Detectable Endosperm in Grass Seed Units Survey Results

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The AOSA/SCST Purity Committee conducted a survey to determine the types and predominance of grass species seed analysts encounter for purity analyses and how determination of pure seed with respect to caryopsis size or detectable endosperm is made. Species requiring application of the Uniform Blowing Method during purity analysis were not included in this survey (except for comments made under question 12). We received 30 responses, some from individuals and some submitted as a single group response of all analysts within a lab. Each group response sheet was scored only once. We thank respondents for taking the time to participate in this very important survey.

1. Do you test lawn grass species on a regular basis? Yes = 28 (93%); No = 2 (7%)

2. Do you test grain type species on a regular basis? Yes = 29 (97%); No = 1 (3%)

3. Do you test native grass species on a regular basis? Yes = 19 (63%); No = 11 (37%)

4. We asked how many respondents test the kinds of grass seeds assigned to PSU 21, 22, 23 where the pure seed unit must contain a caryopsis that is at least 1/3 the length of the palea measured from the base of the rachilla. A tally of responses for species tested, grouped by PSU number, are show in descending order of frequency.

Number of analysts testing the species	PSU	Kind of Seed
29†‡	21	*Festuca arundinacea* Schreb., tall fescue
29†‡	21	*Lolium perenne* L., perennial ryegrass
27†‡	21	*Lolium multiflorum* Lam., annual ryegrass (Italian ryegrass)
22†‡	21	*Lolium ×hybridum* Hausskn., intermediate ryegrass
18†	21	*Bromus* spp., brome
18‡	21	*Festuca* spp., fescue
16†	21	*Elymus trachycaulus* (Link) Gould ex Shinners subsp. *trachycaulus*, slender wheatgrass
15‡	21	*Festuca pratensis* Huds. meadow fescue
14†	21	*Bromus carinatus* Hook & Arn. var. *marginatus* (Steud.) Barkworth & Anderton, mountain brome
14†	21	*Elymus elymoides* (Raf.) Swezey, bottlebrush-squirreltail
13†	21	*Elymus canadensis* L., Canada wildrye
11†	21	*Leymus cinereus* (Scribn. & Merr.) Á. Löve, basin wildrye
11	21	*Pseudoroegneria spicata* (Pursh) Á. Löve, beardless wheatgrass
9†	21	*Psathyrostachys juncea* (Fisch.) Nevski, Russian wildrye
8†	21	*Elymus wawawaiensis* J. R. Carlson & Barkworth, Snake River wheatgrass
7†	21	*Bromus catharticus* Vahl var. *catharticus*, rescuegrass
6†	21	*Bromus arvensis* L., field brome
5	21	*Festuca roemeri* (Pavlick) E. B. Alexeev, Roemer's fescue
4†	21	*Bromus hordeaceus* L., soft chess
4	21	*Festuca filiformis* Pourr., hair fescue
2†	21	*Elymus macrourus* (Turcz. ex Steud.) Tzvelev Tufted wheatgrass, angara wheatgrass
27†‡	22	*Festuca rubra* L. subsp. *rubra*, red and creeping red fescue
25†‡	22	*Festuca rubra* L. subsp. *commutata* Markgr-Dann., chewings fescue
23†‡	22	*Festuca trachyphylla* (Hack.) Krajina, hard fescue
22†	22	*Bromus inermis* Leyss. subsp. *inermis*, smooth brome
15†‡	22	*Festuca ovina* L., sheep fescue
15‡	22	*Pascopyrum smithii* (Rydb.) Barkworth & D.R. Dewey, western wheatgrass

Number of analysts testing the species	PSU	Kind of Seed
15	22	*Thinopyrum intermedium* (Host) Barkworth & D.R. Dewey subsp. *barbulatum* (Schur) Barkworth & D.R. Dewey, pubescent wheatgrass
15	22	*Thinopyrum intermedium* (Host) Barkworth & D.R. Dewey subsp. *intermedium*, intermediate wheatgrass
12	22	*Agropyron desertorum* (Fisch. ex Link) Schult., standard crested wheatgrass
11	22	*Agropyron cristatum* (L.) Gaertn., fairway crested wheatgrass
11	22	*Agropyron* spp., wheatgrass
11	22	*Thinopyrum ponticum* (Podp.) Barkworth & D.R. Dewey, tall wheatgrass
10†	22	*Elymus virginicus* L., Virginia wildrye
15†	23	*Bouteloua gracilis* (Kunth) Lag. ex Griffiths, blue grama

† At least one respondent considered the kind of seed difficult to conduct a purity analysis. See table under question #12 for details.

‡ At least one respondent indicated difficulty with separating seeds of closely related species.

5. We asked how many respondents test the kinds of grass seeds assigned to PSU 12, 13, 14, 15, 16, 17, and 18 where the pure seed unit must contain a caryopsis with some degree of endosperm development. A tally of responses for species tested, grouped by PSU number, are show in descending order of frequency. PSU 14 was divided into five subgroups based on similarity of spikelet structures.

Number of analysts testing the species	PSU	Scientific Name	Common Name
29‡	12	*Secale cereale* L. subsp. *cereale*	rye
28‡	12	×*Triticosecale* Wittm. ex A. Camus spp.	triticale
28‡	12	*Triticum aestivum* L. and other spp.	wheat (also durum)
24	12	*Phleum pratense* L.	timothy
16	12	*Eragrostis* spp.	lovegrass
15	12	*Eragrostis tef* (Zuccagni) Trotter	teff
13	12	*Achnatherum hymenoides* (Roem. & Schult.) Barkworth	Indian ricegrass
12†	12	*Achnatherum* spp.	needlegrass
12	12	*Nassella viridula* (Trin.) Barkworth	green needlegrass
11	12	*Deschampsia cespitosa* (L.) P. Beauv.	tufted hairgrass
11†	12	*Sporobolus cryptandrus* (Torr.) A. Gray	sand dropseed
10	12	*Eragrostis curvula* (Schrad.) Nees	weeping lovegrass
10	12	*Glyceria* spp.	mannagrass
10†	12	*Hesperostipa comata* (Trin. & Rupr.) Barkworth	needle-and-thread
9†	12	*Calamagrostis canadensis* (Michx.) P. Beauv.	bluejoint
9†	12	*Nassella* spp.	needlegrass
8	12	*Disakisperma* spp.	sprangletop
8	12	*Eragrostis trichodes* (Nutt.) Alph. Wood	sand lovegrass
7	12	*Calamovilfa* spp.	sandreed
7	12	*Deschampsia* spp.	hairgrass
7	12	*Distichlis* spp.	saltgrass
6†	12	*Achnatherum thurberianum* (Piper) Barkworth	Thurber needlegrass
6	12	*Calamagrostis* spp.	reedgrass
6†	12	*Hesperostipa* spp.	porcupine grass
5	12	*Vulpia* spp.	small fescue
4	12	*Heteropogon* spp.	tanglehead

Number of analysts testing the species	PSU	Scientific Name	Common Name
4	12	*Secale strictum* (C. Presl) C. Presl subsp. *strictum*	mountain rye
3	12	*Cortaderia* spp.	pampas grass
3	12	*Cynosurus cristatus* L.	crested dogtail
1†	12	*Aristida stricta* Michx.	pineland threeawn
1	12	*Catabrosa* spp.	whorlgrass
1	12	*Piptatherum miliaceum* (L.) Coss.	smilograss
13†‡	13	*Agrostis capillaris* L.	colonial bentgrass
13†‡	13	*Agrostis gigantea* Roth	redtop
13†‡	13	*Agrostis stolonifera* L. var. *palustris* (Huds.) Farw.	creeping bentgrass
12†	13	*Sporobolus* spp.	dropseed
10†	13	*Alopecurus pratensis* L.	meadow foxtail
10	13	*Spartina* spp.	cordgrass
8†	13	*Alopecurus arundinaceus* Poir.	creeping foxtail
8†	13	*Alopecurus* spp.	foxtail
8†	13	*Beckmannia* spp.	sloughgrass
7†‡	13	*Agrostis canina* L.	velvet bentgrass
5	13	*Muhlenbergia* spp.	muhly, scratch grass
2	13	*Zoysia japonica* Steud.	Japanese lawngrass
1	13	*Blepharoneuron* spp.	pine-dropseed
1	13	*Zoysia matrella* (L.) Merr.	manilagrass
27†‡	14 (1)	*Avena sativa* L.	oat and red oat
22‡	14 (1)	*Cynodon dactylon* (L.) Pers. var. *dactylon*	bermudagrass
13‡	14 (1)	*Cynodon dactylon* (L.) Pers. var. *aridus* J. R. Harlan & de Wet	giant bermudagrass
12†	14 (1)	*Koeleria macrantha* (Ledeb.) Schult.	prairie junegrass
8‡	14 (1)	*Poa secunda* J. Presl	Nevada bluegrass
6‡	14 (1)	*Poa annua* L.	annual bluegrass
5	14 (1)	*Chloris gayana* Kunth	rhodesgrass
5	14 (1)	*Holcus lanatus* L.	velvetgrass
2	14 (1)	*Melica* spp.	melicgrass
2‡	14 (1)	*Poa arachnifera* Torr.	Texas bluegrass
2‡	14 (1)	*Poa glauca* Vahl	glaucantha bluegrass
2‡	14 (1)	*Poa nemoralis* L.	wood bluegrass
16†	14 (2)	*Phalaris arundinacea* L.	reed canarygrass
12	14 (2)	*Oryza sativa* L.	rice
8	14 (2)	*Phalaris canariensis* L.	canarygrass
5	14 (2)	*Arrhenatherum elatius* (L.) P. Beauv. ex J. Presl & C. Presl	tall oatgrass
3	14 (2)	*Phalaris aquatica* L.	hardinggrass
2	14 (2)	*Anthoxanthum odoratum* L.	sweet vernalgrass
1	14 (2)	*Ehrharta calycina* Sm.	perennial veldtgrass

Number of analysts testing the species	PSU	Scientific Name	Common Name
1	14 (2)	*Melinis minutiflora* P. Beauv.	molassesgrass
23†‡	14 (3)	*Panicum miliaceum* L. subsp. *miliaceum*	proso millet
18†‡	14 (3)	*Panicum virgatum* L.	switchgrass
17†	14 (3)	*Echinochloa frumentacea* Link	Japanese millet
15†	14 (3)	*Setaria italica* (L.) P. Beauv. subsp. *italica*	Italian millet
14†‡	14 (3)	*Urochloa ramosa* (L.) T. Q. Nguyen	browntop millet
13†	14 (3)	*Paspalum notatum* Flüggé	bahiagrass (cultivars other than 'Pensacola')
10†‡	14 (3)	Panicum spp.	*Panicum* spp., panicgrass
9†	14 (3)	*Paspalum* spp.	paspalum
8†‡	14 (3)	*Coleataenia* spp.	panicum
5†	14 (3)	*Digitaria* spp.	cottontop, crabgrass
4	14 (3)	*Axonopus fissifolius* (Raddi) Kuhlm.	carpetgrass
3†	14 (3)	*Paspalum dilatatum* Poir.	dallisgrass
2†‡	14 (3)	*Coleataenia anceps* (Michx.) Soreng	beaked panicgrass
2†	14 (3)	*Panicum antidotale* Retz.	blue panicgrass
1†‡	14 (3)	*Megathyrsus maximus* (Jacq.) B. K. Simon & S. W. L. Jacobs	Guineagrass, green panicgrass
1†	14 (3)	*Paspalum urvillei* Steud.	vaseygrass
27	14 (4)	*Zea mays* L. subsp. *mays*	field corn and popcorn
24	14 (4)	*Zea mays* L. subsp. *mays*	sweet corn
29	14 (5)	*Hordeum vulgare* L. subsp. *vulgare*	barley
24‡	15	*Sorghum bicolor* (L.) Moench nothosubsp. *drummondii* (Steud.) de Wet ex Davidse	sudangrass
23‡	15	*Sorghum bicolor* (L.) Moench nothosubsp. *drummondii* (Steud.) de Wet ex Davidse	sorghum-sudangrass, shattercane
18‡	15	*Sorghum bicolor* (L.) Moench subsp. *bicolor*	sorghum (incl. grain, sweet, and forage cvs.)
12†	15	*Sorghastrum* spp.	indiangrass
11‡	15	*Sorghum bicolor* (L.) Moench subsp. *bicolor*	broomcorn
9	15	*Eremochloa ophiuroides* (Munro) Hack.	centipedegrass
9†	15	*Sorghastrum nutans* (L.) Nash	yellow indiangrass
6†	15	*Bothriochloa ischaemum* (L.) Keng	yellow bluestem
6‡	15	*Sorghum ×almum* Parodi	almum sorghum
5‡	15	*Sorghum halepense* (L.) Pers.	johnsongrass
4†	15	*Bothriochloa* spp.	beardgrass
3‡	15	*Sorghum* 'Sorgrass'	sorgrass
17†	16	*Schizachyrium scoparium* (Michx.) Nash	little bluestem
14†	16	*Andropogon* spp.	bluestem
8†	16	*Andropogon hallii* Hack.	sand bluestem

Number of analysts testing the species	PSU	Scientific Name	Common Name
3†	16	*Andropogon virginicus* L.	broomsedge bluestem
0†	16	*Andropogon gerardi* Vitman	Big bluestem
10	17	*Triticum aestivum* L. subsp. *spelta* (L.) Thell.	spelt
7	17	*Hordeum* spp.	meadow barley, wild barley
6†	17	*Pleuraphis jamesii* Torr.; full seed unit (caryopses only = 25)	galleta grass
5	17	*Triticum turgidum* L. subsp. *dicoccon* (Schrank) Thell.	emmer
4	17	*Hilaria* spp.	curly-mesquite, hilaria
1	17	*Eremopyrum* spp.	annual wheatgrass
1	17	*Pleuraphis* spp.	tobosagrass
20	18	*Cenchrus americanus* (L.) Morrone	pearl millet
7	18	*Cenchrus ciliaris* L.	buffelgrass
2	18	*Cenchrus purpureus* (Schumach.) Morrone	napiergrass

† At least one respondent considered the kind of seed difficult to conduct a purity analysis. See table under question #12 for details.
‡ At least one respondent indicated difficulty with separating seeds of closely related species.

6. We asked how respondents make the determination of pure seed versus inert matter for kinds that require a caryopsis to be at least 1/3 the length of the palea (e.g., *Lolium, Festuca, Thinopyrum, Pascopyrum*). Respondents were asked to mark all answers that applied.

    a. Only use a microscope and view seed units over a diaphanoscope. (5)
    b. Only use a hand-lens or magnifying lens and view seed units over a diaphanoscope. (4)
    c. Only use a microscope and apply slight pressure to the seed units. (1)
    d. Only use a hand-lens or magnifying lens and apply slight pressure to the seed units. (10)
    e. Use a combination of sight pressure and diaphanoscope while viewing seed units through a microscope. (11)
    f. Use a combination of sight pressure and diaphanoscope while viewing seed units through a hand-lens or magnifying lens. (10)
    g. Other, please explain. (3)

7. We asked what level of magnification is used for kinds related to question #6 above. Respondents were asked to mark all answers that applied.

    a. 0x (5)
    b. 7x (18)
    c. 10x (17)
    d. 20x (5)
    e. 30x (4)
    f. Other, please explain. (8) 1.8x, 2.5x, 3x, 4x, 5x, 6x, 0.5x – 2x and up to 20x

8. We asked how respondents make the determination of pure seed versus inert matter for kinds that require a caryopsis with some degree of endosperm (PSU 12, 13, 14, 15, 16, 17, and 18). Respondents were asked to mark all answers that applied.

    a. Only use a microscope and view seed units over a diaphanoscope. (4)
    b. Only use a hand-lens or magnifying lens and view seed units over a diaphanoscope. (1)
    c. Only use a microscope and apply slight pressure to the seed units. (3)
    d. Only use a hand-lens or magnifying lens and apply slight pressure to the seed units. (10)
    e. Use a combination of sight pressure and diaphanoscope while viewing seed units through a microscope. (10)
    f. Use a combination of sight pressure and diaphanoscope while viewing seed units through a hand-lens or magnifying lens. (13)
    g. Other, please explain. (6)

9. We asked if any of the following methods to aid in separating pure seed from inert matter are used for kinds of seed that require a caryopsis with some degree of endosperm (PSU 12, 13, 14, 15, 16, 17, and 18),. Respondents were asked to mark all answers that applied.

    a. Seed blower, use progressively increased air speed to separate empty/light seed units from caryopsis filled seed units. (28)
    b. Sieves, one or more sizes, to separate empty/light seed units from caryopsis filled seed units. (7)
    c. X-ray analysis, to determine if seed units contain a caryopsis. (0)
    d. Cutting or prying open the seed unit to search for a caryopsis. (8)
    e. Other, please explain (1)

10. We asked what level of magnification is used for kinds related to question #8 above. Respondents were asked to mark all answers that applied.

    a. 0x (6)
    b. 7x (17)
    c. 10x (16)
    d. 20x (9)
    e. 30x (4)
    f. Other, please explain. (7) 1.8x, 2.25x, 3x, 3.2x, 4x, 5x, 6x

11. We asked what method(s) are used to distinguish a caryopsis from other structures such as anthers or insects that may fill a seed unit, but are completed enclosed within the seed unit. Some respondents provided more than one method.

# of responses	Method
19	Slight pressure
15	Diaphanoscope
6	Blower
6	Open floret
6	Increased magnification
3	Comparison to other pure seed units
2	Cut open
1	Appears puffy
1	Appears flat
1	Appears spongy
1	Floret color appears different
1	Hold up to light
1	Sieving

12. We asked analysts to list the five species that they find most difficult to conduct a purity analysis on and why. Since the focus of the survey is grass species, non-grass responses received are not reported here. Responses are grouped into two general categories: (1) grass seed with pure seed issues and (2) grass seed with morphological species identification issues.

Grass seed units with pure seed issues

# responses	PSU #	Scientific name	Common name	Reason
1	12	*Achnatherum, Nassella, Hesperostipa*	Needlegrasses	• Thick lemma and palea make it hard to determine if caryopsis is present. • Often using pressure damages the caryopsis.
1	12	*Aristida* spp.	Purple threeawn	No reason given.
2	12	*Calamagrostis* spp.	Bluejoint and reedgrass	• Little hairs attach seeds to each other and to the inert matter. • Oily caryopses stick to forceps.
2	12	*Hesperostipa comata*	Needle and thread	No reason given.
1	12/13	*Sporobolus* spp.	dropseed	• Small seeds that are difficult to separate from soil/sand particles.
4	13	*Agrostis* spp.	Bentgrasses and redtop	• Small seeds that are difficult to separate from soil/sand particles.

# responses	PSU #	Scientific name	Common name	Reason
4	13	*Alopecurus* spp.	Creeping and Meadow foxtail	• Soft caryopses can be damaged when slight pressure is applied to determine if caryopsis is present.
1	13	*Beckmannia* spp.	Sloughgrass	• Structures make it difficult to determine if endosperm developed.
8	14(1)	*Avena sativa*	Oat	• Thick (sometimes dark) lemma and palea makes it difficult to evaluate and often needs more than slight pressure to determine if a caryopsis is present. • Lemma/palea not transparent using diaphanoscope. • Often using pressure damages the caryopsis. • Sometimes need to open the floret to see if caryopsis is present.
4	14(1)	*Koeleria macrantha*	Junegrass	• Difficult to determine presence of caryopsis. • Oily caryopses stick to forceps. • Caryopsis is extremely delicate and in some samples very fine and difficult to see without lots of magnification.
3	14(2)	*Phalaris arundinacea*	Reed canarygrass	• Thick/hard lemma and palea make it difficult to determine if caryopsis is present. • Diaphanoscope not useful. • Using pressure may damage the caryopsis. • Seed units slippery and hard to handle using forceps.
1	14(3)	*Digitaria* spp.	Cottontop	• Chaffy.
1	14(3)	*Echinochloa frumentacea*	Japanese millet	• Thick/hard lemma and palea make it difficult to determine if caryopsis is present. • Diaphanoscope not useful. • Using pressure may damage the caryopsis. • Seed units slippery and hard to handle using forceps.
5	14(3)	*Panicum virgatum*	Switchgrass	• Thick/hard lemma and palea make it difficult to determine if caryopsis is present. • Diaphanoscope not useful. • Using pressure may damage the caryopsis. • Seed units slippery and hard to handle using forceps. • Difficult to distinguish caryopsis from other structures and insects.
5	14(3)	*Panicum, Megathyrsus, Coleataenia*	Panicums	• Thick/hard lemma and palea make it difficult to determine if caryopsis is present. • Diaphanoscope not useful. • Using pressure may damage the caryopsis. • Seed units slippery and hard to handle using forceps.
4	14(3) 23	*Paspalum* spp.	Bahiagrass (non-pensacola)	• Thick/hard lemma and palea make it difficult to determine if caryopsis is present. • Diaphanoscope not useful. • Using pressure may damage the caryopsis. • Seed units slippery and hard to handle using forceps. • Florets with immature caryopses are difficult to distinguish from empty florets. • Difficult to distinguish caryopsis from other structures and insects.
2	14(3)	*Setaria* spp.	Setaria	• Thick/hard lemma and palea make it difficult to determine if caryopsis is present.

# responses	PSU #	Scientific name	Common name	Reason
				• Diaphanoscope not useful. • Using pressure may damage the caryopsis. • Seed units slippery and hard to handle using forceps.
2	14(3)	*Urochloa ramosa*	Browntop millet	• Thick/hard lemma and palea make it difficult to determine if caryopsis is present. • Diaphanoscope not useful. • Using pressure may damage the caryopsis. • Seed units slippery and hard to handle using forceps.
1	15	*Bothrichloa* spp.		• Opaque glumes make it difficult to determine if caryopsis present without applying pressure.
1	15	*Sorghastrum* spp.	Indiangrass	• Applying enough pressure to determine if caryopsis is present while not causing damage to the caryopsis.
3	16	*Andropogon gerardi*	Big bluestem	• Opaque glumes make it difficult to determine if caryopsis is present. • Diaphanoscope not useful. • Slight pressure not always discernable.
9	16	*Schizachyrium scoparium*	Little bluestem	• Opaque glumes make it difficult to determine if caryopsis is present. • Applying enough pressure to determine the floret is filled while not causing damage to the caryopsis. • Diaphanoscope not useful • Slight pressure not always discernable • Empty florets don't separate out from filled florets very well
3	17	*Pleuraphis jamesii*	galletagrass	• Opaque spikelets/florets and difficult to determine if caryopsis present without applying pressure. • Relatively large seed makes using light impossible for purities, so slight pressure is time consuming. • Empty spikelets/florets don't separate well from filled florets within the seed blower.
2	21	*Elymus, Leymus, Psathyrostachys*	Wildryes	• Often have larvae replacing caryopsis sometimes difficult to tell the difference.
6	21	*Festuca arundinacea*	Tall fescue	• Opaque florets and difficult to determine if caryopsis present without applying pressure.
2	21	*Lolium* spp.	Ryegrasses	• Opaque florets and difficult to determine if caryopsis present without applying pressure.
1	21/22	*Bromus* spp.	brome	• Opaque florets and difficult to determine if caryopsis present without applying pressure.
1	22	*Bromus inermis*	Smooth brome	• Determining length of caryopsis and separating multiple florets.
1	22	*Elymus virginicus*	Virginia wildrye	• Determining length of caryopsis.
8	22	*Festuca* spp.	Fine fescues	• Requires pressure to determine caryopses v. anthers. • Opaque florets and difficult to determine if caryopsis present without applying pressure.
1	23	*Bouteloua curtipendula*	Sideoats grama	• Applying enough pressure to the individual florets of units blown into the light fraction so that damage is not caused to individual caryopses. • Accidently removing floret(s) from the unit when applying pressure.

# responses	PSU #	Scientific name	Common name	Reason
				• Accidently popping the caryopsis out of the floret when applying pressure.
1	23	*Bouteloua gracilis*	Blue grama	No reason given.
1	23	*Poa pratensis*	Kentucky bluegrass – de-coated	• Time consuming because UBP is not applicable.
2	24	*Dactylis glomerata*	Orchardgrass	• Difficult to detect a caryopsis. • Separating singles and multiples for Canadian M&P seems to be a waste of time. Difficult to detect a caryopsis.

Grass seed with morphological species identification issues

# responses	PSU #	Scientific name	Common name	Reason
4	13	*Agrostis* spp.	Bentgrasses and redtop	Difficult to distinguish species. Heavily milled caryopses are indistinguishable.
8	14(1)	*Avena sativa*	Oat	Difficult to separate wild oat and feral oat from black oat and common oat.
6	14(1)	*Cynodon* spp.	Bermudagrass	Separation of giant from common.
6	21	*Festuca arundinacea*	Tall fescue	Difficult to separate from ryegrass.
3	21	*Festuca pratensis*	Meadow fescue	Difficult to separate from tall fescue, ryegrass and festulolium.
8	22	*Festuca* spp.	Fine fescues	Difficult to separate red, chewings, and hard fescues.
1	21	*Festuca* spp., *Lolium* spp., *Festulolium*	tall fescue, meadow fescue, ryegrass, and festulolium	Heavily milled caryopses are indistinguishable.
1	21	*Festulolium*	Festulolium	Hybrid that can look like ryegrass or tall or meadow fescue depending on the female used in the cross.
2	21	*Lolium* spp.	Ryegrasses	Consistently identifying tall fescue contamination.
5	14(3)	*Panicum, Megathyrsus, Coleataenia*	Panicums	Difficult to distinguish species.
1	22	*Pascopyrum smithii*	Western wheatgrass	Finding quackgrass contaminants.
6	14(3)	*Poa* spp.	Bluegrasses	Difficult to distinguish species. Difficult to separate Kentucky and rough bluegrasses. Heavily milled caryopses are indistinguishable.
1	15	*Sorghum* spp.	Sorghum	Separation of sorghum subspecies.
4	12	×Triticosecale	Triticale	Difficult to separate in a mixed sample with wheat or rye.
2	14(3)	*Urochloa ramosa*	Browntop millet	Hard to separate from Texas panicum and look alike millets.

13. We asked respondents to list any other grass species they test that do not appear on the lists for questions #4 and #5.

Bluestems – other than big or little, *Bromus ciliatus* (Fringed brome), *Bromus marginatus* (Mountain brome), *Chloris* spp. (windmillgrass), *Danthonia californica* (California oatgrass), *Elymus glaucus* (blue wildrye), *Elymus multisetus* (big squirreltail), *Festuca californica* (California fescue), *Festuca idahoensis* (Idaho fescue), *Hordeum brachyantherum* (meadow barley), *Leymus triticoides* (beardless wildrye), *Melica californica* (California oniongrass), *Melica imperfecta* (smallflower melicgrass), *Nassella cernua* (nodding needlegrass), *Nassella pulchra* (purple needlegrass), *Panicum hallii* (Hall's panicgrass), *Setaria vulpiseta* (plains bristlegrass),