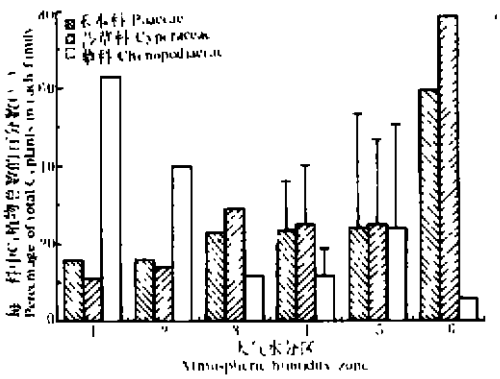

图3 大气水分(H)对于禾本科、莎草科和藜科中C_4植物在各区中分布的影响
(竖线分别表示在不同地理区域中同一水分带中的C_4植物(表3)平均数的标准离差)

Fig. 3 The effect of atmospheric humidity (H) on the distribution of C_4 plants in Poaceae, Cyperaceae and Chenopodiaceae
(The vertical lines represnt one standard deviation, see Table 3 for details)

表3 根据温度和水分带划分的中国各地理区域及各区中的C_4植物种分布数

Table 3 Geographic location in China according to the zones of temperature and atmospheric humidity, and the number of C_4 species distribtued in each region

区域编号 Region code	温度 Temperature	水分 Water	地理位置 Geographic location	C_4种分布数 Number of C_4 species
1	T1	H5	黑龙江北部和内蒙古北部	82
2	T1	H4	西藏,青海和川西	76
3	T2	H5	新疆北部(天山山脉以北)	110
4-1	T3	H4	黑龙江及其和内蒙古临近地区	95
4-2	T3	H5	吉林及其和内蒙古临近地区	111
5-1	T4	H1	疆西和疆南,藏北,青海北部,内蒙古西部和甘肃北部	121
5-2	T4	H2	宁夏,甘肃南部,晋北和内蒙古西南部	115
6-1	T4	H3	晋南,陕西和豫西	150
6-2	T4	H4	冀,辽,鲁和皖北	176
7-1	T5	H4	黄河和长江之间、皖南,苏北和鄂北	208
7-2	T5	H5	四川,湘,鄂南,赣,闽中、闽北,苏南,粤北、桂,滇和西藏东地缘	354
7-3	T6	H6	滇南,桂南,粤中,粤南,闽南,台湾南部和海南岛	327

表4　中国的C4植物及其地理分布

Table 4　C4 plants in China and their geographical distribution

植物种类 Taxon	分布区域 Region of distribution	植物种类 Taxon	分布区域 Region of distribution
DICOTYLEDONEAE:		*Kochia iranica* Litv. ex Boriss	T4H1
Ranunculaceae:		*Kochia prostrata*(L.)Schrad.	T1H4, T1H5, T2H5, T4H1, T4H2, T4H3
Thalictrum squarrosum Steph	T3H4, T3H5, T1H5		
(2)Berberidaceae:		*Kochia prostrata*(L.)Schrad. var. *canescens*Moq.	T1H4, T2H5, T4H1, T4H2
Leontice microrrhyncha Moore	T3H4, T3H5, T1H5		
(3)Caryophyllaceae:		*Kochia prostrata*(L.)Schrad.	
Dianthus amurensis Jacq.	T3H4, T3H5, T1H5	var. *villosissima*Bong. et Mey.	T2H5
Polycarpaea corymbosa(L.)Lam	T5H4, T5H5, T3T4, T3T5	*Kochia scoparia*(L.)Schrad.	All over China
(4)Portulaceae:		*Kochia scoparia*(L.)Schrad. ver. *sieversiana*(Pall.)Uibr. ex Asch. et Gr.	T1H4, T1H5, T2H5, T3H5, T4H1, T4H2, T4H3
Portulaca grandiflora Hook.	All over China		
Portulaca oleracea L.	All over China		
Portulaca pilosa L.	T5H5, T6H6	*Kochia sieversiana*(Pall.)C. A. Mey.	T1H5, T2H5, T4H2, T4H4
Portulaca quadrifida L.	T5H5, T6H6		
(5)Nyctaginaceae:		*Salsola brachiata* Pall.	T2H5, T4H1
Boerhavia diffusa L.	T5H5, T6H6	*Salsola collina* Pall.	All over China
(6)Chenopodiaceae:		*Salsola tenata* Pall.	T2H5
Aellenia glauca(Bieb)Aellen	T2H5, T4H1	*Salsola laricifolia* Turcz. ex Litv.	T4H1, T4H2
Agriophyllum squarrosum(L.)Moq.	T1H5, T1H4, T3H5, T4H1, T4H2	*Salsola orientalis* Gmel.	T2H5, T4H1, T4H2
		Salsola paulsenii Litv.	T2H5, T4H1, T4H2
Anabasis aphylla L.	T2H5, T4H1	*Salsola pellucida* Litv.	T2H5, T4H1, T4H2
*Anabasis brevifolia*C. A. Mey.	T2H5, T4H1, T4H2	*Salsola praecox* Litv.	T2H5, T4H1
Anabasis salsa(C. A. Mey). Benth. ex Volk	T2H5	*Suaeda acuminata*(C. A. Mey.)Moq.	T2H5, T4H1
Atriplex centralasiatica Iljin	T1H4, T1H5, T2H5, T3H4, T3H5, T4H1, T4H2	*Suaeda altissima*(L.)Pall.	T2H5, T4H1
		Suaeda dendroides(C. A. Mey.)Moq.	T2H5, T4H1
(1变种)			
Atriplex dimorphostegia Kar. et Kir.	T2H5	*Suaeda monoica* Forsk.	T6H6
(1变种)		(7)Amaranthaceae:	
Atriplex laevis C. A. Mey	T4H1, T2H5	*Alternanthera bettzichiana*(Regel)Nichol	All over China
Atriplex mammularia Lindl.	T4H2, T4H4	*Alternanthera pungens* H. B. K.	T5H5, T6H6
Atriplex sibirica L.	T3H4, T3H5, T4H3, T4H2	*Amaranthus albus* L.	T1H5, T2H5, T3H4, T3H5, T4H1, T4H2, T4H3, T4H4
Atriplex tatarica L.	T2H5, T4H1, T4H2		
(1变种)		*Amaranthus blitoides* Watson	T4H1, T4H4, T5H4, T3H4, T3H5, T2H5
Bassia hyssopifolia(Pall)Aschers	T2H5, T4H1, T4H2		
Bassia dasyphylla(Fisch)Ktze.	T1H4, T1H5, T2H5, T3H4, T3H5, T4H1, T4H2, T4H3, T4H4	*Amaranthus caudatus* L.	All over China
		Amaranthus hybridus L.	T4H2, T4H3, T4H4, T5H4, T5H5
Camphorosma monspeliaca L.	T5H5-T4H1	*Amaranthus hypochondriacus* L.	T4H4, T4H2, T4H3, T5H4, T5H5
(1亚种)			
Gingensohnia oppositiflora(Pall)Beg.	T4H1, T4H2	*Amaranthus lividus* L.	T3H4, T3H5, T4H3, T4H4, T5H4, T5H5, T2H5, T6H6
Halimocnemis villosa Kar. et Kir.	T2H5	*Amaranthus paniculatus* L.	All over China
Halogeton glomeratus(Bieb.)C. A. Mey.	T1H4, T2H5, T4H1	*Amaranthus retroflexus*L.	T1H4, T1H5, T2H5, T3H4, T3H5, T4H1, T4H2, T4H3, T4H4
Halogeton glomeratus(Bieb.)C. A. Mey.		*Amaranthus retroflexus* L.	
var. *tibeticus*(Bge.)Grubov	T1H4, T2H5, T4H1	var. *delilei*(Richter et Loret)Thell.	T4H3, T4H4
Halogeton tibeticus(Bge.)Grubov.	T1H4, T4H1		
Haloxylon ammodendron(C. A. Mey). Bge.	T4H2	*Amaranthus spinosus* L.	T4H2, T4H3, T4H4, T5H4, T5H5
Haloxylon persicum Bge. ex Boiss et Buhse	T4H1, T4H2	*Amaranthus tricolor* L.	All over China
		Amaranthus viridis L.	T4H1, T4H2, T4H4, T5H5

续表 4

植物种类 Taxon	分布区域 Region of distribution	植物种类 Taxon	分布区域 Region of distribution
Gomphrena clostoides Mart.	H6H6	*Serratula yamatsutana* Kitag. (C_3～C_4)	T3H4,T3H5
Gomphrena globosa L.	All over China	(16)Solanaceae:	
(8)*Polygonaceae*:		*Siphonostegia chinesis* Benth.	T3H4,T3H5,T1H5,T5H5
Calligonum arborescens Litv.	T2H5	(17)Umbelliferae:	
Calligonum caput-medusae Schren.	T2H5	*Sanicula rubriflora* Fr. Schmidt.	T3H4,T3H5,T1H5
		Saussurea japonica(Thunb.)D.C.	T4H4
Calligonum junceum (Fisch. et Ney)	T2H5	(18)Primulaceae:	
		Glaux maritima L. (C_3～C_4)	T4H3,T4H4
Calligonum leucocladum(Schrenk) Bge.	T2H5	(19)Convolvulaceae:	
		Evolvulus alsinoides L.	T5H4,T5H5,T6H6
(9)Euphorbiaceae:		(20)Boraginaceae:	
Euphorbia atoto Forst. f.	T5H5,T6H6	*Heliotropium marifolium* Retz.	T5H5,T6H6
Euphorbia hirta L.	T5H5,T6H6	MONOCOTYLEDONEAE	
Euphorbia humifusa Willd.	T5H5	(1)Liliaceae:	
Euphorbia maculata L.	T5H5,T4H4,T4H3	*Allium macrostemon* Bge.	T1H4, T3H5, T4H1, T4H2, T4H3,T4H4,T5H4
Euphorbia serrulata Engelm.	T5H5,T6H6		
Euphorbia thymifolia L.	T5H5,T6H6,T4H3,T4H4	*Scilla thunbergii* Miyabe et Kudo	T1H5, T3H4, T3H5, T4H4, T6H6,T2H5
Euphorbia terracalli L.	T4H3,T4H4		
(10)Zygophyllaceae:		(2)Hydrocharitaceae:	
Tribulus cistoides L. (C_3-C_4)	T5H5,T6H6	*Hydrilla verticillata*(L. f.)Royle	All over China
Tribulus terrestris L.	All over China	*Vallisneria spiralis* succ. nov L.	T5H4,T5H5,T6H6
(11)Geraniaceae:		(3)Cyperaceae:	
Erodium stephanianum Willd.	T4H2, T4H4, T5H4, T5H5, T1H5	*Bulbostylis barbata*(Rottb.)Kunth	T4H4,T5H4,T5H5
		Bulbostylis capillaris(L.)Nees	T3H4,T3H5,T4H4,T5H5
Oxytropis filiformis D.C.	T1H5,T3H4,T3H5	*Bulbostylis densa* (Wall.) Hand-Mazz	T1H4, T4H4, T5H4, T5H5, T6H6
(12)Polygalaceae:			
Polygala tenuifolia Willd.	T3H4,T3H5	*Carex leiorhyncha* C. A. Mey.	T1H5, T3H4, T3H5, T4H1, T4H2,T4H3,TH4H
(13)Leguminosae.			
Thermopsis lanceolata R. Br.	T3H4,T3H5	*Carex pediformis* C. A. Mey.	T1H5,T3H4,T3H5,T5H4
(14)Rosaceae:		*Cyperus amuricus* Steud.	All over China
		Cyperus brevifolius Bockl.	T4H3,T4H4,T5H5,T6H6
Potentilla anserina L. (C_3～C_4)	T3H4,T3H5	*Cyperus compressus* L.	T3H4, T3H5, T4H2, T4H3, T4H4,T5H4,T5H5,T6H6
Potentilla filipendula Willd. (C_3～C_4)	T3H4,T3H5	*Cyperus cuspidatus* Kunth	T5H4,T5H5,T6H6
		Cyperus dense-spicatus Dhwi	T5H5,T6H6
(15)Compositae:		*Cyperus digitatus* Rexb.	T5H5,T6H6
Artemisia sieversiana Nakai	All over China	*Cyperus distans* L. f.	T6H6
Artemisia vestita Wallich.	T1H5, T4H1, T4H2, T4H3, T4H4,T5H5	*Cyperus elusinoides* Kunth	T5H5,T6H6
		Cyperus eragrostis Willd.	T4H3,T4H4,T5H5,T6H6
Filifolium sibiricum Kitam. (C_3～C_4)	T3H4, T3H5, T4H1, T4H2, T4H3,T4H4	*Cyperus esculentus* Vahl	T2H5, T4H1, T4H3, T4H4, T5H5,T6H6
Glossogyne tenuifolia Cass	T6H6	*Cyperus exaltatus* Retz.	T4H4,T5H4,T5H5,T6H6
Hypochaeris grandiflora Ledeb.	T1H5, T3H4, T3H5, T4H3, T4H4	*Cyperus flabelliformis* Rottb.	T4H3,T4H4,T5H5,T6H6
		Cyperus flavidus Retz.	T5H4
Leontopodium leontopodioides Beauv. (C_3～C_4)	T1H4, T3H5, T4H2, T4H3, T4H4	*Cyperus globosus* auct.	T2H5, T3H5, T4H1, T4H3, T4H4,T5H4,T5H5
Lipocarpha microcephala(R. Br.) Kunth	T4H3,T4H4	*Cyperus glomeratus* L.	T2H5, T4H1, T4H2, T4H3, T4H4, T3H4, T5H4, T5H5, T6H6
Lxeris sonchifolia Hance	T3H5,T4H1,T4H3,T4H4		
Parthenium hysterophorus L.	T5H4,T5H5,T6H6	*Cyperus imbricatus* Retz.	T6H6
Saussurea japonica (Thunb.) D. C.	T3H5, T4H1, T4H2, T4H3, T4H4,T5H4,T5H5	*Cyperus iria* L.	T1H5, T2H5, T3H5, T4H1, T4H3,T4H4,T5H4,T5H5
Senecio integrifolius(L.)Clar.	T1H4,T5H5,T4H3,T4H4	*Cyperus javanicus* Houtt.	T6H6
		Cyperus latifolius Poir.	T5H5,T6H6

续表 4

植物种类 Taxon	分布区域 Region of distribution
Cyperus laxiflorus L. K. Dai	T5H5, T6H6
Cyperus leiorhyncha C. A. Mey.	T4H3, T4H4
Cyperus longibracteatus Dai	T1H5, T3H4, T3H5
Cyperus malaccensis Lam.	T5H5, T6H6
Cyperus michelianus(L.)Link	T4H3, T4H4, T5H4, T5H5, T6H6
Cyperus microaria Steud.	All over China
Cyperus nipponicus Franch.	T4H2, T4H3, T4H4, T5H4, T5H5
Cyperus natans Vahl	T5H5, T6H6
Cyperus orthostachyus Franch.	T4H4, T5H4, T5H5, T6H6
Cyperus pallescens Husnet.	T4H3
Cyperus pangorei Rottb.	T6H6
Cyperus pannonicus Jacq.	T2H5, T3H5, T4H1, T4H2, T4H3, T4H4
Cyperus pediformus C. A. Mey.	T4H3, T4H4
Cyperus pilosus Vahl	T5H4, T5H5, T6H6
Cyperus polystachys Rottb.	T6H6
Cyperus pygmaeus Rottb.	T5H4, T5H5, T6H6
Cyperus radians Nees	T6H6
Cyperus rotundus L.	T2H5, T4H1, T4H2, T4H3, T4H4, T5H4, T5H5, T6H6
Cyperus sanguinolentus Vahl	T4H3, T4H4, T5H5, T6H6
Cyperus serotinus Rottb.	T2H5, T4H3, T4H4, T5H5
Cyperus stoloniferus Retz.	T6H6
Cyperus szechuanensis Koyama	T5H5, T6H6
Cyperus tenuiculmis Boeckl.	T5H5, T6H6
Cyperus tenuifolius(Steud.)Dandy	T5H5, T6H6
Cyperus tuberosus Rottb.	T5H5, T6H6
Eleocharis acicularis(L.)R. & S. (C_3~C_4)	T4H1, T4H2, T3H5, T5H5, T6H6
Fimbristylis aestivalis(Retz.)Vahl	T5H4, T5H5, T6H6
Fimbristylis annua (All.)Roem.	T4H3, T4H4, T5H5
Fimbristylis autumnalis (L.) Roevo.	T4H4
Fimbristylis bisumbellata(Forsk.) Bub.	T2H5, T4H3, T4H4, T5H4, T5H5, T6H6
Fimbristylis complanata (Retz.) Link	T1H4, T4H4, T5H4, T5H5, T6H6
Fimbristylis cymosa(Lam.)B. Br.	T5H4
Fimbristylis dichotoma(L.) Vahl	T3H4, T3H5, T4H2, T4H3, T4H4, T5H4, T5H5, T6H6, T2H5
Fimbristylis diphylloides Makino	T5H4, T5H5
Fimbristylis dispacea Benth.	T6H6
Fimberistylis ferruginea Hook.	T4H4, T5H4, T6H6
Fimbristylis fimbristyloides(F. V. M.)Druce	T5H4
Fimbristylis globulosa Kunth	T6H6
Fimbristylis littoralis Gaudich	T5H5, T6H6
Fimbristylis miliacea(L.) Vahl	T3H4, T3H5, T4H2, T4H3, T4H4, T5H5, T6H6
Fimbristylis monostachya(L.) Hassk	T5H4, T5H5, T6H6
Fimbristylis nutans Vahl	T6H6
Fimbristylis ovata (Burm. f.) Kern.	T5H5, T6H6
Fimbristylis pauciflora R. Br.	T6H6
Fimbristylis pierotii Miq.	T5H4, T5H5, T6H6
Fimbristylis polytrichoides Vahl	T6H6
Fimbristylis quinquangularis (Vahl)Kuoth	T1H4, T5H4, T5H5, T6H6
Fimbristylis schoenoids (Retz.) Vahl	T5H5, T6H6
Fimbristylis sepacea	T6H6
Fimbristylis sericea(Poir.)R. Br.	T5H5, T6H6
Fimbristylis sieboldii Miq.	T5H4
Fimbristylis squarrosa Vahl	T1H4, T4H4, T5H4, T5H5, T6H6
Fimbristylis staunionii Deb. et Fr.	T4H2, T4H3, T4H4, T3H4, T3H5, T5H4
Fimbristylis tetragona R. Br.	T6H6
Fimbristylis tristachya R. Br.	T6H6
Ixeris sonchifolia Hauce	T4H3, T4H4
Kyllinga brevifolia Rottb.	T4H3, T4H4, T5H4, T5H5, T6H6
Kyllinga cororata(L.)Druce	T5H5, T6H6
Kyllinga cylindrica Nees	T5H5, T6H6
Kyllinga melanosperma Nees	T6H6
Kylinga monocephala Rottb.	T4H3, T4H4, T5H5, T6H6
Kyllinga pumila Tang	T5H5, T6H6
Kyllinga odorata Liebm.	T6H6
Kyllinga triceps L.	T6H6
Lapocarpha chinensis Tang	T1H5, T3H4, T3H5, T4H4, T5H4, T5H5, T6H6
Lapocarpha microcephala(R. Br.). Kunth	All over China
Mariscus compactus(Retz.)Druce	T5H5, T6H6
Mariscus cyperinus Vahl	T5H5, T6H6
Mariscus dubius Vahl	T6H6
Mariscus janamcus Houtt.	T5H5, T6H6
Mariscus macrostachys Boeklr.	T5H5, T6H6
Mariscus sieberianus Nees	T5H5, T6H6
Mariscus sumatrensis (Retz.) Koyama	T1H4, T5H4
Pycreus flavidus(Retz.)Koyama	T1H4, T5H4, T6H6
Pycreus globosus(All.)Reicht.	T1H4, T2H5, T3H4, T3H5, T4H2, T4H3, T4H4, T5H4, T5H5, T6H6
Pycreus polystachyos (Rottb.) Beauv.	T4H4, T6H6

续表 4

植物种类 Taxon	分布区域 Region of distribution	植物种类 Taxon	分布区域 Region of distribution
Pycreus pumilus(L.)Domin	T5H5,T6H6	*Arundinella setosa* Trin. var. *esetosa* Bor	T5H5,T6H6
Pycreus sanguinolentus(Vahl)Nees	T2H5, T5H4, T5H5, T6H6, T3H4, T3H5, T4H1, T4H2, T4H3,T4H4	*Arundinella setosa* Trin. var. *tangchongensis* Sun ex Hu et Chen	T5H5
Pycreus unioloides R. Br.	T5H5	*GAxonopus affinis* A. Chase	T6H6
Remirea maritima Aubl.	T6H6	*Axonopus compressus*(Sw.)Beauv.	T6H6
Rhynchospora corymbosa (L.) Britt.	T5H5,T6H6	*Bothriochloa glabra* (Roxb.) A. Camus	T5H5,T6H6
Rhynchospora rubra(Lour)Makino	T5H4,T5H5,T6H6	*Bothriochloa intermedia* (R. Br.) A. Camus	T4H1,T5H4,T5H5,T6H6
Scirpus lateriflorus J. F. Gmel.	T5H5,T6H6	*Bothriochloa ischaemum*(L.)Keng	T1H5, T4H1, T4H3, T4H4, T5H4,T5H5
Torulinium ferax Rich.	T5H5,T6H6	*Bothriochloa parviflorum*	T4H3,T4H4
(4)Poaceae:		*Bothriochloa pertusa*(L.)	T4H1,T5H4,T5H5,T6H6
Achnatherum avinoides (Honda) Chang	T1H5,T3H4,T3H5	*Bouteloua curtipendula* (Michx.) Torr.	All over China
Achnatherum splendens (Trin.) Nevski	T1H4, T1H5, T4H1, T4H4, T5H4,T5H5	*Bouteloua gracilis*(HBK) Lag. ex Steud.	T5H5,T6H6
Achnatherum chingii (Hitchc.) Keng ex Kuo	T4H1	*Brachiaria eruciformis* (Smith) Griseb.	T5H5,T6H6
Acrachne racemosa(H. & R. & S.) Ohwi	T6H6	*Brachiaria mutica*(Forsk.)Stapf	T5H5,T6H6
Aeluropus lagopoides(L.)Trin.	T6H6	*Brachiaria ramosa*(L.)Stapf	T6H6
Aeluropus pilosus(Yang)Chen et Yang	T4H1,T4H3,T4H4	*Brsachiaria semiundulata* (Hochst.)Stapf	T6H6
Aeluropus pungens (Bieb.) C. Koch.	T4H1,T4H3,T4H4	*Brachiaria subquadripara* (Trin.) Hitchc.	T5H5
Aeluropus pungens (Bieb.) C. Koch. var. *hirtulus* Cheng et Yang	T4H1,T4H3,T4H4	*Brachiaria subquadripara* (Trin.) Hitchc. var. *miliiformis* (Presl) Chen et Jin	T6H6
Aeluropus sinensis(Debeaux) Tzvel.	T4H2,T4H4,T5H4,T5H5	*Brachiaria subquadripara* (Trin.) Hitchc. var. *setulosa* Chen et Jin	T6H6
Allotropsis cimicina(L.)Stapf	T6H6	*Brachiaria urochloaoides* Chen et Jin	T6H6
Allotropsis semialata (R. Br.) Hitchc.	T5H4,T6H6	*Brachiaria villosa*(Lam.)A. Camus	T5H4,T5H5,T6H6
Allotropsis semialata (R. Br.) Hitchc. ver. *echloniana* (Nees) C. E. Hubb.	T5H4,T6H6	*Brachiaria villosa* (Lam.) Camus var. *barbata* Bor	T5H5
Andropogon brevifolius Sw.	T1H4,T5H4,T6H6	*Brachiaria villosa* (Lam.) A. Camus var. *glabrata* Chen et Jin	T5H5
Andropogon citratus Thumb.	T5H4,T6H6	*Buchloe dactyloides* (Nutt.) Engelm.	All over China
Apluda mutica L.	T5H5,T6H6	*Caplillepedium parviflorum* (R. Br.)Stapf	T3H4, T3H5, T4H3, T4H4, T5H4,T5H5
Aristida adscensionis L.	T2H5, T3H4, T3H5, T4H2, T4H3,T4H4,T5H4	*Cenchrus calyculatus* Cavan.	T4H4
Aristida pennata Trin.	T2H5,T4H1	*Cenchrus echinatus* L.	T6H6
Arthraxon hispidus(Thumb.) Makino	T2H5, T4H1, T4H4, T5H4, T5H5,T6H6	*Chloris anomosa* Sun et Hu	T6H6
Arundinella anomala Steud.	T4H3,T4H4,T5H4,T5H5	*Chloris barbata* Sw.	T6H6
Arundinella bengalensis (Spreng.) Druce	T5H5,T6H6	*Chloris formosana*(Honda)Keng	T5H5
Arundinella hirta (Thunb.) Tanaka	T1H5, T3H4, T3H5, T4H2, T4H3, T4H4, T5H4, T5H5, T6H6	*Chloris gayana* Kunth	All over China
Arundinella nepalensis Trin.	T5H5,T6H6	*Chloris virgata* Sw.	All over China
Arundinella setosa Trin.	T5H5,T6H6	*Chrysopogon aciculatus* (Retz.) Trin.	T6H6
		Clausiogenes chinensis(Max.)Keng	T4H2,T4H3,T4H4

续表 4

植物种类 Taxon	分布区域 Region of distribution	植物种类 Taxon	分布区域 Region of distribution
Cleistogenes squarrosa (Trin.) Keng	T1H5, T2H5, T3H4, T3H5, T4H1, T4H2, T4H3, T4H4, T5H4	*Digitaria stricta* Roth ex Poem. et Schult.	T5H5
Coix lachryma-jobi L.	T2H5, T4H1, T4H3, T4H4, T5H4, T6H6	*Digitaria ternata* (Hochst.) Stapf et Dyer	T5H5
Crypsis aculeata (L.) Ait.	T1H5, T3H4, T3H5, T4H2, T4H3, T4H4	*Digitaria thwaitesii* (Hack.) Henr.	T6H6
Crypsis schoenoides (L.) Lam.	T2H5, T4H1, T4H2, T4H3, T4H4, T5H4	*Digitaria vinlascens* Link	T2H5, T4H1, T5H4, T5H5, T6H6
Cymbopogon caesius Stapf	T6H6	*Dimeria ornithopoda* Trin.	T5H4, T5H5, T6H6
Cymbopogon citratus (DC) Stapf	T6H6, T5H4	*Dinebra retroflexa* (Vahl) Panz.	T6H6
Cymbopogon jwarancusa (Jones) Schult.	T1H4, T5H4	*Diplachne fasca* (L.) Beauv.	T3H5, T4H3, T4H4, T5H4, T5H5, T6H6
Cymbopogon nardus (L.) Rendle	T6H6	*Eccoilopus cotulifer* (Thunb.) A. Camus	T5H5, T5H4
Cymbopogon tortilis (Presl) A. Camus	T6H6, T5H4	*Echinochlha caudata* Roshev.	T3H4, T3H5, T1H5, T4H3, T4H4, T5H4
Cynodon arcuatus Presl et Presl	T6H6	*Echinochlna colonum* (L.) Link	T5H4, T5H5, T6H6, T2H5, T4H1, T4H3, T4H4
Cynodon dactylon (L.) Pers.	T4H3, T4H4, T5H4, T5H5, T6H6	*Echinochloa crusgalli* (L.) Beauv.	T1H4, T2H5, T4H3, T4H4, T5H4, T5H5, T6H6, T3H4H5, T4H2
Cynodon dactylon (L.) Pers. var. *biflorus* Meriuo	T5H5	*Echinochloa crusgalli* (L.) Beauv. var. *austro-japonensis* Ohwi	T5H4, T5H5
Dactyloctenium aegyptium Beauv.	T6H6	*Echinochloa crusgalli* (L.) Beauv. var. *brevista* (Doell.) Neilr.	T5H5, T6H6
Dismostachya bipinnata (L.) Stapf	T6H6	*Echinochloa crusgalli* (L.) Beauv. var. *mitis* (Pursh) Peterm.	T3H4, T3H5, T4H2, T4H3, T4H4, T5H4, T5H5, T6H6
Dechanthium annulatum (Forsk.) Stapf	T5H4, T5H5, T6H6	*Echinochloa crusgalli* (L.) Beauv. var. *praticola* Ohwi	T5H4, T5H5
Digitaria abludens (Roem. et Schult.) Vedlk.	T5H4, T5H5, T6H6	*Echinochloa crusgalli* (L.) Beauv. var. *zelaymsis* (H. B. K.) Hitchc.	T4H2, T4H3, T4H4, T5H4, T5H5, T6H6
Digitaria bicornis (Lam.) Roem. et Schult.	T5H5, T6H6	*Echinochloa cruspavonis* (HBK) Schult.	T5H5, T6H6
Digitaria chrysoblephara Fig. et De Not.	T1H5, T3H4, T3H5, T4H2, T4H3, T4H4, T5H4	*Echinochloa frumentacea* (Roxb.) Link	All over China
Digitaria ciliaris (Rotz.) Koel.	All over China	*Echinochloa glabrescens* Munro ex Hook. f.	T3H4, T3H5, T4H2, T4H3, T4H4, T5H4, T5H5
Digitaria cruciata (Nees) A. Camus	T1H4, T5H5	*Echinochloa hispidula* (Retz.) Chang	T4H3, T4H4, T5H4, T5H5
Digitaria denudata Link	T1H4, T5H5	*Echinochloa oryzoides* (Ard.) Fritsch.	T2H5, T5H4, T5H5, T6H6
Digitaria fibrosa (Hack.) Stapf	T5H5, T6H6	*Echinochloa phyllopogon* (Stapf) Koss	T5H5
Digitaria fibrosa (Hack.) Stapf var. yunnanensis (Henr.) L. Liou	T5H5	*Echinochloa utilis* Ohwi et Yabuno	T5H5
Digitaria glabrescens (Bor) Liou	T6H6	*Eleusine coracana* (L.) Gaertn.	All over China
Digitaria hangduanensis Liou	T5H5	*Eleusine indica* (L.) Gaertn.	All over China
Digitaria henryi Rendle	T5H5	*Elymus nutans* Griseb.	T1H4, T3H5, T4H1, T4H2, T5H4, T5H5
Digitaria heterantha (Hook) Mer	T5H5, T5H6	*Elymus sibiricus* L.	T1H4, T1H5, T3H4, T3H5, T4H1, T4H2, T4H3
Digitaria ischaemum (Schreb.) Schreb.	T1H4, T5H4, T5H5, T4H3, T4H4, T6H6, T2H5	*Elytrophorus spicatus* A. Camus	T6H6
Digitaria jubata (Griseb.) Henr.	T5H5	*Enneapogon borealis* (Griseb.) Honda	T3H5, T4H1, T4H2, T4H3, T5H4
Digitaria longiflora (Retz.) Pers.	T5H5, T6H6	*Enneapogon brachystachyum* (J. & S.) Stapf	T3H5, T4H1, T4H2, T4H3, T4H4
Digitaria microbachem (Presl) Hitchc.	T5H5, T6H6		
Digitaria mollicoma (Kunth) Henr.	T5H5		
Digitaria radicosa (Presl) Miq.	T5H5, T6H6		
Digitaria sanguinalis (L.) Scop.	All over China		
Digitaria setigera Roth ex Roem. et Schult.	T6H6		
Digitaria stewartiana Bor.	T1H4, T4H1		

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植物种类 Taxon	分布区域 Region of distribution
Enneapogon dolichostachyus (Lag.)Keng	T6H6
Enneapogon unrispiceus (Muell.) Clayt.	T6H6
Eragrostis alta Keng	T6H6
Eragrostis atrovirense (Desf.) Trin. et Steud.	T5H5,T6H6
Eragrostis autumalis Keng	T4H3,T4H4,T5H4,T5H5
Eragrostis bulbilifera Setud.	T5H4,T5H5,T6H6
Eragrostis charis(Schult.) Hitchc	T5H5,T6H6
Eragrostis cilanensis(All.)Link ex Vig.	All over China
Eragrostis ciliata(Roxb.)Nees	T5H5,T6H6
Eragrostis curvula(Schrad.)Nees	T5H5,T6H6
Eragrostis cylindrica(Roxb.)Nees	T5H5,T6H6
Eragrostis dielsii Pilg. ex Diels.	T5H5,T6H6
Eragrostis diplachnoides Steud.	T6H6
Eragrostis fauriei Ohwi	T5H5,T6H6
Eragrostis ferruginea (Thunb.) Beauv.	T1H4, T4H3, T4H4, T5H4, T5H5,T6H6
Eragrostis fractus Sun et Wang	T6H6
Eragrostis guangxiensis Sun et Wang	T5H5,T6H6
Eragrostis hainanensis Chia.	T6H6
Eragrostis japonica (Thunb.) Trin.	T5H5,T6H6
Eragrostis longispicula Sun et Wang	T6H6
Eragrostis maeei Hack.	T5H5
Eragrostis mexicanan Link	T5H5,T6H6
Eragrostis minor Host.	All over China
Eragrostis nerrsii Hance	T5H5,T6H6
Eragrostis nrgro Nees ex Steud.	T4H2,T4H3,T5H4,T5H5
Eragrostis untans (Retz.)Nees	T5H5,T6H6
Eragrostis perennans Keng	T5H5,T6H6
Eragrostis perlaxa (L.)Beauv.	T5H5,T6H6
Eragrostis pilosa (L.)Beauv.	All over China
Eragrostis Pilosa (L.)Beauv. var. *imberbis* Franch.	T1H5, T3H4, T3H5, T4H2, T4H3,T4H4,T5H4,T5H5
Eragrostis pilosissima Link	T5H5,T6H6
Eragrostis poaeoides Beauv.	All over China
Eragrostis pulchra Sun et Wang	T6H6
Eragrostis reflexa Hack.	T5H5,T6H6
Eragrostis rufiecrva Chia.	T6H6
Eragrostis tenella(L.)B. R. S	T5H4,T5H5,T6H6
Eragrostis unidoides (Retz.)Nees	T5H4,T5H5,T6H6
Eragrostis zeylanica Nees et Mey.	T5H4,T5H5,T6H6
Eremochloa ophiuroids (Munro) Hack.	T5H4,T5H5,T6H6
Eriachne pallescens R. Br.	T5H5,T6H6
Eriochloa procera (Retz.)Hubb.	T6H6
Eriochloa villosa (Thunb.)Kunth	T3H4, T3H5, T4H3, T4H4, T5H4,T5H5,T6H6
Eulalia contorta Keng	T5H4,T6H6
Eulalia phatothrix (Hack.)Ktze.	T5H4,T6H6
Eulalia quadrinervis (Hack.) Ktze.	T5H4
Eulalia speciosa (Debeaux)Ktze.	T4H1,T5H4,T6H6
Eulaliopis binata (Retz.) C. E. Hubb.	T5H4,T5H5,T6H6,T4H2
Eustachys tener(Presl)A. Camus	T5H5,T6H6
Garnotia caespitosa Santos	T5H5,T6H6
Garnotia ciliata Merr.	T5H5
Garnotia ciliata Merr. var. *conduplicata* Santos	T5H5
Garnotia decumbens Keng	T5H5
Garnotia fragilis Santos	T5H5
Garnotia maxima Santos	T6H6
Garnotia mutica(Munro)Druce	T5H5,T6H6
Garnotia patula(Munro)Benth.	T5H5,T6H6
Garnotia patula(Munro)Benth. var. *grandior* Santos	T5H5,T6H6
Garnotia tenuis Keng	T5H5
Garnotia triseta Hitchc.	T5H5
Garnotia triseta Hitchc. var. *decumbens* Keng	T5H5,T6H6
Gynandropsis gynandra (Lam.) Merr.	T5H5
Hackelochloa granularis (L.) Ktze.	T5H4,T5H5,T6H6
Harpachne harpachnoides (Hack.)Keng	T5H5
Helictotrichon tibeticum (Roshev.)Holub.	T1H4,T4H1
Hemarthria altissima(Poir.)Stapf	T4H3,T4H4,T5H4,T5H5
Hemarthria compressa (L. f.) R. Br.	T2H5, T3H5, T4H1, T4H2, T5H4
Hemarthria japonica(Hack.) Roshev.	T2H5,T4H4,T5H5
Hemarthria sibirica(Gaud.)Ohwi	T1H5,T2H5,T3H4,T3H5
Heteropogon contorus(L.)Beauv.	T1H4, T4H2, T5H4, T5H5, T6H6
Hierochloe glabra Trin.	T1H4,T3H5,T4H3
Hierochloe odorata(L.)Beauv.	T3H5, T4H1, T4H2, T4H3, T4H4,T5H5,T6H6
Imperata arundinacea Hok.	T5H4,T5H5,T6H6
Imperata cylindrica(L.)Beauv.	All over China
Isachne dispar Trin.	T5H4,T5H5,T6H6
Ischaemum anthephoroides (Steud.)Miq	T4H4,T5H4,T5H5,T6H6
Ischaemum aristatum L.	T4H4,T5H4,T5H5,T6H6
Ischaemum ciliare Retz.	T5H4,T5H5,T6H6
Ischaemum laxum R. Br.	T5H5,T6H6
Leptochloa chinensis (L.)Nees	T5H4,T5H5,T6H6
Leptochloa repens (G. Forst.) R. Br	T6H6
Leptaloma fujianensis Liou.	T5H5
Lepturus repens (G. Forst.)R. Br.	T5H5,T6H6

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植物种类 Taxon	分布区域 Region of distribution
Melinis minutiflora Beauv.	T5H5, T6H6
Microchloa indica (L. f.) Beauv	T5H4
Microchloa indica (L. f.) Beauv. var. *kunthii* (Desv.) Sun et Hu	T5H5, T6H6
Microstegium vimineum (Trin.) A. Camus	T4H4, T5H4, T5H5, T6H6
Miscanthus floridulus (Labill.) Warb	T5H4, T5H5
Miscanthus sacchariflorus (Maxim.) Hack.	T4H3, T4H5, T4H4, T3H4, T3H5, T1H5, T5H5, T5H4
Miscanthus sinensis Anderss	T5H4, T5H5, T6H6, T4H4, T2H5
Muhlenbergia cuticularistata (Ohwi) Ohwi	T3H5, T4H5, T4H4
Muhlenbergia hakonensis (Hack.) Makino	T5H4, T5H5, T6H6
Muhlenbergia himalayensis Hack. ex Hook.	T5H5, T6H6
Muhlenbergia ramosa (Hack.) Makino	T5H5
Muhlenbergia hugelii Trin	T4H3, T4H4, T5H4, T5H5, T6H6, T1H5
Muhlenbergia japonica Steud.	T4H2, T4H3, T4H4, T5H4, T5H5
Ophiurus cochinchinensis (Lour.) Merr.	T5H5, T6H6
Ophiurus exaltatus (L.) Kuntze	T5H5, T6H6
Orinus anomala Keng ex Keng et Liou	T5H5
Orinus kokonorica (Hao) Keng	T4H1
Orinus thoroldii (Stapf ex Hemsl.) Bor.	T1H4
Panicum dichotomiflorum Michx.	T5H5
Panicum maximum Jacq.	T4H4, T5H5, T6H6
Panicum miliaceum L.	T1H4, T2H5, T4H1, T4H3, T4H4, T5H4, T5H5, T6H6
Panicum notatum Retz.	T5H5, T6H6
Panicum psilopodium Trin	T5H5
Panicum repens L.	T5H4, T5H5, T6H6
Panicum turgidum L.	T5H5, T6H6
Paspalidium flavidum (Retz.) A. Camus	T5H5, T6H6
Paspalidium punctatum (Burm f.) A. Camus	T5H5, T6H6
Paspalum ciliatifolium Trin.	T5H5, T6H6
Paspalum commersonii Tam. Illoster	T5H5, T6H6
Paspalum conjugatum Bergius	T5H5, T6H6
Paspalum delavayi Henr.	T5H5
Paspalum dilatatum Poir.	T5H5, T6H6
Paspalum fimbriatum HBK	T5H5, T6H6
Paspalum formosanum Honda	T5H5, T6H6
Paspalum longifolium Roxb.	T6H6
Paspalum malacophyllum Trin.	T4H2
Paspalum notatum Flugge	T4H2, T4H3, T4H4
Paspalum orbiculare G. Forst	T5H4, T5H5, T6H6
Paspalum paspalodes (Michx.) Scribn.	T5H4, T5H5, T6H6
Paspalum plicatulum Michx.	T4H2, T4H3
Paspalum plicatum Pers.	T4H2, T4H3
Paspalum scrobiculatum L.	T5H5, T6H6
Paspalum thunbergii Kunth ex Steud	T5H4, T5H5, T6H6
Paspalum urvillei Steud.	T6H6
Paspalum vaginatum Sw.	T5H5, T6H6
Paspalum virgatum L.	T6H6
Pennisetum alopecuroides (L.) Spreng	T3H4, T3H5, T4H2, T4H3, T4H4, T5H4, T5H5, T6H6
Pennisetum americanum (L.) Leeke	T4H3, T4H4
Pennisetum centrasiaticum Tzvel.	T1H5, T3H4, T3H5, T4H2, T4H3, T5H4, T5H5
Pennisetum centrasiaticum Tzvel. var. *lanpingense* Chen et Jin	T5H5
Pennisetum cladestinum Hochst. ex Chiov	T6H6
Pennisetum lanatum Klotz.	T1H4
Pennisetum longissimum Chen et Jin	T4H2, T5H4, T5H5
Pennisetum longissimum Chen et Jin var. *intermedium* Chen et Jin	T4H2, T5H4, T5H5
Pennisetum purpureum Schum.	T5H5, T6H6
Pennisetum qiannigense Zhong	T5H5
Pennisetum setosum (Sw.) Rich.	T6H6
Pennisetum shaanxiense Chen et Jin	T4H1, T4H2
Pennisetum sichuanense Chen et Jin	T5H5
Perotis hordeiformis Ness	T4H4, T5H4, T5H5, T6H6
Perotis indica (L.) Kteze	T4H3, T4H4, T5H4, T5H5, T6H6
Perotis major Haack	T5H4, T5H5, T6H6
Phacelurus latifolius (Steud.) Ohwi	T4H4, T5H4, T5H5, T6H6
Phaenosperma globosa Munro ex Benth.	T1H4, T4H1, T4H2, T4H3, T4H4, T5H5
Pogonatherum crinitum (Thunb.) Kunth	T5H4, T5H5
Pogonatherum paniceum Hack.	T5H5, T6H6
Pseudoraphis longipaleacea Chia.	T6H6
Pseudoraphis spinescens (R. Br.) Vickery	T5H5, T6H6
Pseudoraphis spinescens (R. Br.) Vickery var. *depauperata* (Nees) Bor	T5H5
Rhynchelytrum repens (Willd.) C. E. Hubb.	T5H5, T6H6
Roegneria grandiglumis Keng	T5H4
Roegneria kokonorica Keng	T1H4, T4H1, T4H2, T5H4
Rottboellia exaltata L. f.	T5H5, T6H6
Rottboellia laevispica Keng	T5H4
Rottboellia uncta Nees	T5H5
Saccharum officinarum L.	T5H4, T5H5, T6H6
Saccharum sinense Roxb.	T2H5, T4H1, T5H4, T5H5, T6H6
Saccharum spontaneum L.	T5H4, T5H5, T6H6
Sacciolepis indica (L.) Chase	T4H4, T5H4, T5H5
Schizachyrium obliquiberbe (Hack.) A. Camons	T5H4
Sehima nervosum (Rottl.) Stapf	T5H5, T6H6
Setaria arenaria Kitag.	T3H4, T3H5, T1H5

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植物种类 Taxon	分布区域 Region of distribution
Setaria chondrachne (Steud.) Honda	T5H5
Setaria faberii Herrm.	T4H4, T5H4, T5H5, T6H6
Setaria forbesiana Herrm. var. *breviseta* Chen et Sheng	T5H5
Setaria forbesiana (Nees) Hook f.	T5H5
Setaria geniculata Beauv.	T6H6
Setaria glauca (L.) Beauv.	All over China
Setaria glauca (L.) Beauv. var. *dura* (Chung) Chung	T5H5
Setaria guizhouensis Chen et Sheng	T5H5
Setaria guizhouensis Chen et Sheng var. *paleata* Chen et Sheng	T5H5
Setaria intermedia Roem. et Schult.	T5H5
Setaria italica (L.) Beauv.	T1H4, T1H5, T2H5, T3H4, T3H5, T4H1, T4H3, T4H4, T5H4, T5H5, T6H6
Setaria italica (L.) Beauv. var. *germanica* (Mill.) Schrad.	T1H4, T1H5, T2H5, T3H4, T3H5, T4H1, T4H3, T4H4, T5H4, T5H5, T6H6
Setaria pallidifusca (Schumach.) Stapf et Hubb.	T6H6
Setaria palmifolia (Koen) Stapf	T1H4, T5H4, T5H5, T6H6
Setaria plicata (Lam.) T. Cooke	T5H5
Setaria plicata (Lam.) T. Cooke var. *leviflora* (Keng) Chen et Sheng	T5H5
Setaria verticillata (L.) Beauv.	T1H4, T2H5, T3H4, T3H5, T4H1, T5H4, T5H5, T6H6
Setaria viridis (L.) Beauv.	All over China
Setaria viridis (L.) Beauv. ssp. *pachystachys* (Fr. et Sav.) Mas. et Yanag	T5H5
Setaria viridis (L.) Beauv. ssp. *pycnocoma* (Steud.) Tzvel.	T1H5, T2H5, T3H4, T3H5, T4H1, T4H2, T4H3, T4H4, T5H4, T5H5
Setaria yunnanensis Keng, Yu, Keng & Ma	T5H5
Sorghum bicolor (L.) Moench	T1H4
Sorghum halepense Pers.	T2H5, T4H1, T6H6
Sorghum propingum (Kunth) Hitchc.	T5H4, T5H5, T6H6
Sorghum sudanense (Piper) Stapf	T4H1, T4H2, T4H3, T4H4, T2H5, T5H4, T5H5
Sorghum technicum (Koern) Roshev.	T2H5, T4H1
Sorghum vulgare Pers.	T1H4, T2H5, T5H4, T5H5, T4H1, T4H2, T4H3, T4H4, T6H6
Spartina alterniflora Lois.	T4H3, T4H4, T5H4, T5H5
Spartina anglica Hubb.	T4H3, T4H4, T5H4, T5H5
Spartina maritima (Cott) Fenard	T4H3, T4H4, T5H4, T5H5
Spartina patens (Ait.) Muhl.	T4H3, T4H4, T5H4, T5H5
Spartina townsendii Goroves	T4H3, T4H4, T5H4, T5H5
Spinifex littoradis (Burm f.) Merr.	T6H6
Spodiopogon sibiricus Trin.	T3H4, T3H5, T4H3, T4H4, T5H4, T1H5
Sporobolus diander (Retz.) Beauv.	T5H4, T5H5
Sporobolus fertilis (Steud.) Clayt.	T5H4
Sporobolus halepense (L.) Pers.	T5H4
Sporobolus kansei Rendle	T5H5
Sporobolus piliferus (Trin.) Kunth	T5H5
Sporobolus pulvinatus Swallen	T4H4
Sporobolus virginicus (L.) Kunth	T5H4, T5H5
Stenotaphrum helferi Munro et Hook.	T5H5, T6H6
Stenotaphrum subulatum Trin.	T6H6
Themeda forskolii Hack.	T5H5, T6H6
Themeda japonica (Willd.) Tanaka	T4H4, T5H4, T5H5, T6H6
Themeda triandra Forsk.	T1H4, T4H3, T4H4, T5H4, T5H5, T6H6
Thuarea involuta R. Br.	T6H6
Tragus berteronianus Schult.	T2H5, T3H4, T3H5, T4H3, T4H4, T5H4, T5H5
Tragus racemosus (L.) Scop.	T2H5, T4H2, T4H3, T4H4, T5H4
Tripogon bromoides Roem. et Schult.	T1H4, T5H5
Tripogon bromoides Roem. et Schult. var. *yunnanensis* (Keng et Yang) Chen et Yang	T5H5
Tripogon chinensis (Franch.) Hack.	T1H5, T3H4, T3H5, T4H1, T4H2, T4H4, T5H5
Tripogon filiformis Nees et Steud.	T1H4, T4H2, T5H4, T5H5
Tripogon humilis Yang	T1H4
Tripogon longe-aristatus Nakai	T5H5
Tripogon nanus Keng	T1H4, T5H5
Tripogon purpurascens Duthie	T4H1
Urochloa cordata Keng et Chen	T6H6
Urochloa longifolia Sun et Hu	T5H5
Urochloa longifolia Sun et Hu var. *yuanmiuensis* Sun et Hu	T5H5
Urochloa panicoides Beauv.	T5H5, T6H6
Urochloa pospaloides Presl et Presl	T6H6
Urochloa reptans (L.) Stapf	T5H5, T6H6
Urochloa reptans (L.) Stapf var. *glabra* Chen et Jin	T5H5
Vetiveria zizanioides (L.) Nash	T5H4, T5H5, T6H6
Zea mays L.	All over China
Zoysia japonica Steud.	T4H3, T4H4, T5H4, T5H5, T3H4, T3H5
Zoysia macrostachya Fr. et Sav.	T4H3, T4H4
Zoysia matrella (L.) Merr	T5H5, T6H6
Zoysia sinica Hance	T3H5, T4H4, T5H4, T5H5, T6H6, T1H5, T3H4
Zoysia sinica Hance var. *nipponica* Ohwi	T1H5, T3H4, T3H5, T4H4, T5H4, T5H5, T6H6
Zoysia tenuifolia Willd. ex Trin.	T4H4, T5H4, T5H5, T6H6

注：

T1＝寒温带；T2＝冷温带；T3＝中温带；T4＝暖温带；T5＝亚热带；T6＝南亚热带或边缘热带；H1＝极干旱区；H2＝干旱区；H3＝半干旱区；H4＝半湿润区；H5＝季节性干旱区；H6＝湿润区；C_3～C_4＝C_3～C_4 中间植物。

Note:

T1＝frigid temperate, T2＝cold temperate, T3＝cool temperate, T4＝warm temperate, T5＝subtropical, T6＝southern subtropical of marginally tropical, H1＝very arid, H2＝arid, H3＝semi-arid, H4＝semi-humid, H5＝seasonal arid, H6＝humid, C_3～C_4＝C_3～C_4 intermediate.

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