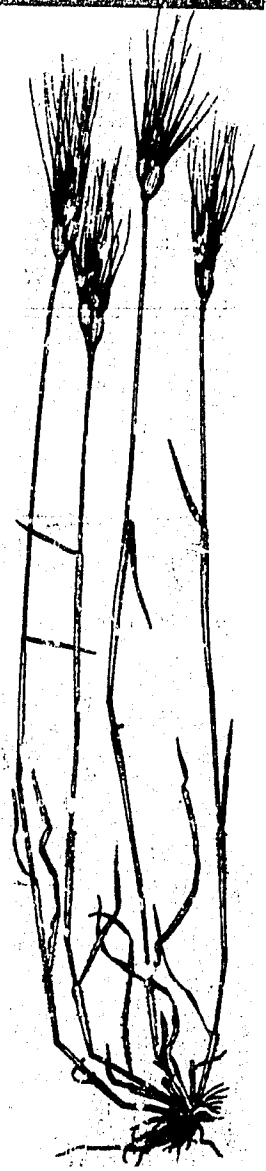
A Guide to the Species of *Aegilops* L.



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INTERNATIONAL BOARD
FOR PLANT GENETIC
RESOURCES
WHEAT PROGRAMME

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A GUIDE TO THE SPECIES OF *AEGILOPS* L.
Their taxonomy, morphology and distribution

by
J. R. Witcombe

IBPGR SECRETARIAT
Rome

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PREFACE

The International Board for Plant Genetic Resources (IBPGR) has a mandate to develop a world network of genetic resources activities on the major crop species for use in present and future breeding programmes. Wheat has been given high priority by the IBPGR because it is a major food crop and because of the rapid changes in the agriculture which have led to loss of traditional cultivars.

Following an IBPGR Symposium on Wheat Genetic Resources held in Leningrad in 1975, the Board has encouraged and monitored the collection of wheat genetic resources with the guidance of an International Wheat Advisory Committee which meets about every two years. This Committee of the IBPGR is co-sponsored by CIMMYT and ICARDA actively participates. In 1981, the Committee noted that wheat collections were extensive and, in many areas, field work necessary was approaching completion. However, species of the closely related genus *Aegilops* were poorly represented in collections especially in relation to their distribution patterns; moreover for some species only a handful of samples could be traced.

Clearly, additional collecting of *Aegilops* is needed. Work has been hampered, however, by the lack of a recent publication adequately covering the genus. Recognizing this, the Wheat Advisory Committee recommended the preparation of this guide. It fills an important gap for wheat germplasm work and ought to do much to enhance the collection and utilization of *Aegilops*.

CONTENTS

THE TAXONOMY, MORPHOLOGY AND DISTRIBUTION OF THE GENUS *AEGILOPS* L.

TAXONOMY

It has been argued by Stebbins (1956) and by Bowden (1959) that *Triticum* and *Aegilops* should not be maintained as separate genera, since there are no genetic barriers between them. They proposed that the two genera should be united in the single genus *Triticum* and Bowden revised the taxonomy on this basis.

This revision has not been universally adopted. Bor (1968) argues against it and Chennaveeraiah (1960) gives many reasons as to why Bowden overstates his case. Nevertheless, Chennaveeraiah 'with much hesitation' placed a transitional group between the two genera, section *Sitopsis* of *Aegilops*, in the genus *Triticum*.

Since the genus is an ill-defined concept, is usually subjective and based on morphological features, it is largely a matter of opinion as to which scheme is adopted. The two genera have been maintained here on the grounds that *Triticum* and *Aegilops* form distinct morphological groups and that this classification is still followed by many scientists. A commonly accepted classification of the genus *Aegilops* is presented in table 1.

The sections of the genus *Aegilops* in table 1 follow closely the genomes of the species and this classification is a slight modification of that of Kihara (1959). Both Eig (1929) and Zhukovsky (1928) also classified the genus *Aegilops* (appendix 1). Eig's classification, which was based on morphology, differs little from that of Kihara.

Any study of *Aegilops* encounters the problems of synonyms. Some common synonyms are shown in appendix 2, whilst the synonyms for when the genus *Aegilops* is placed in the genus *Triticum* are in appendix 3. Unfortunately, Bowden (1959) used many invalid names when he made this change of genus (appendix 3).

Table 1. THE GENUS *AEGILOPS* L.

SECTION	SPECIES	CHROMOSOME No.
Amblyopyrum	*A. mutica* Boiss.	14
Sitopsis	*A speltoides* Tausch	14
	**A. ligustia* (Savign.) Coss.	14
	A. longissima Schweinf. & Muschl.	14
	A. sharonensis Eig	14
	A. bicornis (Forsk.) Jaub. & Sp.	14
	**A. searsii* Feld. & Kis.	14
Vertebrata	*A. squarrosa* L.	14
	A. crassa Boiss.	28
	A. crassa Boiss.	42
	A. vavilovii (Zhuk.) Chenn.	42
	A. ventricosa Tausch	28
	A. juvenalis (Thell.) Eig	42
Cylindropyrum	*A. caudata* L.	14
	A. cylindrica Host	28
Comopyrum	*A. comosa* Sibth. et Sm.	14
	A. uniaristata Vis.	14
Polyeides	*A. umbellulata* Zhuk.	14
	A. ovata L.	28
	A. triaristata Willd.	28
	A. triaristata Willd.	42
	A. columnaris Zhuk.	28
	A. lorentii Hochst.	28
	A. kotschyi Boiss.	28
	**A. peregrina* (Hack.) Maire et Weill.	28
	A. triuncialis L.	28

*Not included as separate species in other classifications (see below).

LUMPING AND SPLITTING OF SPECIES

In several cases pairs of *Aegilops* species can be combined together as a single species. This happens when there are morphological and perhaps ecological differences within a species. Whilst some authors are of the opinion that the differences are sufficiently large to justify the creation of a new species, others disagree.

Some examples of pairs of species are given below.

A. ligustica *A. speltoides*	= *A. speltoides*
A. peregrina *A. kotschyi*	= *A. kotschyi*
A. sharonensis *A. longissima*	= *A. longissima*
A. searsii *A. longissima*	= *A. longissima*
A. triaristata 4 *x* *A. recta* 6 *x*	= *A. triaristata* 4 *x* and 6 *x*

There is little justification for maintaining the separation within *A. speltoides* which is an outbreeder; the two forms *ligustica* and *speltoides* readily intercross. There is little or no evidence that *A. speltoides* and *A. ligustica* occupy separate habitats. Nevertheless, pure populations of the two forms are often found.

A. peregrina and *A. kotschyi* do occupy separate habitats. *A. kotschyi* is more adapted to arid zones than *A. peregrina* (Zohary and Feldman, 1962). Chennaveeraiah (1960) gives evidence that the two species have distinct karyotypes; previous workers who published that the genomes of the two species were similar used *A. kotschyi* that was mis-identified and was really *A. peregrina.*

A. sharonensis and *A. longissima* not only occupy separate habitats, but are seasonally separated since *A. longissima* flowers 2-3 weeks later than *A. sharonensis* (Ankori and Zohary, 1962). However, on the basis of their similar karyotype Chennaveeraiah (1960) places *A. sharonensis* as a subspecies of *A. longissima.*

Feldman and Kislev (1978) described a new species of *Aegilops* as *A. searsii*, which was formerly thought to be a variant of *A. longissima*. Chromosome pairing behaviour between *A. searsii* and *A. longissima* indicated that *A. searsii* was a true species, but the experimental evidence is based on only a single line of *A. searsii*. In view of the widely differing behaviour, at the genome level, of different genotypes of the same species this evidence is not universally accepted.

Chennaveeraiah (1960) argued that to maintain different levels of ploidy in a single species was incorrect and he divided the tetraploid and hexaploid forms of *A. triaristata* into separate species. He also did this in *A. crassa* but it was subsequently found that his hexaploid form of *A. crassa* was, in fact, *A. vavilovii*. Consequently *A. crassa* will remain with both tetraploid and hexaploid forms until these are validly named as separate species.

HYBRIDISATION BETWEEN SPECIES

Hybridisation between *Aegilops* species is common (Zohary and Feldman, 1962) and examples which are known to occur in the native habitats of the species are given below.

A. speltoides	×	*A. ligustica*
A. peregrina	×	*A. ovata*
A. peregrina	×	*A. lorentii*
A. triuncialis	×	*A. lorentii*
A. triuncialis	×	*A. triaristata*
A. triaristata	×	*A. columnaris*

This is not an exhaustive list. The presence of hybrids where species overlap (particularly in disturbed habitats) presents problems when identifying *Aegilops* species. The most striking examples of blurred specific boundaries are to be found in the *Polyeides*.

KEY TO THE *AEGILOPS* SPECIES

The following dichotomous key for the identification of *Aegilops* in the field should be used in conjunction with the full descriptions of the species, their known distributions and the figures.

In a genus with many polymorphic species it is impossible to construct a perfect key and the following points should be noted:

(a) Dimensions refer to typical specimens and in certain cases the limits specified will be exceeded. Nevertheless, in the *Polyeides* glume length is an important diagnostic characteristic and refers to the length of the lowermost glumes excluding the awns. Spike and spikelet lengths also exclude the awns.

(b) In section *Polyeides* difficulties may be encountered due to the range of morphological variation shown by some species. The key for the *Polyeides* has been constructed using the published literature and numerous specimens from Iraq, Syria and Jordan but further variation may be found. The user of the key should also be aware of the existence of hybrids in the *Polyeides*. Awnless forms of *A. triuncialis* will not be identified by using the key!

(c) Although various authors including Zhukovsky (1928) have used the number of glume awns as a diagnostic character in the *Polyeides* it is not always reliable. For example, even though the key of Zhukovsky relies on *A. umbellulata* having at least four awns on the basal glumes, specimens can be found with less.

1a. SPIKE MORE OR LESS CYLINDRICAL, NOT MUCH THICKER AT THE BASE THAN AT THE TOP, OVER TEN TIMES AS LONG AS BROAD:

2a. Glumes truncate, (ending abruptly as though cut off) with or without a short tooth or blunt teeth on the upper margin, awnless or rarely with short awns:

3a. Spikelets somewhat squat; less than three times as long as broad:

4a. Spikelets covered with a short silvery pubescence: Moniliform.* Awns of uppermost lemmas distinctly flattened, solitary without lateral teeth. Lemma awns of lateral spikelets progressively longer towards apex of the spike *A. crassa* (9)**

Moniliform. Awns of upper lemmas triangular in section, with a lateral tooth on each side at its base.

*Spike as a string of beads.

**Refers to description commencing on page 11.

Lateral lemmas with central awns flanked by 2 shorter awns or teeth *A. juvenalis* (12)

4b. Spikelets non-pubescent:

Spike truely cylindrical (except ssp. *strangulata*). Awns of the uppermost lemmas solitary without lateral teeth *A. squarrosa* (8)

Spike markedly moniliform. Awns of the uppermost lemmas solitary with a lateral tooth at each side at its base *A. ventricosa* (11)

3b. Spikelets not squat but at least three times as long as broad:

5a. Glumes broad slightly inflated at the base:

Individual spikelets ± cylindrical ± three times as long as broad. Lemmas of terminal spikelets with long awns, triangular in section, with a small lateral tooth at each side at its base. Lemmas of lateral spikelets usually awnletted or with teeth (if awned never longer than 3 cm) *A. vavilovii* (10)

5b. Glumes narrow never inflated at the base:

Terminal lemmas long awned, lateral spikelets unawned, or (var. *polyathera*) with fine awns *A. speltoides* (2)

As *A. speltoides* but lateral lemmas awned and terminal awns not markedly the longest. Joints always shorter than the glumes *A. ligustica* (3)

2b. Glumes not truncate:

6a. Terminal glume long awned, lateral glumes with 1 or 2 teeth, one of which may be shortly awned:

7a. Spikelets ± cylindrical:

Terminal glume awns solitary and longer than the spike itself. Awn of terminal lemma, if present, much shorter than the glume awn *A. caudata* (13)

Terminal glume awns solitary, shorter than spike. Terminal lemma awn usually longer than glume awn *A. cylindrica* (14)

7b. Spikelets somewhat swollen, oval or pear shaped: Both glumes of terminal spikelet with solitary awns *A. uniaristata* (16)

At least one glume of the terminal spikelet with 3 awns, of which the central one is the largest *A. comosa* (15)

6b. Terminal lemma long awned, all glumes with 1 to 2 blunt triangular teeth without awns:

8a. Terminal lemma awn with tooth at either side at the base:

9a. Lemmas on lateral spikelets awned *A. sharonensis* (5)

9b. Lemmas on lateral spikelets awnless: Rachis disarticulates at single point near middle of spike. Terminal awns more or less equal *A. longissima* (4)

Rachis disarticulates at single point near base of spike. Terminal awns usually unequal *A. searsii* (7)

8b. Terminal lemma awn without teeth at the base: Lemmas on lateral spikelets awned *A. bicornis* (6)

1b. SPIKE NOT CYLINDRICAL, BUT LANCEOLATE OR OVATE IN OUTLINE, CONSISTING OF A FEW FERTILE SPIKELETS AT THE BASE SUCCEEDED BY A NUMBER OF SMALLER FERTILE OR INFERTILE SPIKELETS, LESS THAN TEN TIMES AS LONG AS BROAD:

10a. Nerves on the lower glume narrow, definite, equally broad, approximately parallel; seed covered i.e. when seed removed from spikelet some of the palea and lemma adhere to it:
Spike 2-3 cm long, spikelets 2-6, usually 4, glumes 3-5 mm in length, usually 3 awned, and as long as the lemma awns, unless central one missing and replaced by a tooth or space. 2-3 rudimentary spikelets *A. kotschyi* (22)

Spike 1.5-6 cm long, spikelets 2-7, glumes up to 8 mm

long, usually 2-3 awned, mostly very irregular, and longer than the lemma awns, if glume awn absent replaced by irregular teeth. Usually 3 rudimentary spikelets.

A. peregrina (23)

10b. Nerves on the lower glume unequally broad, flattened, not parallel, internerve spaces shallow; seed naked:

11a. Spikes (excluding awns) 4-6 cm long, lower spikelets not crowded, with joints about three quarters the length of the spikelets: spikes gradually tapering: Spikelets 3-7, usually all fertile, uppermost with a smaller grain; lowest glume 8-9 mm long with not more than 3 awns; glume awns of uppermost spikelet each with three awns, except in var. *assyriaca* where it is 1-3, awns of uppermost spikelet more strongly developed on lower spikelets, with central awn the longest *A. triuncialis* (24)

Spikelets 4-6, usually 5, the lower 2-3 fertile, the rest sterile; lowest glume 9-13 mm long, with 2 awns, one of which is much broader at the base than the other, remainder of glumes with 3 awns

A. columnaris (20)

11b. Spike (excluding awns) 2-3 cm long:

12a. Rudimentary spikelets at the base of inflorescence two or three:

13a. Awns of lowest glumes more or less equal in width at the base:

14a. Awns of uppermost spikelet markedly the longest:
Spikelets 3-7, all fertile, uppermost with a smaller grain; lowest glume 8-9 mm long with not more than 3 awns; glume awns of uppermost spikelet each with 3 awns, more strongly developed than on the lower spikelets, with central awn the longest

A. triuncialis (24)

14b. Awns of uppermost spikelet ± equal or shorter than lower awns:

Spikelets usually 4, the upper 1 or 2 sterile; lowest glume 8-1' mm long, not markedly inflated with 2 or 3 awns (rarely 4); 2 or 3 rudimentary spikelets

A. triaristata (19)

Spikelets 4-6 the upper 1-3 sterile and much contracted; lower glumes of fertile spikelets 5-8 mm long, inflated and widest above the middle, each glume 2-6 awned; 3 rudimentary spikelets *A. umbellulata* (17)

13b. Awns of lowest glumes markedly unequal in width at the base:
Spikelets 3-6, the upper 1 or 2 sterile, lowest glume 9-13 mm long, usually with 2 awns (rarely 3) one with a much broader base *A. columnaris* (20)

12b. Rudimentary spikelets at base of inflorescence 1, rarely 2:
Upper spikelets usually fertile, spikelets 2 (sometimes 3), awns of the lower glume of the uppermost spikelets 3, those of the lower 2 or 3; the upper glume awns longer than the lower

A. lorentii (21)

Uppermost spikelet sterile, spikelets 3, rarely 2 or 4, ovoid in shape (i.e. wider below the middle); awns of the lower glume mostly more than 3 (rarely 2); lower glume awns longer or same length as the upper *A. ovata* (18)

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DESCRIPTIONS AND DISTRIBUTIONS

1. A. mutica

Culms up to 45 cm tall. Leaf blades up to 10 cm long, 3-5 mm broad.

Inflorescence a long, narrow, cylindrical spike up to 28 cm long; axis tough or eventually fragile, noded, grooved on the side facing the spikelets; no rudimentary spikelets. Spikelets seated at the nodes, alternate, distichous, all alike, somewhat laterally compressed, 5-8 flowered, the upper florets more or less reduced. Glumes wider at the top, unevenly bluntly toothed at the top or shallowly notched, adherent to palea and lemma. Figure 1.

Habitat: Sandy soils.
Distribution: Central and E Turkey, Iran (1).*

2. A. speltoides

Culms up to 60 cm tall. Leaf-blades about 15 cm long, sparsely hairy.

Spike rather slender, 8-11 cm long, falling entire, axis not fragile; rudimentary spikelet 1, seldom 2. Glumes truncate, unawned, with a solitary tooth on the upper margin. Joints more than half as long or longer than the spikelets, suddenly bent at the base. Lemmas unawned except the two lowest of the terminal spikelet, which are long-awned. In the variety *polyathera* (Boiss.) Eig the lateral lemmas have short, fine awns. Figure 2.

Habitat: Denuded oak forest, steppes and plains, disturbed habitats.
Distribution: Turkey, Israel, Syria, Jordan (2),* Iraq, Iran, Lebanon.

3. A. ligustica

Culms up to 60 cm tall. Leaf-blades scabrid or shortly hairy, up to 20 cm long, 4 mm broad or less.

Spike rather stout, up to 12 cm long, with a fragile axis; rudimentary spikelet 1, seldom 2. Joints much shorter than the spikelets, not

*See notes on page 21.

suddenly bent at the base. Glumes truncate, unawned with a single tooth at the upper margin. Lemmas mostly awned, the lower more weakly than the upper. Figure 3.

Habitat: See *A. speltoides.*
Distribution: More limited than *A. speltoides,* probably Turkey, Israel, Syria, Iraq.

4. **A. longissima**

Culms 30-100 cm.

Spike two-ranked straight and cylindrical, up to 15 cm long by 3-4 mm in width; no rudimentary spikelets. Spikelets 8-20 with 2-5 florets. Glumes glabrous, scabrid, strongly keeled in the upper part, apex 1-3 toothed (usually 2). Lateral lemmas also strongly keeled in upper part, truncated or with 2-3 teeth; lemmas of uppermost spikelets long awned, up to 11 cm in length, with a fine tooth at either side at the base. Spike disarticulates only at one or two points near the middle. Caryopsis adheres to the palea. Figure 4.

Habitat: Ill-drained sandy loams. Steppes.
Distribution: Egypt, Israel, Lebanon, Jordan, Syria (3)*, Iran (4)*.

5. **A. sharonensis**

Spike of 8-17 spikelets with 2-5 florets. Lateral lemmas awned. Glumes with two teeth one of them very blunt. Terminal lemmas long awned with a broad tooth at either side at the base. Spike disarticulating into single spikelets. Otherwise similar in morphology to *A. longissima.*

Habitat: Consolidated sand dunes, well drained sandy loams.
Distribution: Israel.

6. **A. bicornis**

Plant small. Culms 15-35 cm.

Spike two ranked; 6-10 cm long, 8 mm broad; spikelets somewhat longer than the joints, about three flowered, the upper floret sterile. Glumes truncate, 1-2 toothed, scabrous at the nerves. Lower lemmas

*See notes on page 21.

awned, with the lateral nerves at the base of the awn sometimes produced into a short tooth. Figure 5.

Habitat: Sandy places and deserts.
Distribution: Israel, Egypt (Sinai), Libya.

7. **A. searsii**

Spike markedly similar to *A. longissima* but spike disarticulates near to the base. Terminal lemmas usually unequal and arched or diagonally oriented, in contrast to the straight awns of *A. longissima*. The caryopsis is more or less free.

Habitat: Heavy soils and steppe.
Distribution: Israel, Jordan, Lebanon, Syria (5).*

8. **A. squarrosa**

Culms up to 30 cm tall. Leaf-blades up to 10 cm long, glabrous or sparsely hairy.

Spike cylindrical, up to 8 cm long 2-4 mm broad, slightly tapered towards the tip, with a fragile axis; 1 or 2 rudimentary spikelets. Glumes truncate, unawned, oblong, with a short tooth on the upper margin. Lowest lemmas mostly unawned, or weakly awned in spikelets towards the tip of the spike; lemmas of the terminal spikelet long-awned (3-6 cm); awns sometimes recurved. Figure 6.

In variety *strangulata* Eig spike markedly moniliform. There is much variation in this species for ear length, thickness of ear and degree of awning of the lemmas.

Habitat: Grassy steppic slopes, sandy desert, disturbed habitats.
Distribution: Turkey, Syria, Iraq, Iran, S USSR (Caucasus, Turkmenia, Pamir-Alai, Tian Shan), Afghanistan.

9. **A. crassa**

Culms 20-30 cm tall. Leaf-blades up to 20 cm long, 4-10 mm wide, glabrous or hairy.

Spike stout, coarsely moniliform, fragile, 4-8 cm long excluding the awns; 0-2 rudimentary spikelets. Spikelets excluding the awns

*See notes on page 21.

10-14 mm long 5-7 mm wide, ovate with marked constriction near top, densely and shortly covered with appressed silvery hairs. Glumes toothed, rarely awned. Lemmas awned, the lower awns short, the upper becoming progressively more substantial, markedly flattened and 2-3 mm broad. Figure 7.

Habitat: Common weed of cereal fields, degraded forest on limestone, in fertile soils of dry areas.

Distribution: Turkey, Israel, Lebanon, Syria, Iraq, Iran, Afghanistan, S USSR (Turkmenia, Pamir-Alai).

10. **A. vavilovii**

Culms 20-40 cm tall. Leaf-blades up to 20 cm long, 5 mm wide.

Spike cylindrical 5 to 15 cm long; rudimentary spikelets 0-3, usually 1. Spikelets 5-11, 12-14 mm long and equal to the joints, 2-5 mm broad. Glumes truncate with 2-3 teeth, covered with a fine and sparse silvery pubescence. Lateral lemmas 2-3 toothed with one of them sometimes produced into a short awn. Two lowermost lemmas of terminal spikelet with strong broad awns up to 8 cm in length, having two short teeth at either side near the base; the dorsal surface of the awn with a prominent nerve. Figure 8.

Depauperate forms and late tillers can have atypically small spikes; slender, 3 spikelets, less than 4 cm long sometimes with a single terminal awn.

Habitat: Weed on edge of cereal fields, sandy places. Desert areas.

Distribution: Israel, Lebanon, Syria, Iraq, Jordan.

11. **A. ventricosa**

Culms 20-30 cm tall.

Spike of 5-10 spikelets strongly swollen at the base; 5-10 cm in length, markedly moniliform. Lower lemmas are oblong, terminating in two teeth and a median awn; awns long in the upper spikelets, short in the others. Glumes oval with 2 or 3 teeth of which one is sometimes continued with a short awn. Figures 9a and 9b.

Distribution: Spain, France, Italy, Morocco, Algeria, Libya, Jordan? (introd. (6)).*

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*See notes on page 21.

12. **A. juvenalis**

Culms 20-40 cm tall. Leaf-blades up to 30 cm long, 10 mm wide.

Spike erect, somewhat moniliform, 4-8 cm long; 1-2 rudimentary spikelets. Spikelets about 8, 4-flowered. Glumes elliptic truncate, 7-8 mm long, covered with a silky appressed pubescence and longer hairs, 2-toothed or with awns. Lemmas with a long awn flanked at the base by 2 teeth or short awns. Figure 10.

Habitat: Stony ground, weed in wheat fields.
Distribution: NE Syria, Iraq, Iran, S USSR (Turkmenia, Syr Darya, Pamir-Alai).

13. **A. caudata**

Culms up to 40 cm tall, smooth and glabrous. Leaf-blades narrow, short, hairy; lower sheaths sparsely hairy, the upper smooth and glabrous.

Inflorescence a short spike up to 7 cm long; 2-3 rudimentary spikelets. Spikelets cylindrical, 4-5, very narrow, erect, as long as the joints. Lower glume of the lateral spikelets with a solitary acuminate tooth, or two teeth, one short, occasionally the longer awned; glumes of the terminal spikelets with solitary awns longer than the spike itself. Lemmas 1-3 toothed, one being rarely produced into a short awn; the awn of the terminal lemma, if present much shorter than the awns of the glumes. Figure 11.

Habitat: Oak forests, on sandy stony slopes, often on calcareous soils.
Distribution: Hungary, Greece, Cyprus, Turkey, Israel, Lebanon, Syria, Iraq, Iran, Afghanistan.

14. **A. cylindrica**

Culms 20-40 cm tall. Leaf-blades short, 4-5 cm long, glabrous or sparsely hairy.

Spike cylindrical, 8-19 cm long; 0-2 rudimentary spikelets. Spike disarticulating into single spikelets. Joints about as long as the spikelets. Lower glumes with one blunt tooth and a sharper one which is usually produced as a short awn; angle between the teeth almost a right angle; glumes and lemma of the terminal spikelet awned, the awn of the lemma usually longer than the glume awns, but in any event the terminal awns shorter than the spike. Figure 12.

Habitat: Weed in fallow fields. On hillsides at high elevations.
Distribution: France, Italy, Hungary, Bulgaria, Crete, Turkey, Syria (2),* Israel?, Iraq, Iran, S USSR (Caucasus, Syr Darya to Tian Shan), Afghanistan.

15. **A. comosa**

Culms 15-30 cm tall, leaf-blades mostly pubescent.

Spike slender, with 3 spikelets (sometimes 1, 2 or 4); on maturity falling entire; rudimentary spikelets 1, rarely 2. Spikelets as long as the internodes or longer, lanceolate or ovate. Glumes of lateral spikelets broad, 2-3 toothed at tip; teeth triangular-lanceolate becoming progressively more awned up the spike; awns of glumes of uppermost spikelets 1-3, long. Uppermost lemma toothed or short awned. Figures 13a and 13b.

A polymorphic species. The typical form has both terminal glumes 3-awned whereas subsp. *heldreichii* (Holzm.) Eig has one glume 3-awned, the other one awned. Some forms even have both the glumes single awned but these can be separated from *A. uniaristata* since this latter species has an infertile upper spikelet, shorter awns (4-5 cm) compared to those of subsp. *heldreichii* (5-7 cm), and more rudimentary spikelets.

Distribution: Greece, W Turkey, N Syria (6).*

16. **A. uniaristata**

Culms up to 30 cm tall, leaf-blades mostly pubescent.

Spike cylindrical, with 2-3 spikelets (rarely 4); on maturity falling entire; rudimentary spikelets 3, seldom 2. Glumes of lateral spikelets with one pointed tooth and one awn; those of the uppermost spikelets with a single awn sometimes with a tooth at either side at the base. (See *A. comosa* above).

Distribution: Greece, Turkey (Mamara Sea coast), Yugoslavia (Adriatic coast).

17. **A. umbellulata**

Culms up to 45 cm tall. Leaf-blades short, narrow, 2 mm wide, hairy or glabrous.

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*See notes on page 21.

Spike lanceolate to ovate, 2.5-4 cm long excluding the awns, falling entire; 2 or 3, rarely 4, rudimentary spikelets. Spikelets 3-5, the lower two fertile, much longer than the joints, the upper sterile, half the length of the joints. Lower glumes of the fertile spikelets 5-8 mm long, suddenly widened above the middle, constricted at the top, 3-5 awned usually 4. Lemmas 1-3 awned. Awns often spreading at maturity. Very similar to *A. ovata* but can be distinguished from it by the number of rudimentary spikelets. Figure 14.

Habitat: Denuded oak forest, grassy steppes, dry hills, weed.
Distribution: Greece, Turkey, Syria, Iraq, USSR (Transcaucasia), Iran.

18. **A. ovata**

Culms up to 20 cm tall. Leaf-blades hairy or glabrous.

Spike 1-2 cm long, 4-9 mm wide (about twice as long as broad), falling entire; 1 (very rarely 2) rudimentary spikelet. Spikelets 3 (rarely 2, 4 or 5), urn-shaped or elliptic, upper spikelets sterile and much smaller than the lower. Lower glume 7-8 mm long, 5-6 mm broad, usually 3 or more awned (if 2-awned, one awn broader than the other). Figure 15.

Habitat: Dry stony slopes, grassy steppes, weed, disturbed habitats.
Distribution: Portugal (including Madeira), Spain (incl. Tenerife Isl.), France, Italy, Yugoslavia, Greece, Cyprus, USSR (Crimea), Israel, Lebanon, Jordan, Syria, Iraq, Iran, Egypt, Libya, Tunisia, Algeria, Morocco.

19. **A. triaristata**

Culms up to 45 cm tall. Leaf-blades hairy, 3 mm wide, and often ciliate on the margins.

Spike lanceolate, suddenly contracted, four times as long as broad, falling entire; 2, rarely 3, rudimentary spikelets. Spikelets 4, rarely 5, the lower two fertile, crowded with a very short joint between them, the upper two much shorter than the joints. Lower glume of the fertile spikelets 8-11 mm long, 5-7 mm broad, with unequally broad nerves somewhat broader above the middle; usually awns of at least one of the lowermost glumes 3, the other usually 2. Upper glumes usually with 3 awns. Lemma awns more or less equal to glume awns in length. Figure 16.

Habitat: Oak forest, eroded hills, stony hillsides.
Distribution: Spain, France, Italy, Greece, Turkey, USSR (Crimea, Caucasus), Israel, Lebanon, Syria, Iraq, Iran, Egypt, Algeria, Morocco.

20. **A. columnaris**

Culms up to 30 cm tall. Leaf-blades not more than 6 cm long, sparsely hairy.

Spike 4-6 cm long but sometimes shorter (in Syrian specimens); usually 3 rudimentary spikelets. Spikelets usually 5, of which the two lowest are fertile. Lower glumes of the fertile spikelets 9-13 mm long, with two awns, of which one is much broader at the base than the other. Awns of the lemma shorter and more slender. Glumes of upper spikelets sometimes 3 awned. Figure 17.

Habitat: Disturbed habitats, pastures.
Distribution: Turkey, Lebanon, Syria, Iraq, USSR (Transcaucasia), Iran.

21. **A. lorentii**

Culms up to 30 cm tall, often only 5-10 cm tall. Leaf-blades short, ciliate.

Spike, excluding awns, 2-3 cm long, lanceolate; 1, very rarely 2, rudimentary spikelets. Spikelets two, sometimes 3, ellipsoid; uppermost spikelet often sterile. Lower glume of lowest spikelet 8-9 mm long, 5-6 mm wide; awns of the upper glumes 3, of the lowest two or three, the latter shorter than those of the upper. Lemmas with at least 1 awn, which is definitely shorter than those of the glumes. Figure 18.

Habitat: Degraded oak forests, stony hillsides, disturbed habitats, pastures.
Distribution: Spain, France, Italy, Yugoslavia, Romania, Greece, Cyprus, Turkey, USSR (S Ukraine, Transcaucasia), Israel, Lebanon, Syria, Jordan (2),* Iraq, Iran, Algeria, Libya.

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*See notes on page 21.

22. **A. kotschyi**

Many erect or ascending culms branched from the base, up to 30 cm tall, smooth and glabrous, leafy. Leaf-blades ciliate on the margins, rough.

Spike rather congested, roughly lanceolate in outline, 2-3 cm long; rudimentary spikelets 2-3. Spikelets 2-6, usually 4, slightly inflated above the middle; lower spikelets longer than the joints. Glumes 5-6 mm long, with more or less parallel equal nerves, glabrous or hairy, usually 3-awned, or the central missing and replaced by a tooth or space (rarely 5-awned). Lemmas awned but shorter than those of the glumes. Caryopsis adherent to the palea.

Habitat: Wide ecological range. Forest, desert, weed. *A. kotschyi* is adapted to more arid climates than *A. peregrina.*

Distribution: Cyprus, Turkey, Israel, Jordan, Lebanon, Syria, Iraq, Kuwait, Saudi Arabia, Iran, USSR (Turkmenia to Tian Shan), Afghanistan, Pakistan (7),*

23. **A. peregrina**

Culms up to 40 cm tall. Leaf-blades glabrous or shortly pilose, up to 6 cm long, 2-3 mm wide.

Spike of 2-7 spikelets, lanceolate, 1.5-6 cm long excluding the awns, falling entire; rudimentary spikelets usually 3. Lower glume of the basal spikelets 6-8 mm long, 4-6 wide, awned or awns replaced by teeth; nerves equal, narrow, more or less parallel. Awns often spreading at right angles at maturity. Lemma, particularly the lower, with rudimentary awns or the awns completely absent or with teeth. Caryopsis adherent to the lemma and palea. Figure 19.

There are many forms of this species including those where all awns are replaced by teeth. Some forms have long cylindrical awnless or awned spikes.

Habitat: See *A. kotschyi.*

Distribution: Italy, Greece, Cyprus, Turkey, Israel, Jordan, Lebanon, Syria, Iran, Egypt, Libya, Morocco.

24. **A. triuncialis**

Culms up to 45 cm tall. Leaf-blades 10 cm long or less, sparsely hairy or glabrous.

Spike on a long-exserted peduncle, 4-6 cm long excluding the awns (rarely shorter); rudimentary spikelets 3, sometimes 2. Spikelets decreasing in size upwards, falling entire or in divided spikelets; usually all spikelets fertile with uppermost with a smaller grain. Glumes of the lowest spikelets 7-10 mm long, with nerves of unequal breadth and shallow furrows between them, scabrid or covered with short silvery hairs, usually with three teeth or awns, often the two teeth awned and the central one not awned; uppermost spikelet with glumes having three flat awns, the central one usually the longest of all the awns in the spike (3-6 cm). Figures 20a and 20b.

In some forms (var. *assyriaca* Eig) the lateral spikelets have glumes with one fine awn and one broad tooth and resemble *A. cylindrica* in this respect. The uppermost spikelet has glumes either with one awn or a single awn with two fine awns at either side at the base. Forms with awnless lateral spikelets and sometimes even awnless terminal spikelets also occur.

Habitat: Oak forest, scrub, stony mountain slopes, dry hills, weed.

Distribution: Portugal, Spain, France, Italy, Yugoslavia, Greece, Bulgaria, Cyprus, Turkey, Israel, Lebanon, Syria, Iraq, Kuwait, Saudi Arabia, Iran, USSR (Turkmenia to Tian Shan), Afghanistan, Pakistan (7),* Morocco, Algeria, USA (introd.).

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*See notes on page 21.

Notes

Distribution follows that of Eig (1928), Post (1933), Mouterde (1966) and Bor (1970) except where indicated:

(1) Kyoto University Botanical Exped. to the highlands of Mesopotamia (1970).

(2) Witcombe et al. (1982).

(3) Perhaps all forms are *A. searsii.*

(4) According to Kuckuck (1956). Unconfirmed by others.

(5) Witcombe. Personal observation 1982. *A. searsii* and *A. comosa* are found in the north of Syria.

(6) According only to Mouterde (1966). An introduction.

(7) From personal examination of herbarium sheets, Herbarium of Pakistan.

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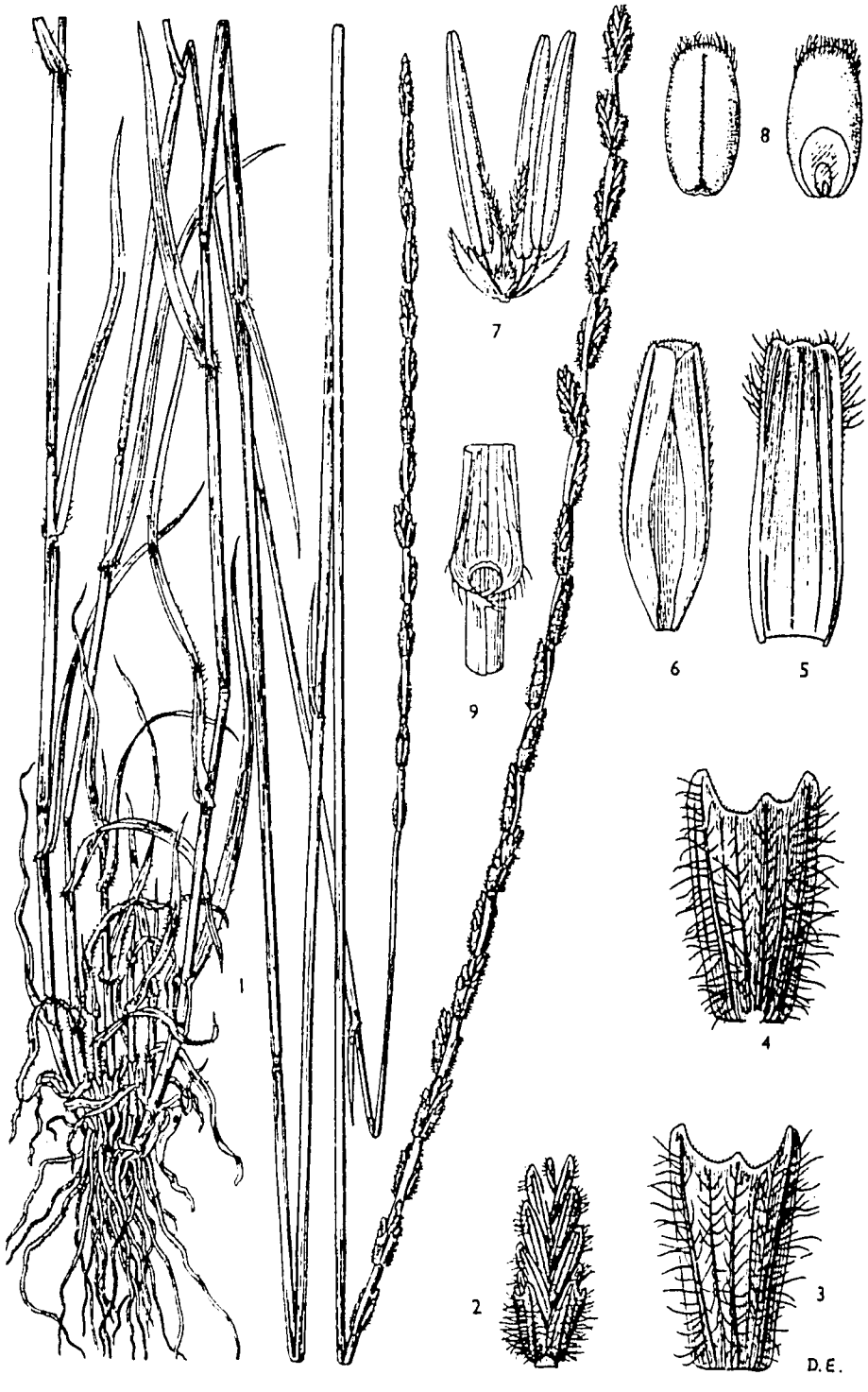
Figure 1. *A. mutica* Boiss.

1, habit of whole plant, x 2/3; **2**, spikelet, x 2; **3**, **4**, glumes, x 6; **5**, lemma, x 6; **6**, palea, x 6; **7**, flower, x 6; **8**, grain, x 6; **9**, ligule, x 2.

(Hennipman et al. 1973, Turkish material, from Bor, 1968).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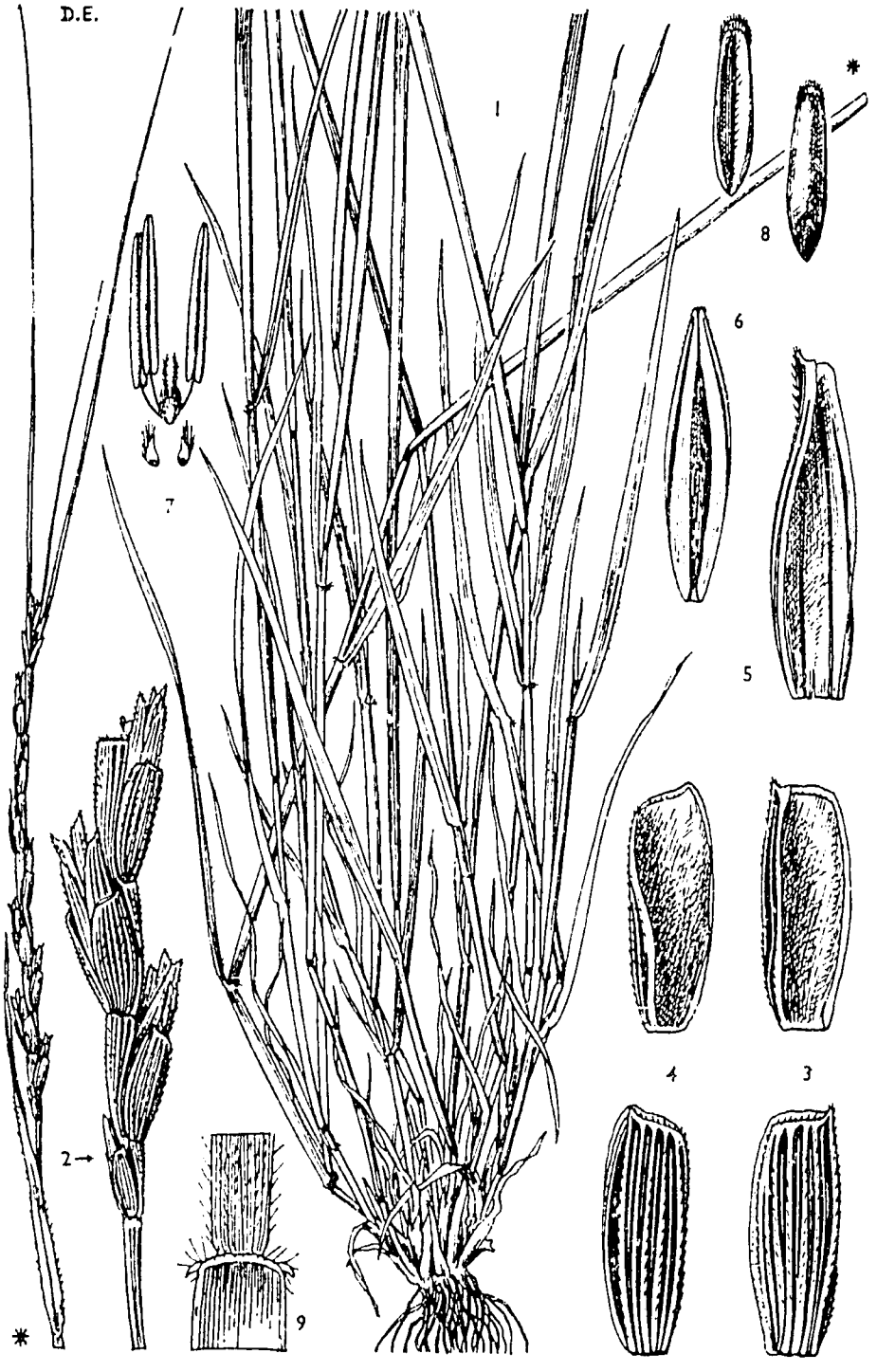
8
9
D.E.

Figure 2. *A. speltoides* Tausch

1, habit of whole plant, x 2/3; **2**, lower portion of inflorescence, x 2; **3**, lower glume, x 4; **4**, upper glume, x 4; **5**, lowest lemma, x 4; **6**, its palea, x 4; **7**, flower, x 4; **8**, grain, x 4; **9**, ligule, x 3.

(Davis and Hedge 28419, Turkish material, from Bor, 1968).


D.E.
1
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9

Figure 3. *A. ligustica* (Savign.) Coss.

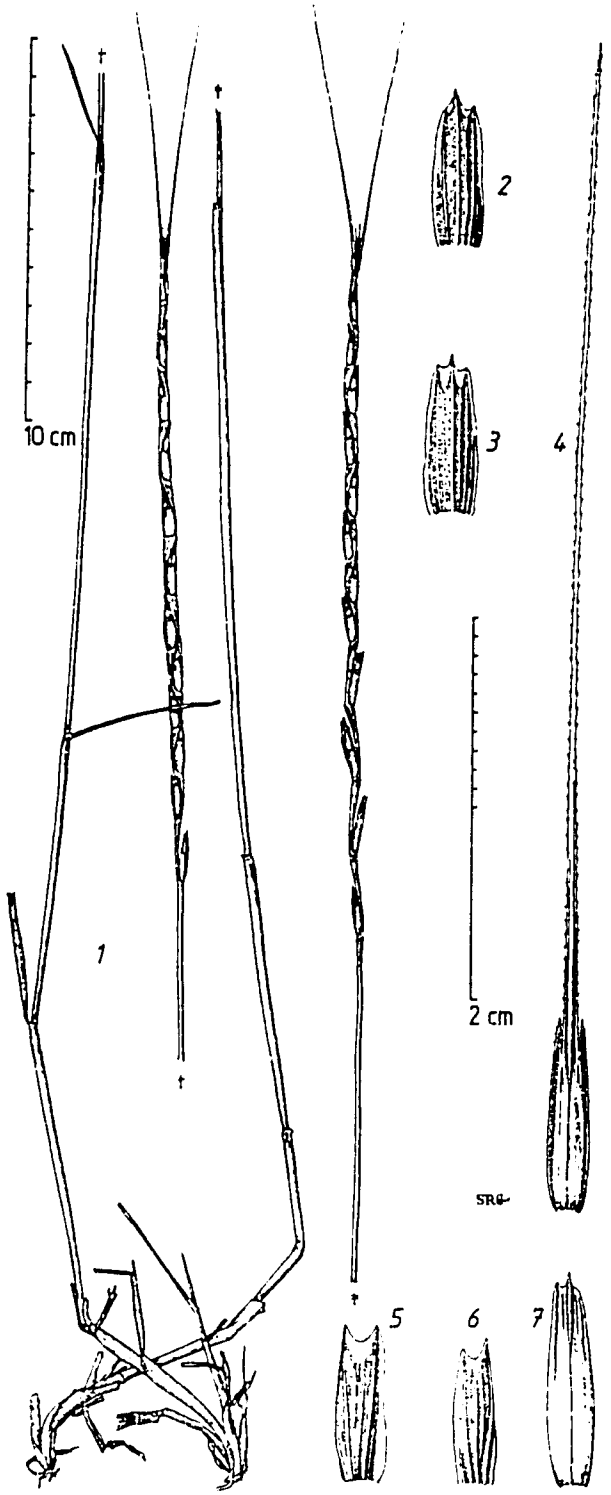
Lower spikelets of spike. The rachis is fragile and the upper spikelets have fallen.
Specimen from N.E. Syria (coll. J.R. Witcombe).

Figure 4. *A. longissima* Schweinf. et Muschl.

1, habit of whole plant, drawn dry from herbarium sheet; **2**, **3**, Glumes of uppermost spikelet; **4**, Lemma of uppermost spikelet (from lowest floret in spikelet); **5**, **6**, Glumes of lowest fertile spikelet; **7**, Lemma of lowest fertile spikelet (from lowest floret in spikelet).

Note ornamentation (hairs, teeth) of glume veins is not indicated.

(A. Eig et M. Zohary, 21, V. 1928 (MANCH)).


10 cm
1
2
3
4
2 cm
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7

Figure 5. *A. bicornis* (Forsk.) Jaub. et Sp.

1, Habit of whole plant, drawn dry from herbarium sheet; **2**, **3**, Glumes of uppermost spikelet; **4**, Lemma of uppermost spikelet (from lowest floret in spikelet); **5**, **6**, Glumes of lowest fertile spikelet; **7**, Lemma of lowest fertile spikelet (from lowest floret in spikelet).

Note ornamentation (hairs, teeth) of glume veins is not indicated.

(A. Eig, N. Feinbrun et M. Zohary, 16, IV. 1928 (MANCH)).

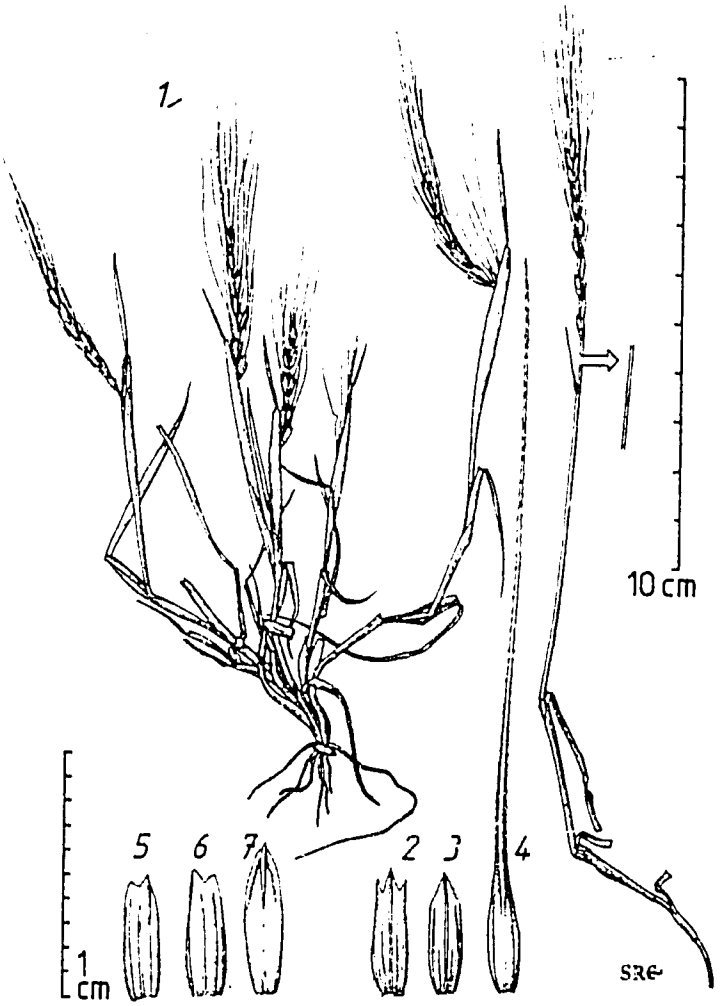
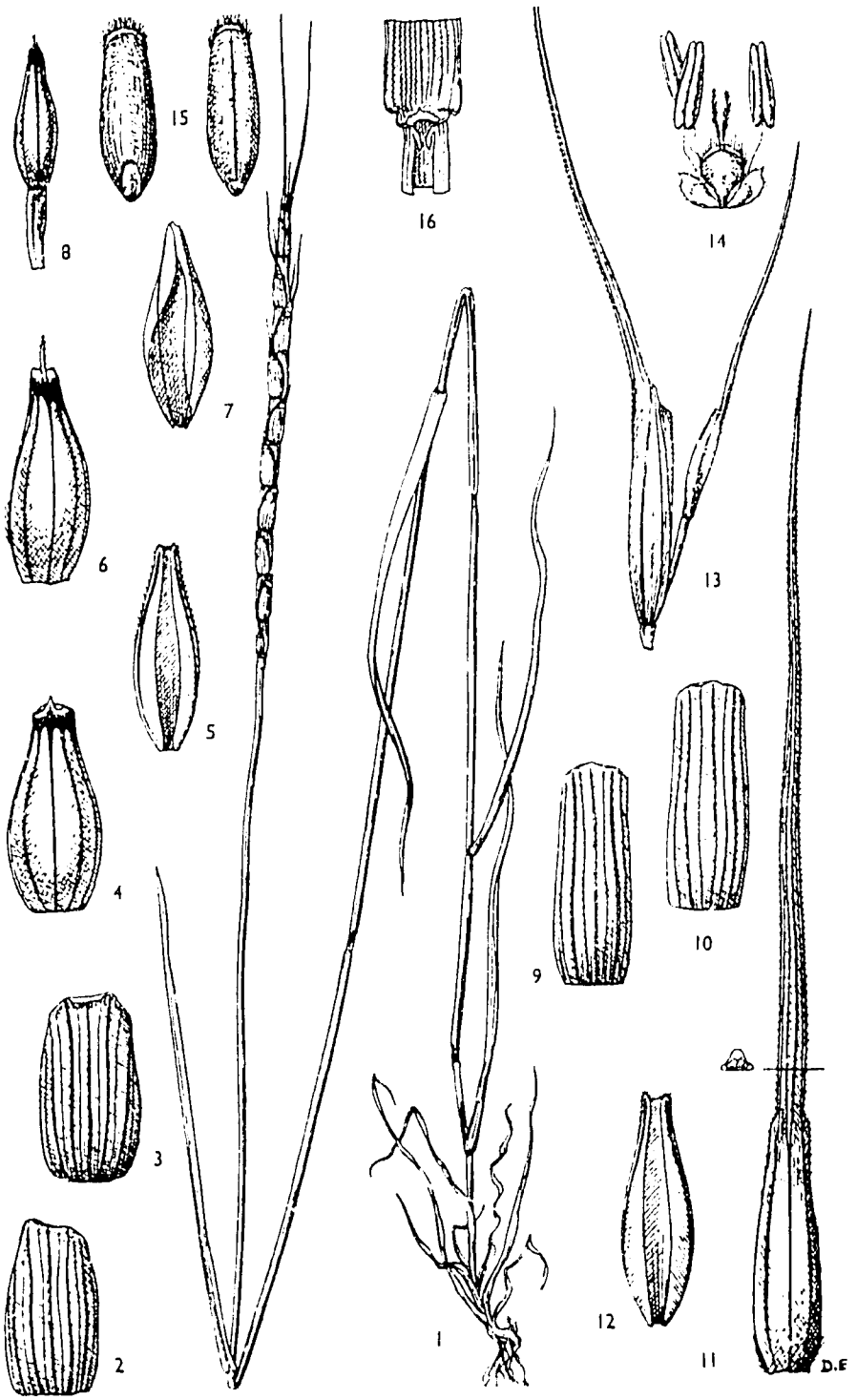

1
10 cm
5
6
7
2
3
4
1 cm
SRE

Figure 6. *A. squarrosa* L.

1, habit of whole plant, x 2/3; **2**, lower glume of lowest spikelet, x 4; **3**, upper glume, x 4; **4**, lemma of lowest floret, x 4; **5**, its palea, x 4; **6**, lemma of second floret, x 4; **7**, its palea, x 4; **8**, rhachilla and terminal floret, x 4; **9**, lower glume of terminal spikelet, x 4; **10**, upper glume, x 4; **11**, lowest lemma, x 4; **12**, its palea, x 4; **13**, succeeding florets, x 4; **14**, flower, x 6; **15**, grain, x 4; **16**, ligule, x 3.
(Rawi 31170, from Bor, 1968).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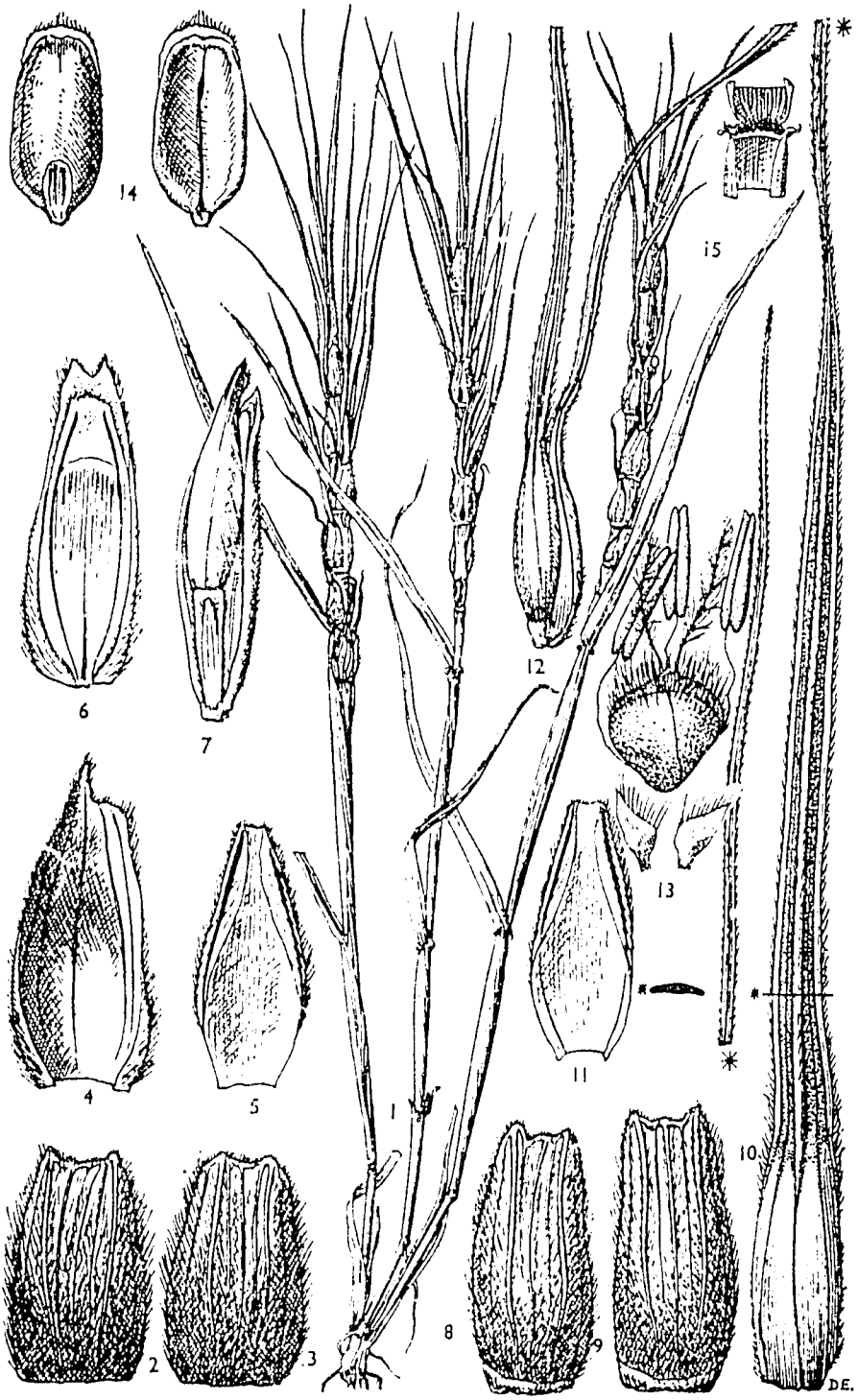
D.E

Figure 7. *A. crassa* Boiss.

1, habit of whole plant, x 2/3; **2,** lower glume of lowest spikelet, x 3; **3,** per glume, x 3; **4,** lowest lemma, x 3; **5,** its palea, x 3; **6.** emma and palea of second floret, x 3; **7,** lemma, palea, and rhachilla of third floret, x 3; **8,** lower glume of terminal spikelet, x 3; **9,** upper glume, x 3; **10,** lowest lemma, x 3; **11,** its palea, x 3; **12,** succeeding florets, x 3; **13,** flower, x 8; **14,** grain, x 3; **15,** ligule, x 2.
(Rawi 21501, from Bor, 1968).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1
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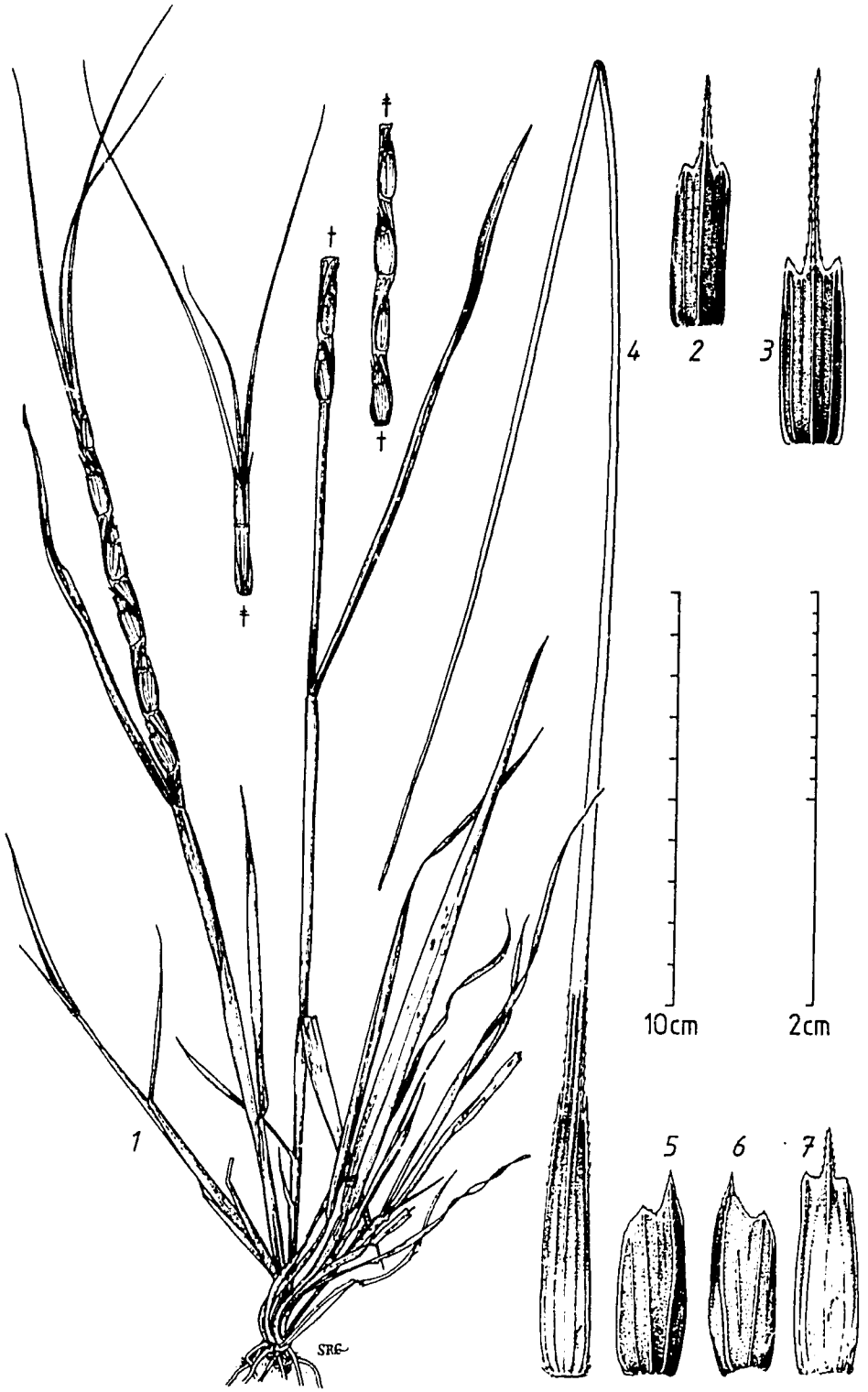
8
9
DE.

Figure 8. *A. vavilovii* (Zhuk.) Chenn.

1, Habit of whole plant drawn dry from herbarium sheet; **2**, **3**, Glumes of uppermost spikelet; **4**, Lemma of uppermost spikelet (from lowet floret in spikelet); **5**, **6**, Glumes of lowest fertile spikelet; **7**, Lemma of lowest fertile spikelet (from lowest floret in spikelet).

Note ornamentation (hairs, teeth) of glume veins is not indicated.

(J.R. Witcombe, s.n., April 1980 (MANCH)).


1
2
3
4
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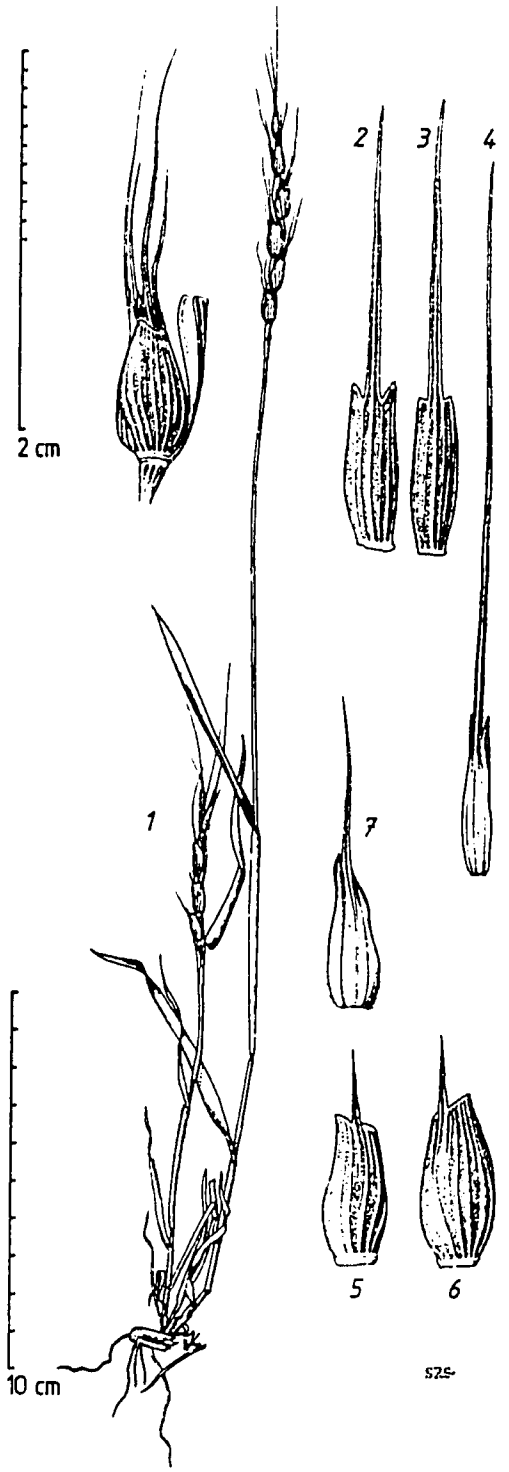
7
10cm
2cm
SRG

Figure 9a. *A. ventricosa* Tausch

1, Habit of whole plant, drawn dry from herbarium sheet; **2, 3**, Glumes of uppermost spikelet; **4**, Lemma of uppermost spikelet (from lowest floret in spikelet); **5, 6**, Glumes of lowest fertile spikelet; **7**, Lemma of lowest fertile spikelet (from lowest floret in spikelet).

Note ornamentation (hairs, teeth) of glume veins is not indicated.

(E. Bourgeau, 926, (MANCH)).


2 cm
10 cm
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6
7

Figure 9b. *A. ventricosa* Tausch

1, Habit of whole plant, drawn dry from herbarium sheet; **2, 3,** Glumes of uppermost spikelet; **4,** Lemma of uppermost spikelet (from lowest floret in spikelet); **5, 6,** Glumes of lowest fertile spikelet; **7,** Lemma of lowest fertile spikelet (from lowest floret in spikelet).

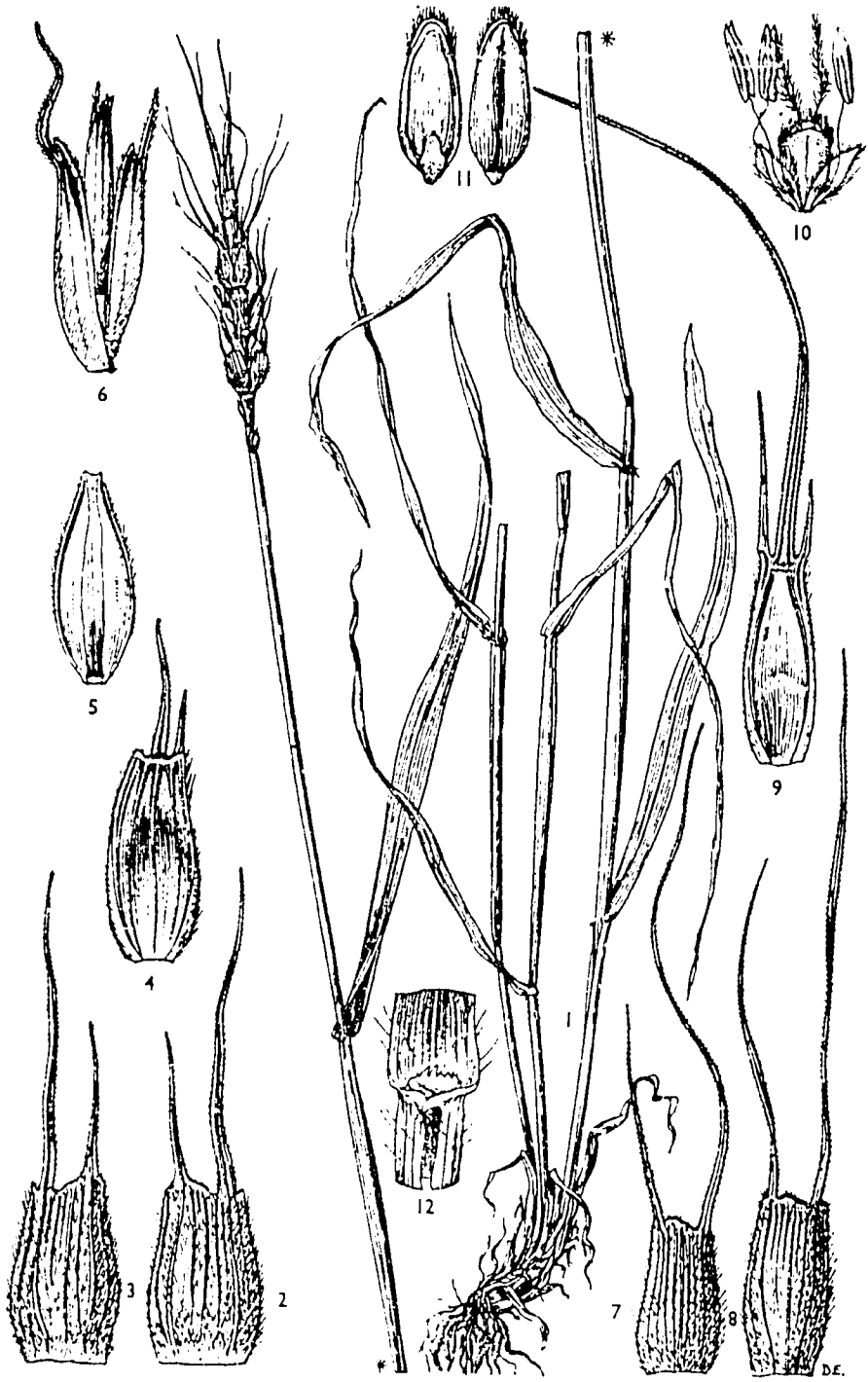
Note ornamentation (hairs, teeth) of glume veins is not indicated.

(B. Balansa, 695, MANCH)).


5
2
3
2
cm
7
6
4
1
SRE
10 cm

Figure 10. *A. juvenalis* (Thell.) Eig

1, habit of whole plant, x 2/3; **2**, lower glume of lowest spikelet, x 3; **3**, upper glume, x 3; **4**, lowest lemma, x 3; **5**, its palea, x 3; **6**, succeeding florets, x 3; **7**, lower glume of terminal spikelet, x 3; **8**, upper glume, x 3; **9**, lowest lemma, x 3; **10**, flower, x 3; **11**, grain, x 3; **12**, ligule, x 3.
(Helbaek 1083, from Bor, 1968).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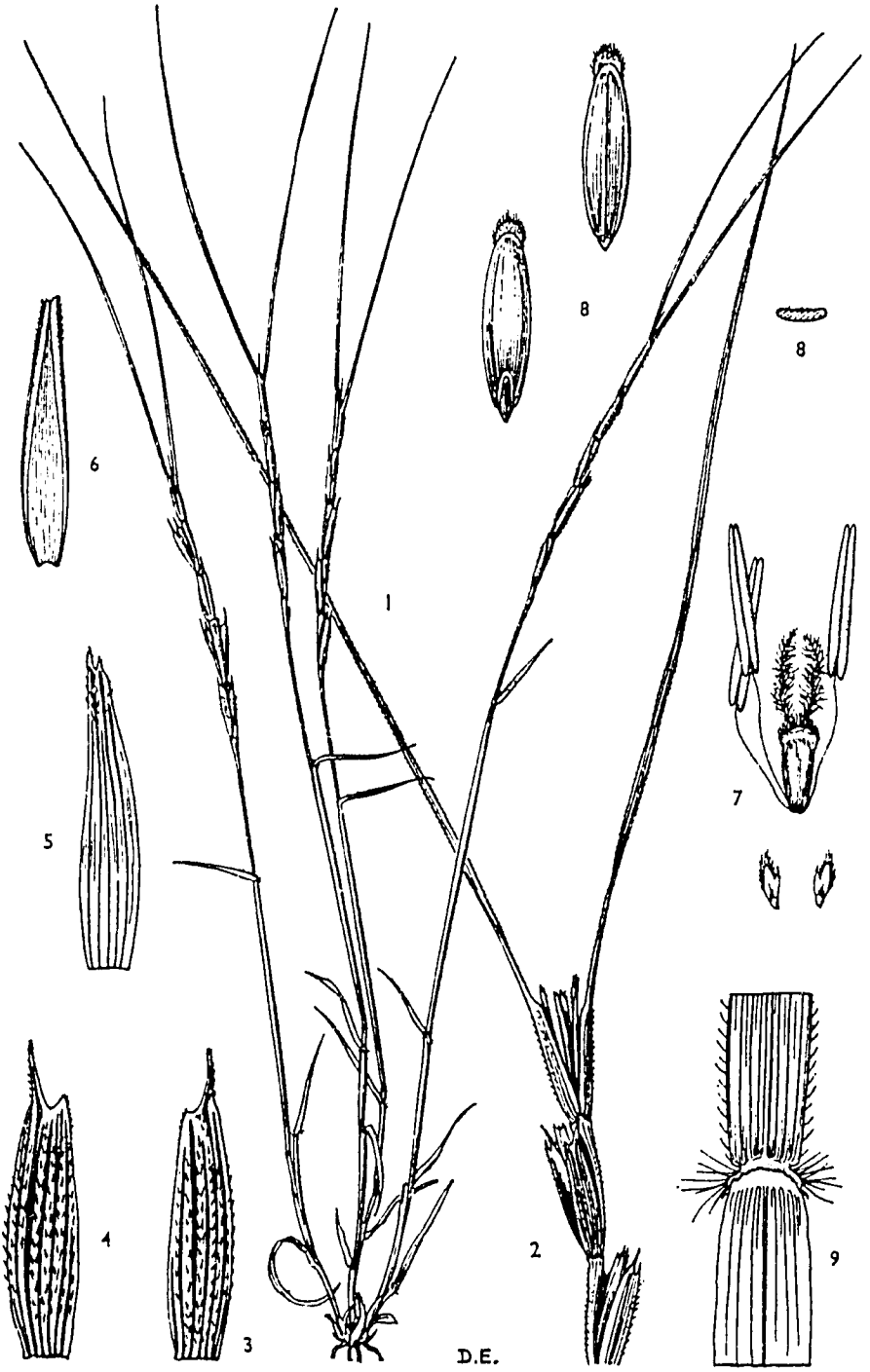
DE.

Figure 11. *A. caudata* L.

1, habit of whole plant, x 2/3; **2**, upper portion of inflorescence, x 2; **3**, lower glume, x 4; **4**, upper glume, x 4; **5**, lowest lemma, x 4; **6**, its palea, x 4; **7**, flower, x 4; **8**, grain, x 4; **9**, ligule, x 3.

(Helbaek 1796, from Bor, 1968).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D.E.

Figure 12. *A. cylindrica* Host

1, Habit of whole plant, drawn dry from herbarium sheet; **2, 3,** Glumes of uppermost spikelet; **4,** Lemma of uppermost spikelet (from lowest floret in spikelet); **5, 6,** Glumes of lowest fertile spikelet; **7,** Lemma of lowest fertile spikelet (from lowest floret in spikelet).

Note ornamentation (hairs, teeth) of glume veins is not indicated.

(Robert Lonard 2328 (MANCH)).

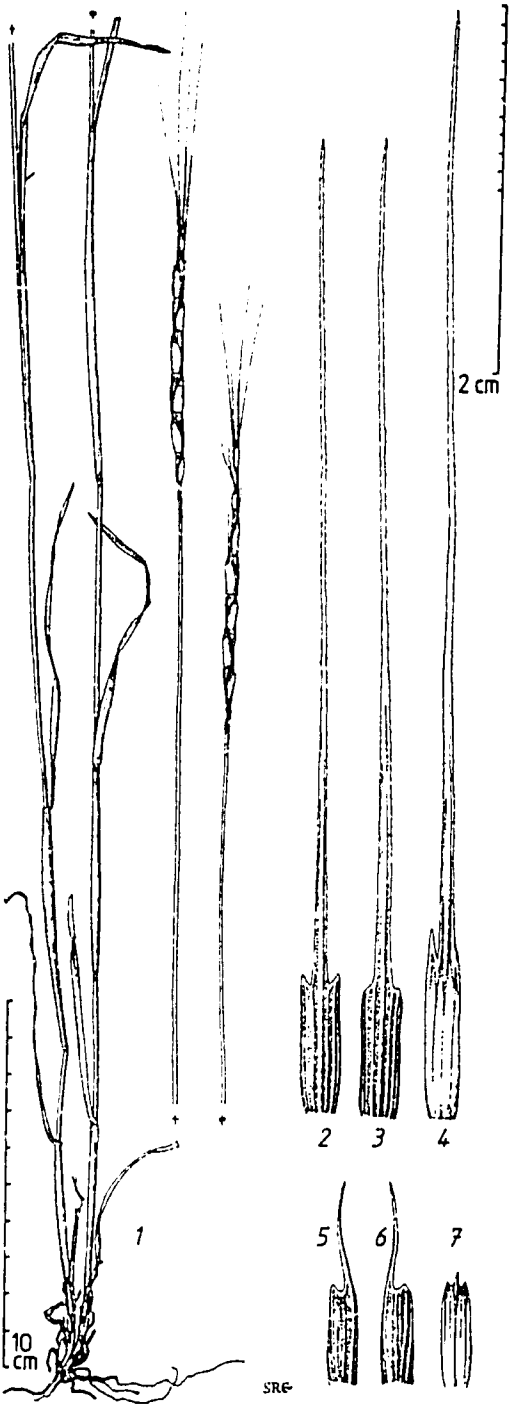

2 cm
10 cm
1
2
3
4
5
6
7
SRE

Figure 13a. *A. comosa* Sibth. et Sm.

1, Habit of whole plant, drawn dry from herbarium sheet; **2**, **3**, Glumes of uppermost spikelet; **4**, Lemma of uppermost spikelet (from lowest floret in spikelet); **5**, **6**, Glumes of lowest fertile spikelet; **7**, Lemma of lowest fertile spikelet (from lowest floret in spikelet); **8**, ornamentation from vein on glume.

Not a typical specimen as some terminal spikelets are single awned.

(Arro-Corinthe (MANCH)).

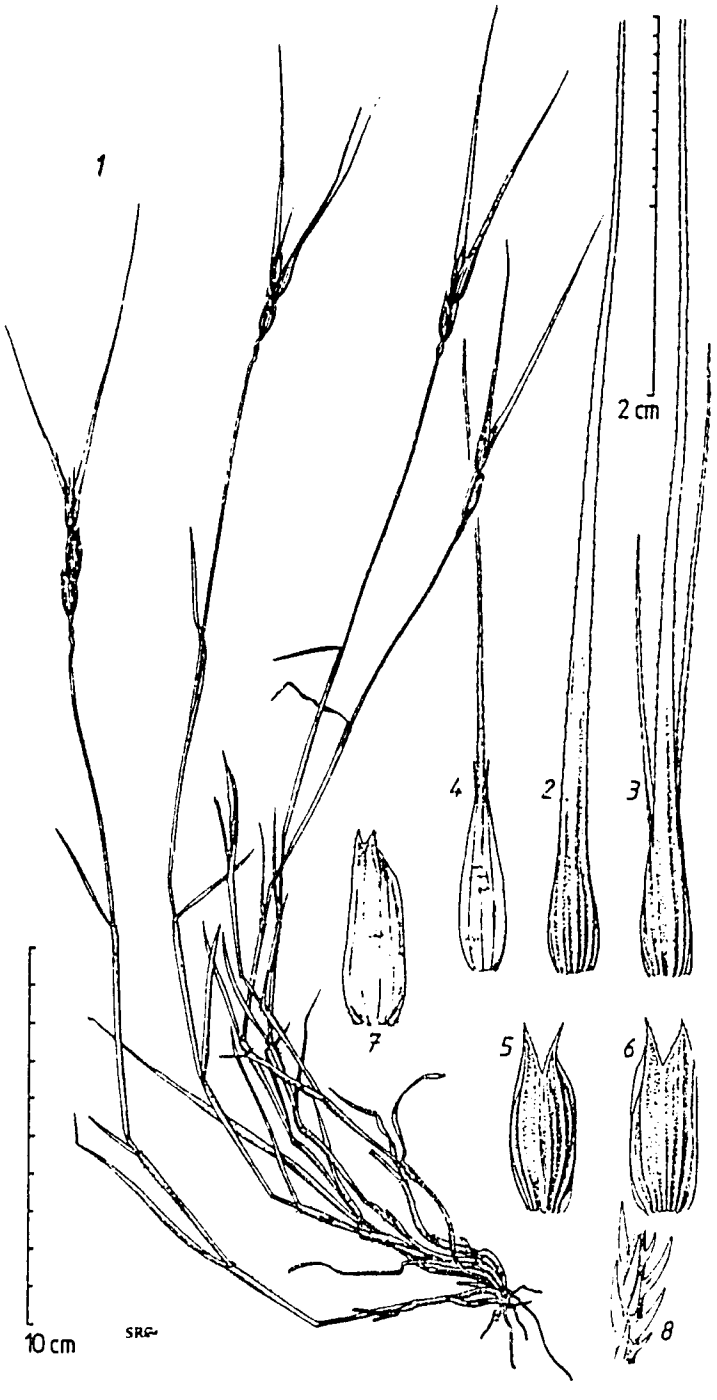

1
2 cm
4
2
3
7
5
6
8
10 cm
SRG

Figure 13b. *A. comosa* Sibth. et Sm.

e2, e3, e4, subsp. *eu-comosa* Eig var. *typica;* **h2, h3, h4,** subsp. *heldreichii* (Holz.) Eig; **2, 3,** Glumes of uppermost spikelet; **4,** Lemma of uppermost spikelet.

Note the diffrence between the typical form of *A. comosa* (three awned terminal glumes) and that of subsp. *heldreichii* (shorter awns, one glume three awned, the other single awned).

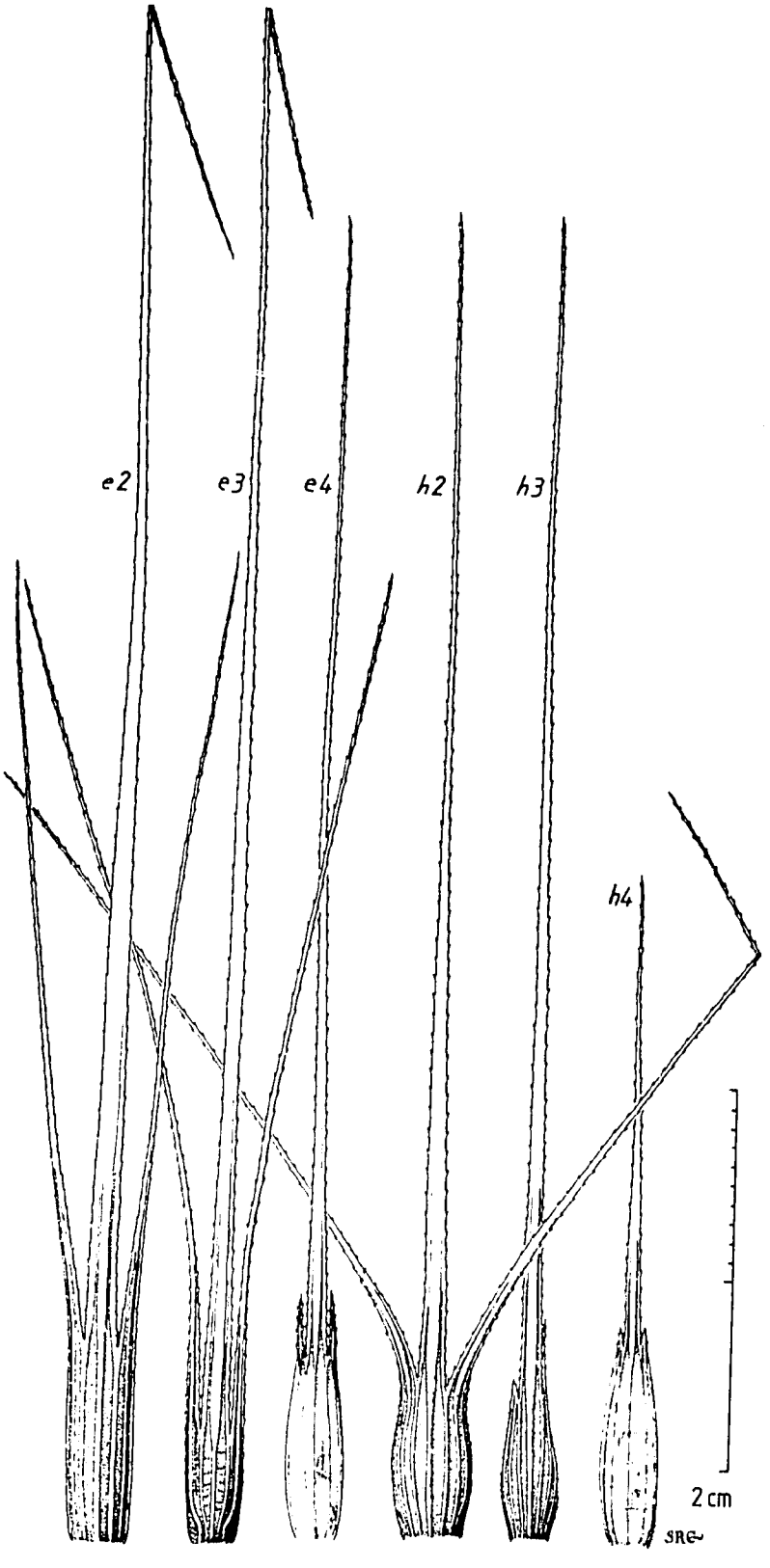

e2
e3
e4
h2
h3
h4
2 cm
SRG

Figure 14. *A. umbellulata* Zhuk.

1, habit of whole plant, x 2/3; **2**, lower glume, x 3; **3**, upper glume, x 3; **4**, lowest lemma, x 3; **5**, its palea, x 3; **6**, florets above lowest, x 3; **7**, flower, x 4; **8**, grain, x 4; **9**, ligule, x 6.

(Haines W. 1894, from Bor, 1968).

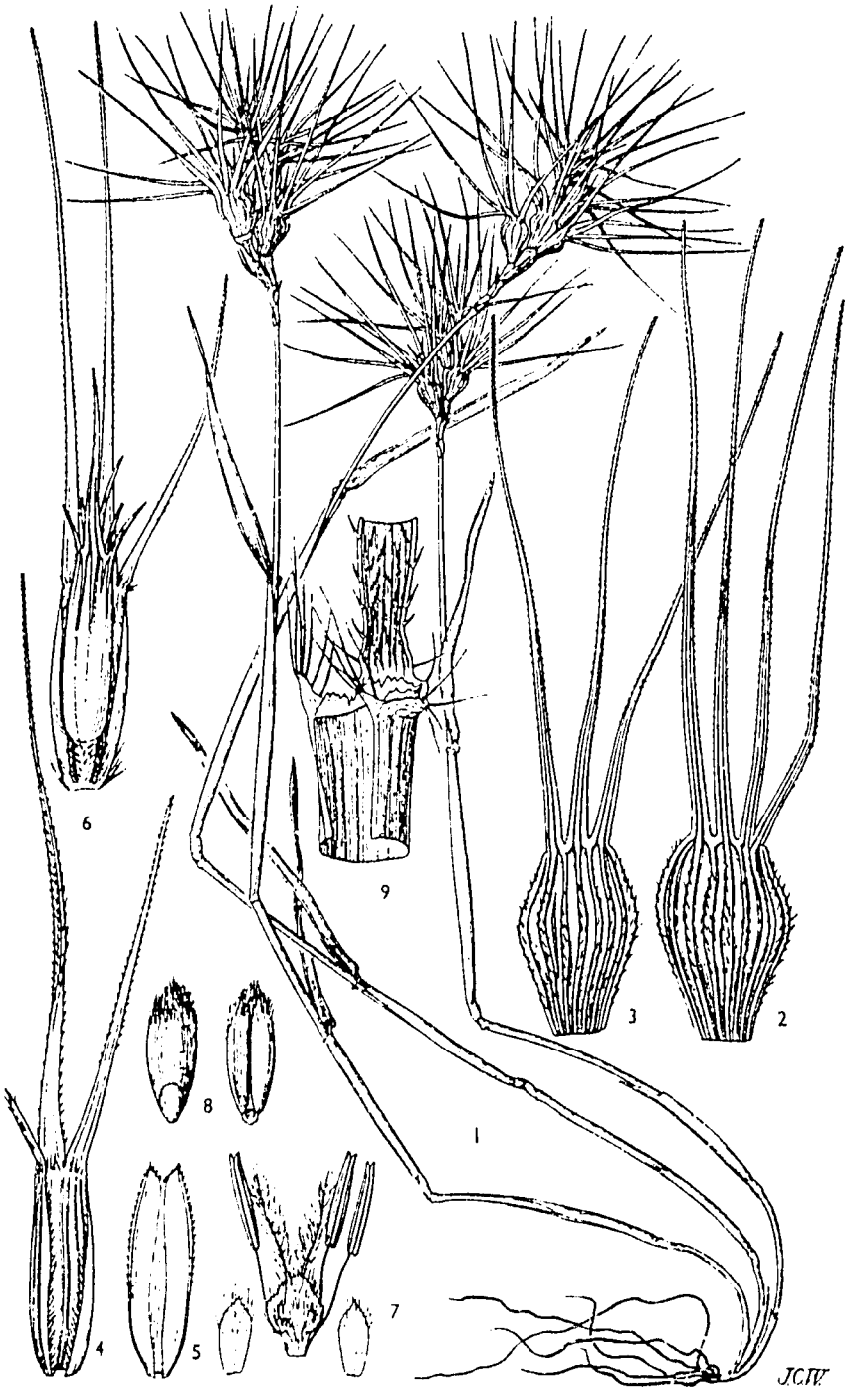
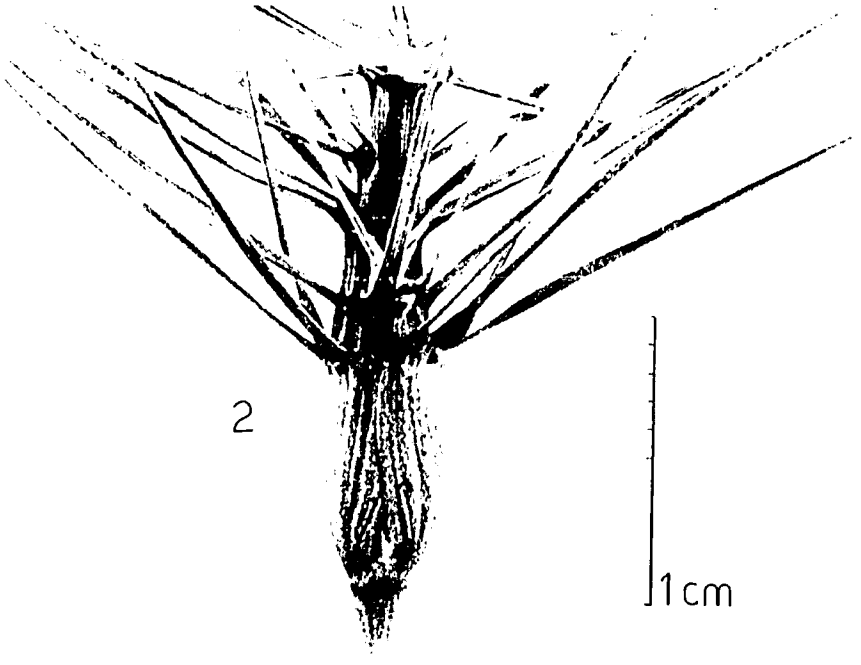

6
9
3
2
8
1
4
5
7
JCW

Figure 15. *A. ovata* L.

1, spike; **2**, spikelets.
Specimen from N. Syria (coll. J.R. Witcombe).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1cm

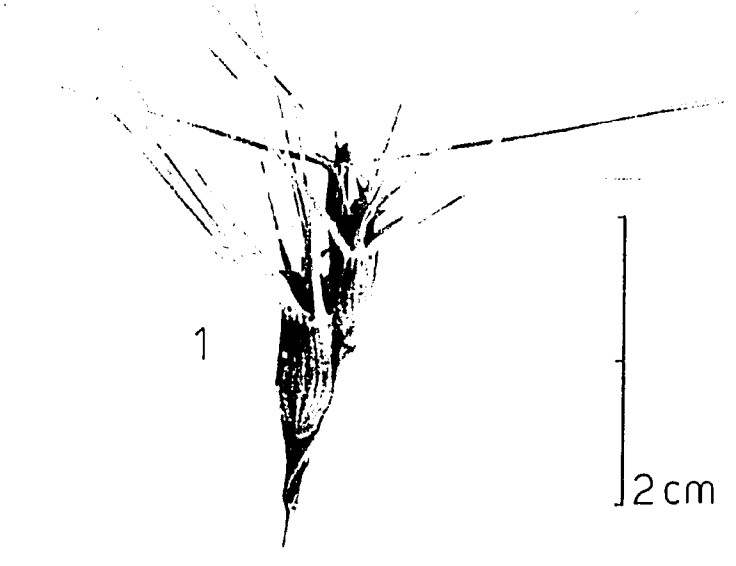

1
2cm

Figure 16. *A. triaristata* Willd.

1, Habit of whole plant, drawn from herbarium sheet; **2, 3,** Glumes of uppermost spikelet; **4,** Lemma of uppermost spikelet (from lowest floret in spikelet); **5, 6,** Glumes of lowest fertile spikelet; **7,** Lemma of lowest fertile spikelet (from lowest floret in spikelet).

Note ornamentation (hairs, teeth) of glume veins is not indicated.

(F. de Parseval Grandmaison, s.n. (MANCH)).

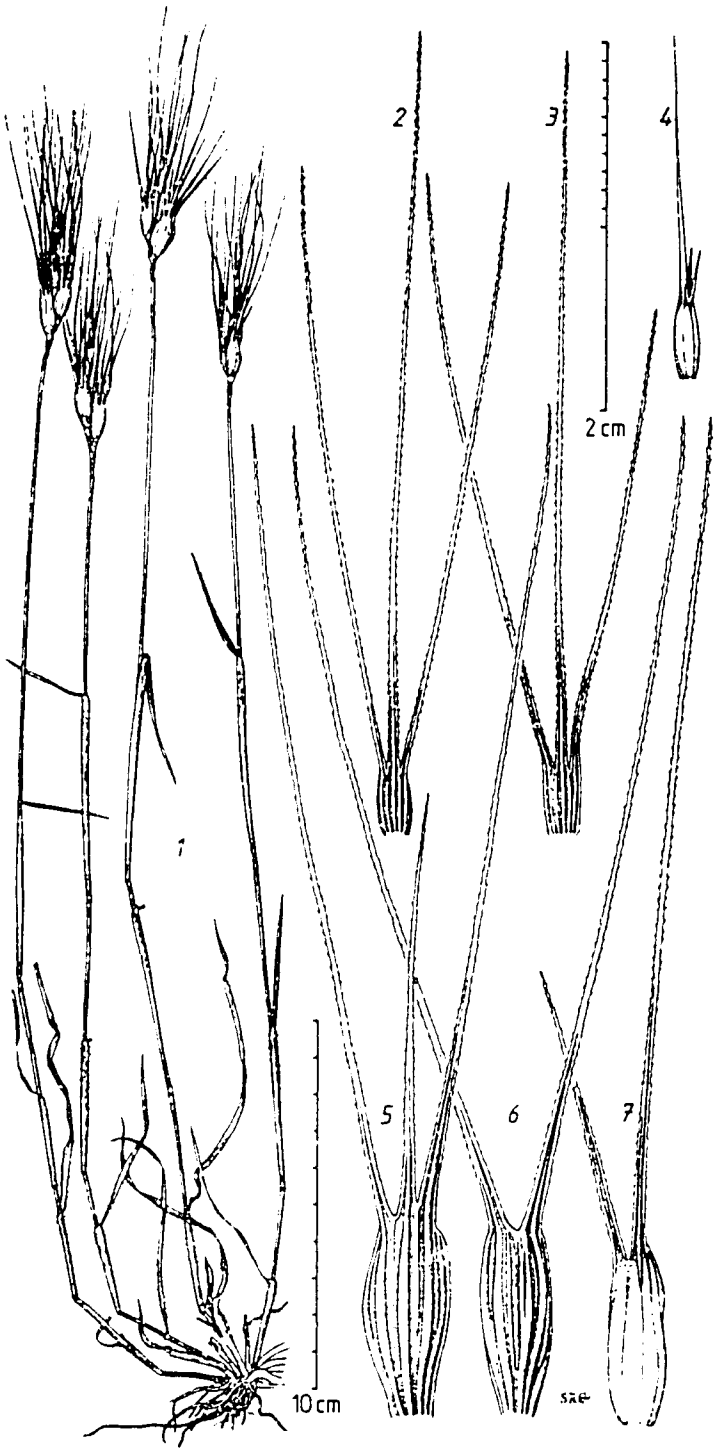

1
2
3
4
5
6
7
2 cm
10 cm

Figure 17. *A. columnaris* Zhuk.

1, habit of whole plant, x 2/3; **2**, spikelets and vestigial spikelets, x 2; **3**, lower glume, x 2; **4**, upper glume, x 2; **5**, lowest lemma, x 2; **6**, its palea, x 2; **7**, second lemma, x 2; **8**, its palea, x 2; **9**, upper sterile florets, x 2; **10**, flower, x 2; **11**, grain, x 2; **12**, ligule, x 2.

(Davis and Hedge D. 29108, Turkish material, from Bor, 1968).

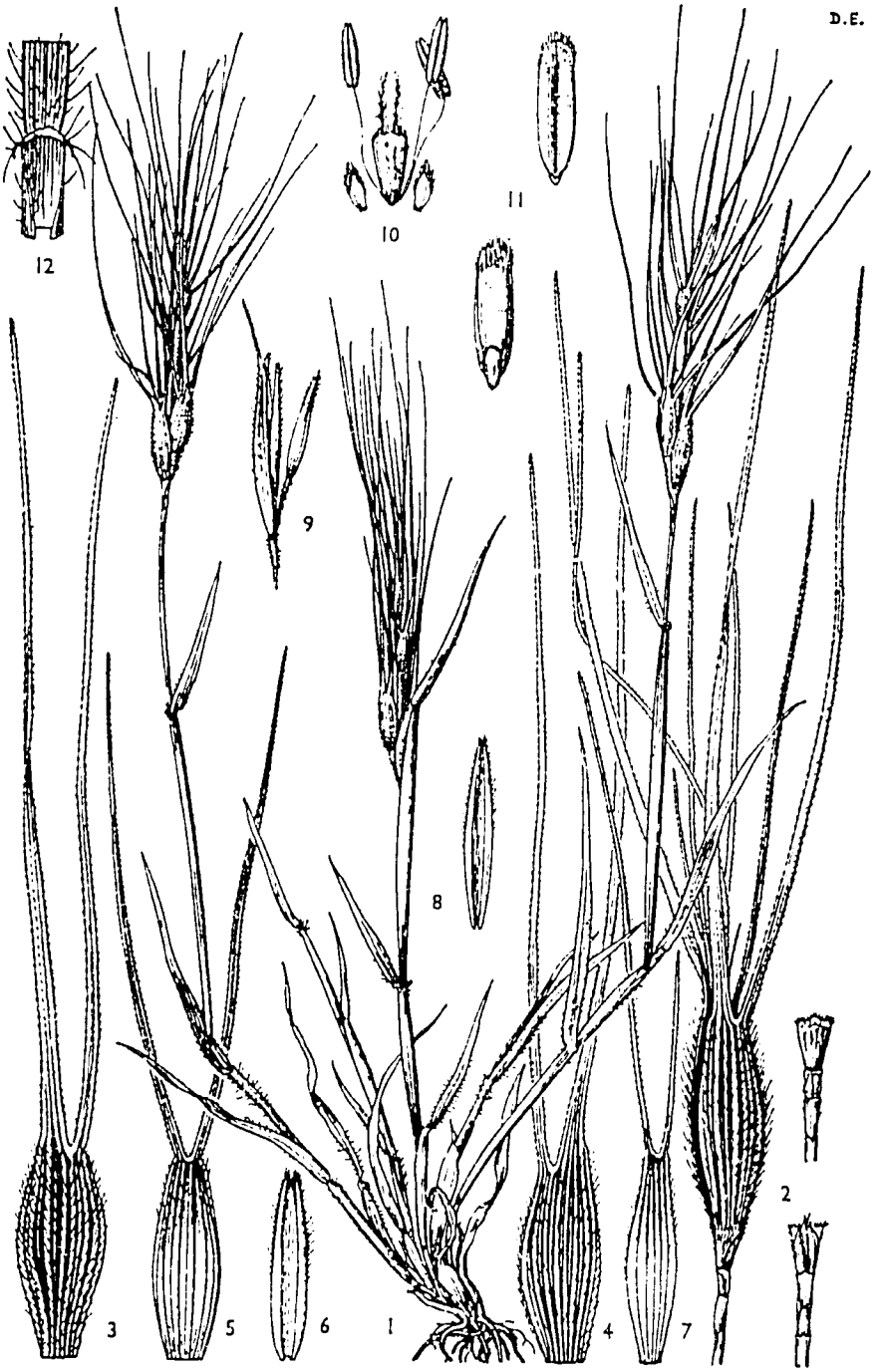

D.E.
12
10
11
9
8
2
3
5
6
1
4
7

Figure 18. *A. lorentii* Hochst.

1, spike; **2**, spikelets.
Specimen from Aleppo, N. Syria (coll. J.R. Witcombe).


1
2 cm
2
1 cm

Figure 19. *A. peregrina* (Hack.) Maire et Weill.

1, Habit of whole plant, drawn dry from herbarium sheet; **2**, **3**, Glumes of uppermost spikelet; **4**, Lemma of uppermost spikelet (from lowest floret in spikelet); **5**, **6**, Glumes of lowest fertile spikelet; **7**, Lemma of lowest fertile spikelet (from lowest floret in spikelet).

Note ornamentation (hairs, teeth) of glume veins is not indicated.

(J.R. Witcombe, s.n., April 1980 (MANCH)).

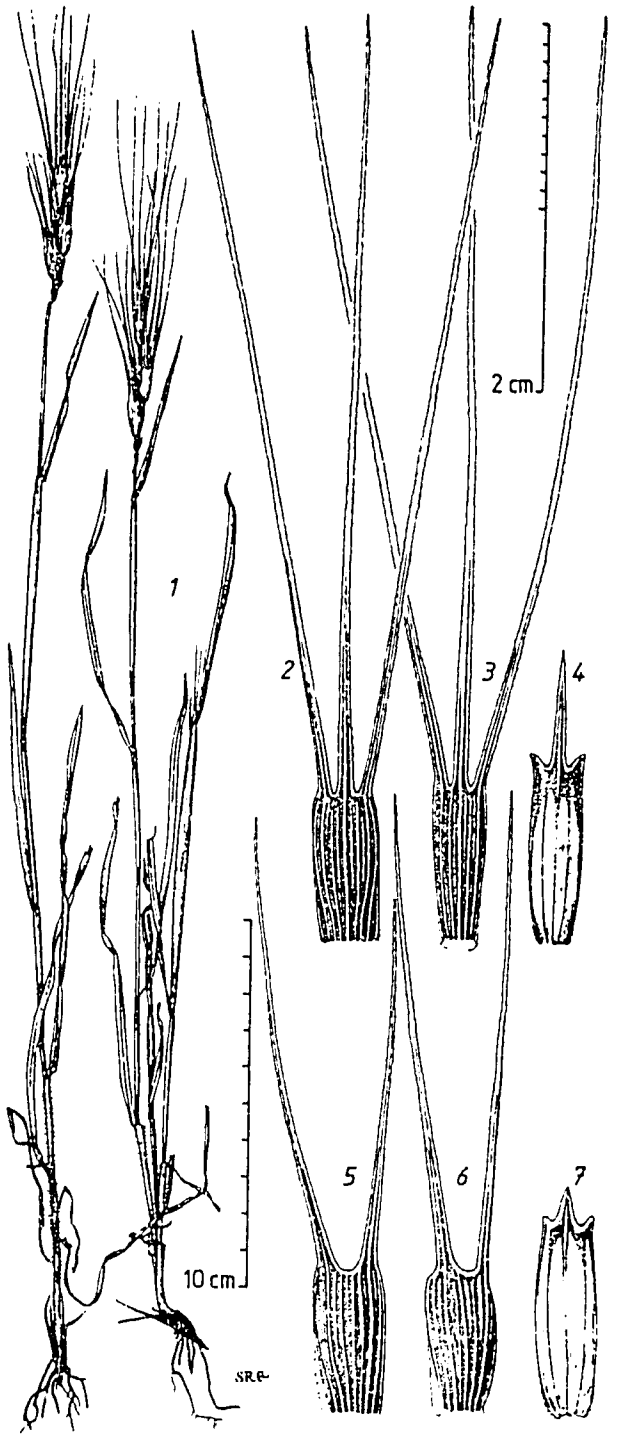

1
2
3
4
5
6
7
2 cm
10 cm

Figure 20a. *A. triuncialis* L.

1, Habit of whole plant, x 1; **2,** terminal spikelet, x 3; **3,** basal portion of the inflorescence, x 3; **4,** lower glume, x 4; **5,** upper glume, x 4; **6,** lemma, x 4; **7,** palea, x 4; **8,** flower, x 8; **9,** grain, x 6; **10,** ligule, x 8.

(**1** and **3, 4-10** from Haines W. 16420, **2** from Gillett 8312, from Bor, 1968).

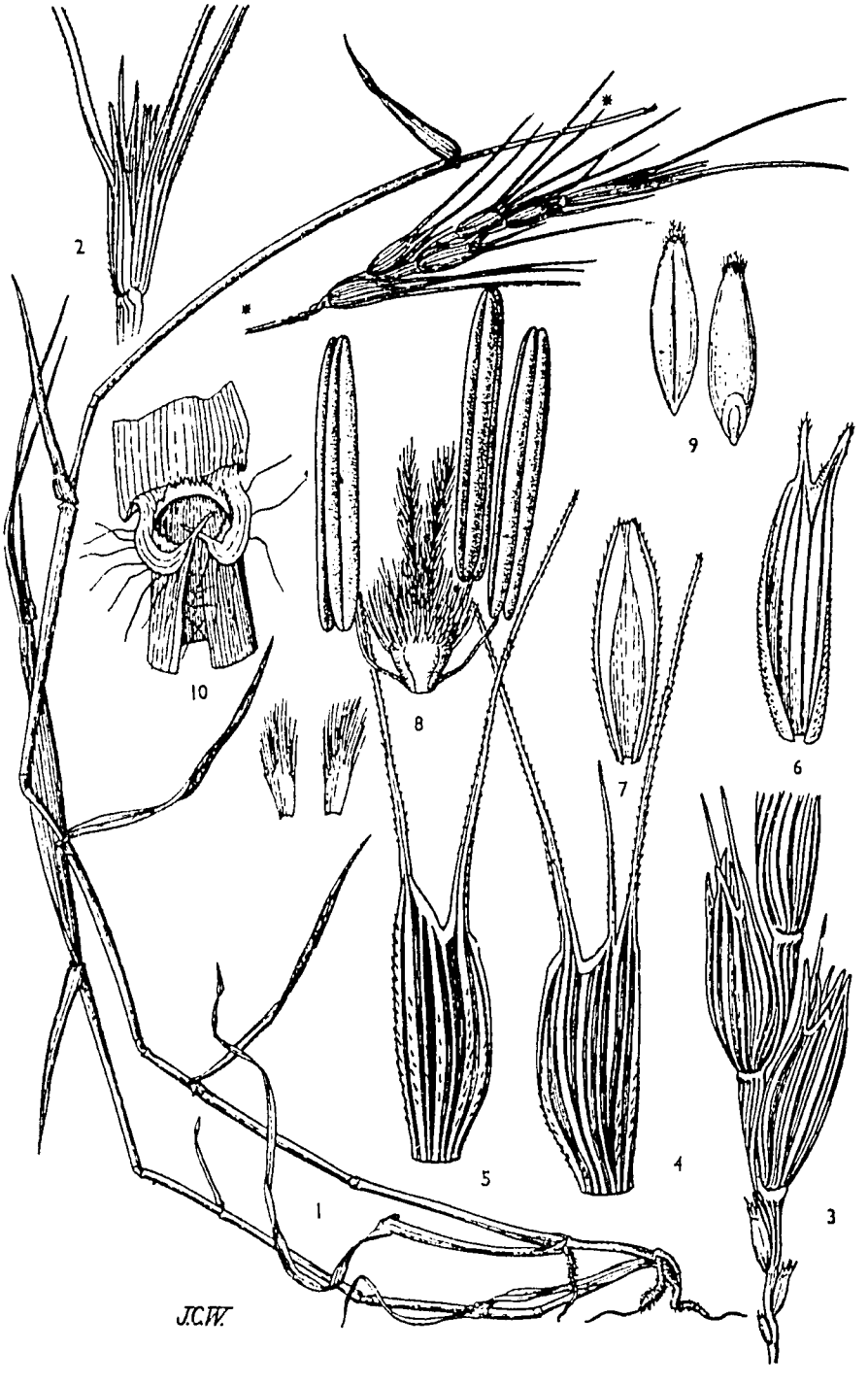
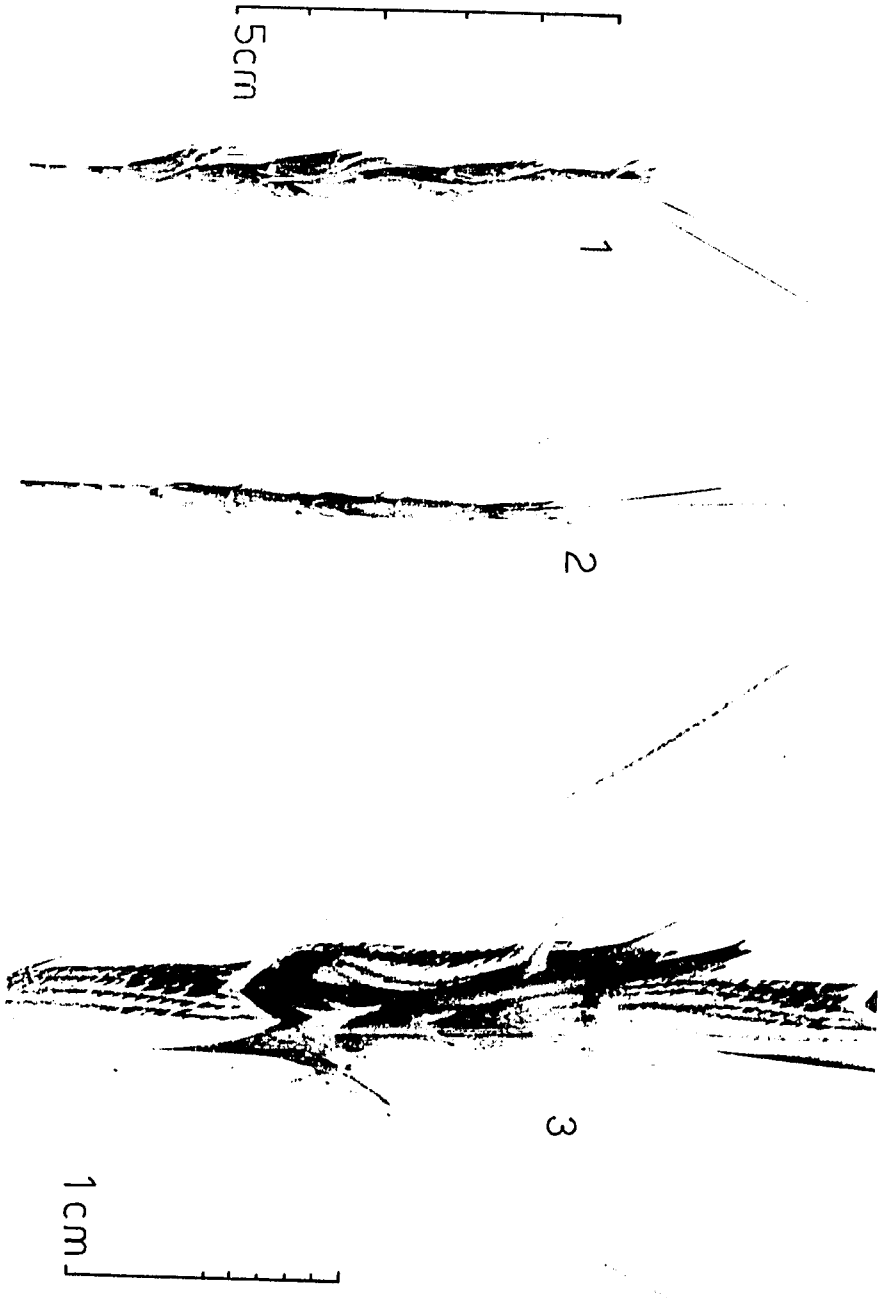

2
10
8
9
6
7
5
4
3
1
J.C.W.

Figure 20b. *A. triuncialis* L. var. *assyriaca* Eig

1, two-rowed profile of spike; **2**, spike face view; **3**, detail of spikelets.

Specimen from N. Syria (coll. J.R. Witcombe).


5cm
1
2
3
1cm

Appendix 1. Classification of *Aegilops* into sections according to Eig and Zhukovsky

Eig (1929)	Zhukovsky (1928)
ANATHERA	AMBYLOPYRUM
*A. mutica**	*A. mutica*
PLATYSTACHYS	SITOPSIS
A. bicornis	*A. bicornis*
A. sharonensis	
A. longissima	*A. longissima*
A. liguistica	*A. aucheri*
A. speltoides	*A. speltoides*
PACHYSTACHYS	VERTEBRATA
A. squarrosa	*A. squarrosa*
A. crassa	
A. juvenalis	GASTROPYRUM
A. ventricosa	*A. ventricosa*
MONOLEPTATHERA	CYLINDROPYRUM
A. cylindrica	*A. cylindrica*
MACRATHERA	COMOPYRUM
A. caudata	*A. caudata*
A. comosa	*A. comosa* and *A. heldreichii (=comosa)*
A. uniaristata	*A. uniaristata*
PLEIONATHERA	POLYEIDES
A. umbellulata	*A. umbellulata*
A. variabilis	
A. kotschyi	
A. triuncialis	
A. columnaris	
A. biuncialis	*A. biuncialis*
A. triaristata	*A. triaristata*
A. ovata	*A. ovata*
	A. crassa
	A. turcomanica (=juvenalis)
	SURCULOSA
	A. triuncialis ssp. *brachyathera (=triuncialis)*
	A. triuncialis ssp. *kotschyi (=kotschyi)*
	A. columnaris

*Later placed in genus *Ambylopyrum* by Eig as *Ambylopyrum muticum* (Boiss.) Eig. Even though Eig's classification was more closely followed by Kihara the section names used by Kihara were taken from Zhukovsky (1928) since these had priority.

Appendix 2. Common Synonyms of *Aegilops*

(a) Synonyms due to revision of taxonomy or priority of publication.

Valid Name		Invalid Name
A. comosa Sibth. et Sm.	=	*A. heldreichii* Holzm.
A. juvenalis Thell.	=	*A. turcomanica* Rosh.
A. lorentii Hochst.	=	*A. biuncialis* Vis.
A. mutica Boiss.	=	*Ambylopyrum muticum* (Boiss.) Eig*
A. peregrina (Hack.) Maire et Weill.	=	*A. variabilis* Eig
A. speltoides Tausch	=	*A. aucheri* Boiss.
A. squarrosa L.	=	*A. tauschii* Coss.**
A. triuncialis L.	=	*A. bushirica* Rosh.
A. vavilovii (Zhuk.) Chenn.	=	*A. crassa* Boiss. ssp. *vavilovii* Zhuk.
	=	*A. crassa* Boiss. ssp. *palaestina* Eig

*A separate genus *Ambylopyrum* is accepted by some (e.g. Bor, 1968).
**Invalid name but some authors will regard it as valid.

(b) Synonyms due to the lumping or splitting of species.

A. ligustica (Savign.) Coss.	in	*A. speltoides* Tausch
A. peregrina (Hack.) Maire et Weill	in	*A. kotschyi* Boiss.
A. sharonensis Eig	in	*A. longissima* Schweinf. et Muschl.
A. searsii Feld. et Kis.	in	*A. longissima* Schweinf. et Muschl.
A. triaristata Willd.	divided into	*A. triaristata* Willd. s. str. and *A. recta* (Zhuk.) Chenn.

(c) Synonyms after Hammer (1980).

Hammer has argued that not only is *A. squarrosa* L. an invalid name but that the following revisions should also be made.

A. markgrafii Greuter	=	*A. caudata* L.
A. geniculata Roth	=	*A. ovata* L.
A. neglecta Req. ex Bertool.	=	*A. triaristata* Willd.

A more conservative nomenclature has been adopted here and the evidence that *A. squarrosa* is an invalid name has been considered and rejected.

Appendix 3. Synonyms When Genus *Aegilops* is Placed in Genus *Triticum*

A. mutica Boiss.	= *T. muticum* (Boiss.) Hack.
A. speltoides Tausch	= *T. speltoides* (Tausch) Gren. ex Richter
A. ligustica (Savign.) Coss.	= *T. tripsacoides** (Jaub. & Spatch) Bowden
A. longissima Schweinf. & Muschl. *A. sharonensis* Eig	= *T. longissimum* (Schweinf. & Muschl.) Bowden
A. bicornis (Forsk.) Jaub. & Spach.	= *T. bicorne* (Forsk.)
A. searsii Feld. & Kis.	= *T. searsii* Feld. & Kis.
A. squarrosa L.	= *T. squarrosum* (L.) Raspail
	= *T. aegilops** P. Beauv. ex R. & S.
	= *T. tauschii** (Coss.) Schmalh.
A. crassa Boiss.	= *T. crassum* (Boiss.) Aitch. & Hemsel
A. vavilovii (Zhuk.) Chenn.	= *T. syriacum** Bowden
A. ventricosa Tausch	= *T. ventricosum* Ces., Pass & Gib.
A. juvenalis (Thell.) Eig	= *T. juvenale* Thell.**
A. caudata L.	= *T. caudatum* (L.) Godr. & Gren.
	= *T. dichasians** (Zhuk.) Bowden
A. cylindrica Host	= *T. cylindricum* Ces., Pass. & Gib.
A. comosa Sibth. & Sm.	= *T. comosum* (Sibth. & Sm.) Richter
A. uniaristata Vis.	= *T. uniaristatum* (Vis.) Richter
A. umbellulata Zhuk.	= *T. umbellulatum* (Zhuk.) Bowden
A. ovata L.	= *T. ovatum* (L.) Raspail

*Invalid names though many of them incorrectly listed by Bowden (1959) and in common use. The botanical rules of nomenclature state that in the case of a change in genera the oldest specific epithet of the base name (*basionym*) should be used; in all cases the *basionym* is in the genus *Aegilops*. *T. vavilovii* (Zhuk.) remains to be cited. In any event *T. aegilops* should not be used as a synonym for *A. squarrosa* as it is an invalid name *(nomen nudum)*.

**Bowden (1959) listed both *T. turcomanicum* and *T. juvenale* as species but Eig (1929) records these as synonyms.

A. triaristata Willd.	=	*T. triaristatum* (Willd.) Godr. & Gren.
A. columnaris Zhuk.	=	*T. columnare* (Zhuk.) Morris & Sears
A. lorentii Hochst.	=	*T. lorentii* (Hochst.) Zeven
	=	*T. machrochaetum* * (Shuttl. & Huet) Richter
A. kotschyi Boiss.	=	*T. kotschyi* (Boiss.) Bowden
A. peregrina (Hack.) Maire & Weill.	=	*T. peregrinum* Hack.
A. triuncialis L.	=	*T. triunciale* (L.) Raspail