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Agaricales of the Hawaiian Islands. 6. Agaricaceae I. Agariceae: *Agaricus* and *Melanophyllum*

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Nineteen species belonging to Tribe Agariceae (Agaricaceae) are reported from the Hawaiian Islands. This group, the dark spored members of the Agaricaceae, is represented in the Hawaiian Islands by eighteen species of *Agaricus* and one species of *Melanophyllum*. Of these species, all are found only in alien habitats, nine are new, and sixteen are first reports. All taxa are described, illustrated, and compared with phenetically similar taxa, and an artificial dichotomous key to aid in determining Hawaiian *Agaricus* and *Melanophyllum* species is presented.

Keywords: agarics, fungal systematics.

In this paper, the sixth installment of our ongoing study of the Agaricales of the Hawaiian Islands, nineteen species belonging to Tribe Agariceae (Agaricaceae) are reported. This group, the dark spored members of the Agaricaceae, is represented in the Hawaiian Islands by eighteen species of *Agaricus* and one species of *Melanophyllum*. Of these, nine are new species and sixteen are first reports. Prior to our investigation, only four species in the tribe had been reported from the Hawaiian Islands, viz. *A. campestris* L: Fr. (Arnold, 1944), *A. comtulus* Fr. (Ueki, 1973), *A. diminutivus* Peck (Ueki, 1973), and *A. praeclaresquamosus* Freeman (Ueki, 1973, as *A. meleagris* Jul. Schäff.).

Because these fungi were collected only in alien or disturbed habitats in the Hawaiian Islands, we suspect that members of the Agariceae are also alien to the islands, having been introduced relatively recently with alien plants, soils, and other matter. This hy-

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pothesis is supported by the observation that most of the species belonging to the tribe are known from a single island, and often from only a single location. Furthermore, looking at the Agaricales as a whole in the Hawaiian Islands, eighty three percent of the species are putative aliens (Desjardin & Hemmes, unpubl. data). As with many other Hawaiian agarics, the new species are most phenetically similar to taxa from North America, South America, Australasia or Malesia, and their progenitors may have originated in those regions.

All descriptions are based on material collected from the Hawaiian Islands. Plant communities cited in habitat descriptions are those designated by Gagné and Cuddihy (1990) and flowering plant names are those given by Wagner & al. (1990). Color terms and notations in parentheses are those of Kornerup & Wanscher (1978).

Macroscopic features crucial for the identification of *Agaricus* taxa were observed and recorded from fresh material. Included in these observations were odors, and color changes upon cutting, bruising, or drying. Since these features may be immediate or delayed and localized in certain tissues, periodical observations were made on all parts of the basidiomata, especially on the lamellae, external surfaces, and inner context. Schäffer's and KOH reactions were used to verify subjective color and odor observations [for additional diagnostic tests not used in this study see Kerrigan (1986) and Heinemann (1956a)]. A 3% solution of KOH was applied to pileus surfaces of fresh material and the resulting yellow (positive) or unchanging (negative) reactions were noted. In cases where no KOH reaction data were recorded from fresh material for a species, dried material was tested and all unequivocal determinations are reported. Schäffer's reaction was not tested on fresh material. A variation of Schäffer's reaction was used exclusively on dried material in which a line of fresh, pure aniline was applied on the pileus surface and bisected by a line of glacial acetic acid (rather than the usual concentrated HNO_3). Any bright orange to scarlet (positive) or unchanging (negative) reactions were noted. Equivocal results, especially those from darkly pigmented material, were investigated further by using Schäffer's microreaction. A small amount of pileus cuticle was excised and treated with aniline for ten minutes after which a small drop of glacial acetic acid was added and the resulting reaction was observed microscopically.

All colors and measurements reported for microscopic features were obtained from dried material rehydrated in 100% ethanol followed by distilled water then 3% KOH. To insure maturity and reproducibility, only normally pigmented basidiospores taken from natural deposits (i.e., from the stipe, annulus, or adjacent pilei) were measured. Spore statistics include: $\bar{x}$, the arithmetic mean of the

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spore length by spore width (± SD) for n spores measured in a single sample (specimen); $\bar{x}_r$, the range of spore means and $\bar{x}_m$, the mean of all spores measured (± SD) where more than one specimen was available; Q, the quotient of spore length and spore width in any one spore, indicated as a range of variation in n spores measured; $\bar{q}$, the mean of Q values in a single sample; $\bar{q}_r$, the range of $\bar{q}$ values and $\bar{q}_m$, the mean of $\bar{q}$ values where more than one specimen was available. Because cheilocystidia in this group of fungi can be ephemeral, their distributions, sizes, and shapes were observed from three developmental stages: immature (closed cap, unpigmented lamellae), moderately mature (partially expanded cap, lightly pigmented lamellae), and mature (fully expanded cap, darkly pigmented lamellae). Cryptic universal veil remnants, present in all species in the tribe, were observed from a variety of locations, including the stipe surface below the annulus, the pileus surface, the stipe base, and the abaxial surface of the annulus. It should be noted that the annulus was often composed of two parts: an adaxial partial veil and an abaxial universal veil.

All specimens are deposited in SFSU unless specified otherwise. In the descriptions that follow, frequently cited collectors are abbreviated as: D. E. Desjardin (DED), D. E. Hemmes (DEH), and K. R. Peterson (KRP).

Synopsis of taxa

Agaricus subgenus Agaricus
- sect. Agaricus
  - *Agaricus campestris* L. : Fr.
- sect. Arvenses
  - subsect. Arvenses
  - *Agaricus arvensis* Schaeff. : Fr.
  - subsect. Augusti
  - *Agaricus subrufescens* Peck
  - subsect. Minores
  - *Agaricus azoetes* K. R. Peterson, Desjardin & Hemmes
  - *Agaricus cheilotulus* Heinem.
  - *Agaricus comptuloides* Murrill
  - *Agaricus comtulus* Fr.
  - *Agaricus entibigae* K. R. Peterson, Desjardin & Hemmes
  - *Agaricus kiawetes* K. R. Peterson, Desjardin & Hemmes
  - *Agaricus* aff. *semotus* Fr.
  - *Agaricus xeretes* K. R. Peterson, Desjardin & Hemmes
- sect. Nigrobrunnescentes sect. nov.
  - *Agaricus nigrobrunnescens* K. R. Peterson, Desjardin & Hemmes

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sect. Spissicaules
Agaricus arorae Kerrigan
Agaricus kipukae K. R. Peterson, Desjardin & Hemmes
sect. Xanthodermatei
Agaricus kai K. R. Peterson, Desjardin & Hemmes
Agaricus praeclaresquamosus A.E. Freeman
Agaricus rotalis K. R. Peterson, Desjardin & Hemmes
Agaricus subgen. Lanagaricus
sect. Lanosi
Agaricus lanatorubescens K. R. Peterson, Desjardin & Hemmes
Melanophyllum haematospermum (Bull.: Fr.) Kreisel

Artificial key to Hawaiian Agariceae

1. Fresh spore print green; lamellae red to reddish brown when young; spores minutely echinulate; clamp connections present ... *Melanophyllum haematospermum*
1*. Fresh spore print dark chocolate brown; lamellae white to pink, grey or brown when young; spores smooth; clamp connections absent ..... *Agaricus* 2

2. Basidiomata covered by a well developed, cottony universal veil ..... *Agaricus* subgen. Lanagaricus *A. lanatorubescens*
2*. Basidiomata covered by an indistinct universal veil ..... *Agaricus* subgen. Agaricus 3

3. Basidiomata tissue colors unchanging when bruised or cut; odor indistinctly fungal, not of almonds or phenol; lamellar margin fertile; KOH reaction negative; Schäffer's reaction negative ... 4
3*. Basidiomata tissue colors unchanging or becoming yellow, red, or brown when bruised or cut; odor of almonds, phenol, or indistinct; lamellar margin usually sterile; KOH reaction negative or positive; Schäffer's reaction negative or positive 5

4. Pileus appressed fibrillose to appressed squamulose, fibrils orange to brown; spores on average 5.2×3.4 µm, lacking a germ pore. ..... *A. kipukae*
4*. Pileus ± glabrous, white; spores on average 7.8×5.7 µm, some possessing a germ pore .....sect. Agaricus ..... *A. campestris*

5. Stipe surface powdery; surfaces, especially of stipe, quickly becoming dark brown to black when bruised; pileipellis elements spirally incrusted; odor indistinct; KOH reaction

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negative; Schäffer's reaction negative ..... sect. Nigrobrunnescentes ..... *A. nigrobrunnescens*

5*. Stipe surface not powdery; surfaces not quickly becoming dark brown when bruised (but may become reddish brown long after bruising); pileipellis elements not spirally incrusted; odor of almonds, phenol, or indistinct; KOH reaction negative or positive; Schäffer's reaction negative or positive 6

6. Basidiomata becoming pink or red when bruised or cut, sometimes becoming yellow at stipe base; odor indistinct or like almonds; KOH reaction negative or positive ..... sect. Spissicaules 7

6*. Basidiomata becoming yellow or unchanging when bruised or cut, or in age, or with drying, not becoming pink or red (but sometimes turning reddish brown after yellow reaction); odor of almonds, phenol, or indistinct; KOH reaction positive 8

7. Pileus <50 mm diam.; Schäffer's reaction scarlet; cheilocystidia up to 10 µm broad and broadly clavate ..... *A. arorae*

7*. Pileus >50 mm diam.; Schäffer's reaction negative to equivocal (brown); cheilocystidia up to 25 µm broad and globose ..... *A. kipukae*

8. Basidiomata unchanging or becoming yellow, especially at stipe base, but fading to original color or to reddish brown; odor of phenol or indistinct; Schäffer's reaction negative ..... sect. Xanthodermatei 9

8*. Basidiomata unchanging or becoming yellow and persisting, especially with drying; odor of almonds or indistinct; Schäffer's reaction positive ..... sect. Arvenses 11

9. Pileus ± entirely black when young, remaining black or in age becoming grey or brown and cuticle splitting to become radially rimose exposing the white context, forming a pinwheel pattern ..... *A. rotalis*

9*. Pileus background white to brownish grey with grey to brown or black fibrils when young, cuticle not rimose in age 10

10. Pileus ± glabrous and white overall (but sometimes greyish and appressed fibrillose at disc); cheilocystidia up to 7µm broad ..... *A. kai*

10*. Pileus appressed fibrillose to appressed squamulose, background white to brownish grey with brown to black fibrils; cheilocystidia up to 13 µm broad ..... *A. praeclaresquamosus*

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11. Basidiomata medium to large (pileus usually >50 mm diam.); spores on average >5.8 µm long; cheilocystidia present and composed of one, two, or many cells, commonly catenulate ... 12
11*. Basidiomata small (pileus usually <50 mm diam.); spores on average <5.8 µm long; cheilocystidia absent or if present typically composed of one cell, rarely two-celled or catenulate ..... subsect. Minores 13

12. Pileus ± glabrous and white, sometimes fibrillose and orange in age; spores on average 7.2 × 5.1 µm ..... subsect. Arvenses ..... *A. arvensis*
12*. Pileus appressed fibrillose to appressed squamulose, fibrils reddish brown to violet brown or dark brown; spores on average 5.9 × 4.3 µm ..... subsect. Augusti ..... *A. subrufescens*

13. Pileus background grey; cheilocystidia present, sometimes catenulate ..... *A. xeretes*
13*. Pileus background white, at least when young; cheilocystidia present or absent, not catenulate but sometimes two-celled ... 14

14. Pileus squamulose or squamose, with brown or reddish brown to violet brown or violet (but not yellow) squamulae 15
14*. Pileus glabrous or sometimes squamulose (but usually only at disc, in age), white or (especially at disc) yellow to brown, lacking reddish brown or violet brown squamulae 18

15. Pileus 12–25 mm diam.; cheilocystidia absent ..... *A. kiawetes*
15*. Pileus 30–55 mm diam.; cheilocystidia present 16

16. Stipe base squamulose; spores on average 4.5 × 3.8 µm (range 4.0–5.5 × 3.0–4.2 µm) ..... *A. entibigae*
16*. Stipe base lacking squamulae; spores on average 5.7 × 4.0 µm (range 4.3–7.2 × 3.0–4.8 µm) 17

17. Stipe slender, 3–5 mm diam. at median, 6–7 mm diam. at base; cuticles often not becoming yellow when bruised; cheilocystidia 14–45 × 7–17 µm ..... *A. comptuloides*
17*. Stipe ± robust, 7–12 mm diam. at median, 20 mm diam. at base; cuticles usually becoming yellow when bruised; cheilocystidia ca. 16 × 5.8 µm ..... *A.* aff. *semotus*

18. Pileus >45 mm diam.; cheilocystidia present ..... *A. cheilotulus*
18*. Pileus <45 mm diam.; cheilocystidia absent 19

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19. Pileus ± glabrous and white overall, disc sometimes squamulose and slightly brown in age; not (or rarely) becoming yellow when bruised ..... *A. comtulus*

19*. Pileus appressed squamulose, squamulae yellow to yellowish brown; usually becoming yellow when bruised, at least near stipe base ..... *A. azoetes*

Taxonomy

Agaricus arorae Kerrigan, Mycotaxon 22: 427. 1985. – Figs. 1–3.

Selected descriptions and icones. – Kerrigan (1985: 427, Fig. e); Kerrigan (1986: 17, pl. 6: 17).

Pileus 23–45 mm diam., at first flattened campanulate, expanding in age to campanulate to plane umbonate with a flat and often depressed umbo; surface dull, moist, with minute radiating fibrils or squamules; disc dark reddish brown (8–9F5–8), paler centrally to reddish brown (8D6–8) with a white margin, becoming red in age and when bruised; context features not recorded. – Odor mildly fungal. – Lamellae free, crowded with 2–4 series of lamellulae, moderately broad, convex, at first white, soon becoming deeply pink, then greyish pinkish brown, finally dark greyish brown to dark brown at maturity. – Stipe 30–60 × 3–6 mm (at apex) × 5–8 mm (at base), terete, tapering upward; interior color not recorded, hollow; surface white-downy to white-pubescent overall, overlaying a reddish brown background in age, becoming red when bruised. – Veils forming a thin, evanescent, membranous, pendant, subapical annulus.

Basidiospores (Fig. 1) 4.3–5.8 × 3.0–4.6 µm [$\bar{x}$ = 4.7 ± 0.4 × 3.4 ± 0.3 µm, Q = 1.2–1.8, $\bar{q}$ = 1.4 ± 0.1, n = 25 spores], ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix not prominent to semiprominent; germ pore not evident. – Basidia (Fig. 2) 12–19 × 5–7 µm, cylindroclavate, hyaline, tetrasporic, with sterigmata up to 2 µm long. – Cheilocystidia (Fig. 3) 17–20 × 6.5–10 µm, oblong to broadly clavate, hyaline, thin-walled, common to rare, scattered; lamellar margin nearly fertile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 2.5–17 µm diam, highly inflated, ± repent, interwoven, hyaline. – Pileus trama composed of hyphae 3–19 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 3–25 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 3–23 µm diam, inflated, hyaline. – Partial veil hyphae 1.5–8.5 µm diam, slightly inflated, hyaline, thin-walled. – Universal veil (from abundant remnants on stipe below annulus)

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hyphae 1.5–10 µm diam, inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH (in exsiccati) yellow; aniline × glacial acetic acid (in exsiccati) scarlet.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered in soil under common guava (*Psidium guajava* L.; Myrtaceae), Norfolk Island pine (*Araucaria heterophylla* (Salisb.) Franco; Araucariaceae), and blue gum (*Eucalyptus globulus* Labill.; Myrtaceae) in Montane Mesic Forest. Maui. July.

World distribution. – USA: Hawai'i and California.

Specimen examined. – USA. HAWAI'I: Maui, Waihe'e Ridge Trail near Maluhia Camp off Hwy. 340 on the northern slope of the West Maui Mts., elev. ca. 500 m, 28 Jul. 1993, DED 5826.

Agaricus arorae (subgen. Agaricus, sect. Spissicaules) is characterized in the Hawaiian Islands by its small size, rufescence, positive KOH and Schäffer's reactions, reddish brown, fibrillose pileus, and small spores. No other small local species has rufescent tissues paired with positive KOH or Schäffer's reactions. The Hawaiian collection of *A. arorae* differs from those reported from California in being more slender, having a reddish brown rather than brown pileus, and having a stipe surface that is downy overall rather than zonal above the annulus and glabrous to transversely scaly below. Of the relatively few described species of sect. Spissicaules, *A. arorae* is distinctive in being significantly smaller and more slender than the typical robust representatives such as *A. spissicaulis* F. H. Møller and *A. lilaceps* Zeller.

Agaricus arvensis Schaeff.: Fr., Syst. Mycol. 1: 282. 1821. – Figs. 4–7.

≡ *A. arvensis* Schaeff., Fung. Bavar. Palat. nasc. 4: 73, pl. 310–311. 1774.
≡ *Psalliota arvensis* (Schaeff.: Fr.) P. Kumm., Führer Pilzk.: 67. 1871.
≡ *Pratella arvensis* (Schaeff.: Fr.) Gillet, Hyménomycètes: 563. 1878.

Selected descriptions and icones. – Wasser (1989: 85, pls. 18 & 28/2); Kerrigan (1986: 18, pl. 6: 18); Cappelli (1984: 225, pl. 33); Essette (1964: pl. 36); Møller (1952: 161, Fig. 26 & pl. 30); and Lange (1939: 57, pl. 138/a).

Pileus (Fig. 4) (40–) 70–120 mm diam., hemispherical to convex when young, becoming truncately convex, finally applanate in age; surface dry, glabrous to radially fibrillose, sometimes becoming satiny when desiccated, white to buff, sometimes developing orange overtones in age, becoming yellow when bruised; context up to

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10 mm thick, white, unchanging. – Odor of almond extract. – Lamellae free, close with 4–5 series of lamellulae, up to 9 mm broad, light pink to orange grey (6B2) when young, becoming brown (6E4), finally dark brown at maturity. – Stipe 50–140 × 11–17 mm, equal, sometimes above a slightly enlarged base; interior white, unchanging; surface glabrous, white, becoming yellow when bruised; sometimes subtended by mycelial strands. – Veils forming a pendant, supramedian annulus.

Basidiospores (Fig. 5) 5.8–9.0 × 4.0–5.5 µm [$\bar{x}_r$ = 7.2–7.3 × 4.9–5.2 µm, $\bar{x}_m$ = 7.2 ± 0.7 × 5.1 ± 0.4 µm, Q =1.1–1.7, $\bar{q}_r$ = 1.4–1.5, $\bar{q}_m$ = 1.4 ± 0.1, n = 25 spores per 3 collections], ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix not prominent; germ pore not evident. – Basidia (Fig. 6) 13–28 × 7–9 µm, cylindroclavate to clavate, hyaline, tetrasporic, with sterigmata up to 4 µm long. – Cheilocystidia (Fig. 7) 4–22 × 4–17 µm, at first oblong and aseptate or multiseptate, soon inflating to become catenulate or not, ellipsoid to globose, clavate to broadly clavate, or pyriform, hyaline, thin-walled, abundant, continuous; lamellar margin sterile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 2–30 µm diam, slightly inflated, ± repent interwoven, hyaline. – Pileus trama composed of hyphae 1–32 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 3–30 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 2–30 µm diam, inflated, hyaline. – Partial veil hyphae 1–23 µm diam, uninflated to slightly inflated, hyaline, thin-walled. – Universal veil (from stipe below annulus) hyphae 3–23 µm diam, highly inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

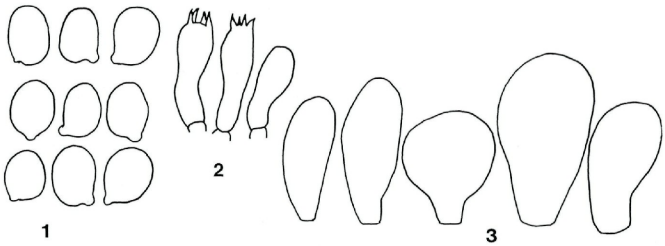
Chemical reactions. – KOH yellow; aniline × glacial acetic acid (in exsiccati) bright orange to scarlet.

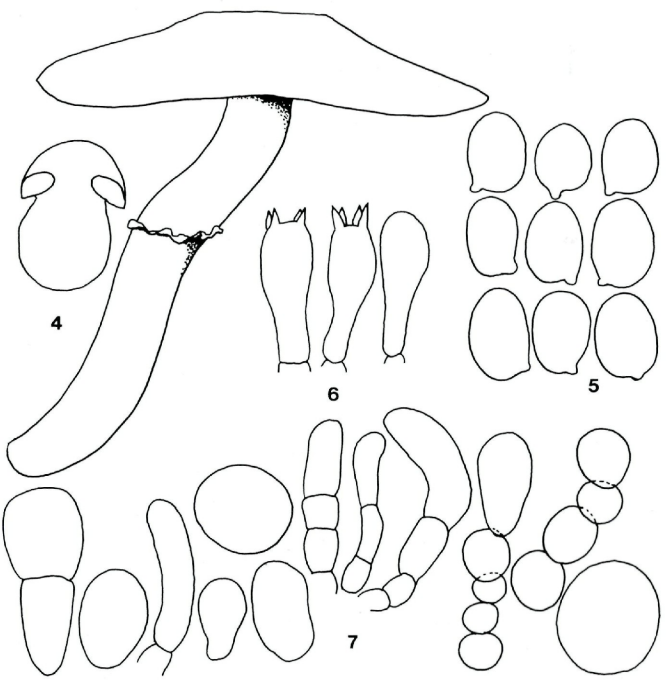
Habit, habitat, and distribution in the Hawaiian Islands. – Scattered in soil and duff under Monterey pine (*Pinus radiata* D. Don; Pinaceae) in an introduced montane pine forest surrounded by pasture. Hawai'i. June through August.

World distribution. – Cosmopolitan.

Figs. 1–7. *Agaricus arorae* and *Agaricus arvensis*. – Figs. 1–3. *Agaricus arorae* (DED 5826). – 1. Basidiospores. – 2. Basidia and basidiole. – 3. Cheilocystidia. – Figs. 4–7. *Agaricus arvensis* (DEH 1103). – 4. Basidiomata. – 5. Basidiospores. – 6. Basidia and basidiole. – 7. Cheilocystidia. – Scale bar: Figs. 4 = 10 mm; 1, 5 = 5 µm; 2–3, 6–7 = 10 µm.

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Specimen examined. – USA. HAWAI'I: Hawai'i, saddle area between Mauna Kea and Mauna Loa, Parker Ranch, 26 Aug. 1994, DEH 543; same location, 19 Jun. 1996, DEH 1103; same location, 20 Aug. 1996, KRP 069.

Agaricus arvensis (subgen. Agaricus, sect. Arvenses, subsect. Arvenses) is characterized in the Hawaiian Islands by its small to medium size, flavescence, almond odor, positive KOH and Schäffer's reactions, whitish basidiomata, and large spores. Locally, no other species resembles it. Although *A. arvensis* is typically grass loving, the known Hawaiian population has been found growing only in duff of an introduced Monterey pine grove in the midst of a cattle pasture. *Agaricus silvicola* (Vittad.) Sacc., a sylvan species macroscopically similar to *A. arvensis*, possess spores that are one micron smaller (on average) than those of the Hawaiian entity [*fide* Wasser, 1989; Kerrigan, 1986; Capelli, 1984; and Heinemann, 1977]. Another sylvan species, *A. macrocarpus* (F. H. Møller) F. H. Møller, has spores of about the same size as *A. arvensis*, but its stipes are more robust and bulbous [*fide* Capelli, 1984 and Heinemann, 1977]. *Agaricus arvensis* variants have been reported as occurring under conifers in other areas (e.g., Kerrigan, 1986; Imazeki & al., 1988; Wasser, 1989).

Agaricus azoetes K. R. Peterson, Desjardin, & Hemmes, **sp. nov.** – Figs. 8–10.

Pileus 22–45 mm latus, convexus deinde expansus, albus, squamulis appressis, ochraceis deinde griseobrunneis obtectus. Lamellae liberae. Stipes –25 × –6 mm, cylindraceus, albidus deorsum lutescens tactu. Annulus medianus. Odor amygdalinus. Basidiosporae 5.3–6.3 × 4.0–4.5 µm, ellipsoideae vel ovoideae, atrobrunneae. Cheilocystidia nulla. Ad terram. Holotypus: HAWAII, Lana'i, 25 Jan. 1997, D. E. Hemmes 1461 (SFSU).

Pileus (Fig. 8) 22–45 mm diam., convex when young, becoming applanate in age; surface dry, appressed squamulose in age, squamules yellow to yellowish brown, becoming greyish brown in age, background buff, unchanging; context thickness, color, and color changes not recorded. – Odor slightly of almond extract. – Lamellae free, other features not recorded. – Stipe 25 × 6 mm, equal; interior features not recorded; surface glabrous, white, becoming yellow at base when bruised, otherwise unchanging. – Veils forming a scant, intermediate, subapical to median annulus.

Basidiospores (Fig. 9) 5.3–6.3 × 4.0–4.5 µm [$\bar{x}$ = 5.7 ± 0.2 × 4.3 ± 0.1 µm, Q = 1.1–1.5, $\bar{q}$ = 1.3 ± 0.1, n = 25 spores per 1 collection], ellipsoid-ovoid to broadly ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix not prominent to prominent; germ pore not evident. – Basidia (Fig. 10) 14–20 × 6.5–7 µm, clavate, hyaline, tetrasporic, with sterigmata up to 2 µm long. – Cheilocystidia not

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observed; lamellar margin apparently fertile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 7 µm diam, ± repent, interwoven, hyaline. – Pileus trama composed of hyphae 2.5–13 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 1.5–17 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 2–17 µm diam, inflated, hyaline. – Partial veil hyphae 3–14 µm diam, inflated, hyaline, thin-walled. – Universal veil (from abundant remnants on stipe below annulus) hyphae 1.5–12 µm diam, inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH yellow; aniline × glacial acetic acid (in exsiccata) scarlet.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered in soil under kiawe (mesquite; *Prosopis pallida* (Humb. & Bonpl. ex Willd.) Kunth; Fabaceae) in Kiawe Forest. Lana'i. January.

Specimen examined. – USA. HAWAI'I: Lana'i, Shipwreck Beach, 25 Jan. 1997, DEH 1461 (Holotype, SFSU; Isotype, BISH).

Etymology. – azo (Grk.): dry, in reference to the habitat; etes (Grk.) = to dwell.

Agaricus azoetes (subgen. Agaricus, sect. Arvenses, subsect. Minores) is characterized by its small size, flavescence, almond odor, positive KOH and Schäffer's reactions, white pileus with yellow to yellowish brown squamules, and fertile lamellar margin. Locally, it is likely to be confused with *A. kiawetes*, which occurs in the same habitat and can be distinguished by its even smaller size and dark, red to purple squamules. Worldwide, *A. azoetes* can be distinguished from other species of subsect. Minores by the combination of its lack of cheilocystidia and its yellow to yellowish brown pileus squamules. Similar species of subsect. Minores that lack cheilocystidia possess pilei that are either white to yellow and glabrous or that have red to purple pigments.

Agaricus species are typically uncommon in arid habitats throughout the world. The association of the xerophytic *A. azoetes* and its congeners *A. kiawetes* and *A. xeretes* with kiawe (a type of mesquite) is therefore noteworthy. The first kiawe tree to reach the Islands was planted from seed on O'ahu in 1828 (Rock, 1917). Kiawe, a native of Peru, Colombia and Ecuador, has become naturalized through lowland, arid, disturbed habitats in the Hawaiian Islands.

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Agaricus campestris L: Fr., Syst. Mycol. 1: 281. 1821. – Figs. 11–13.

≡ *A. campestris* L., Species Plantarum 2: 1173. 1753.
≡ *Pratella campestris* (L: Fr.) S.F. Grey, Nat. arr. Brit. pl. 1: 626. 1821.
≡ *Psalliota campestris* (L: Fr.) Quél., Mém. Soc. Emul. Montbéliard, Sér. 2, 5: 140. 1872.

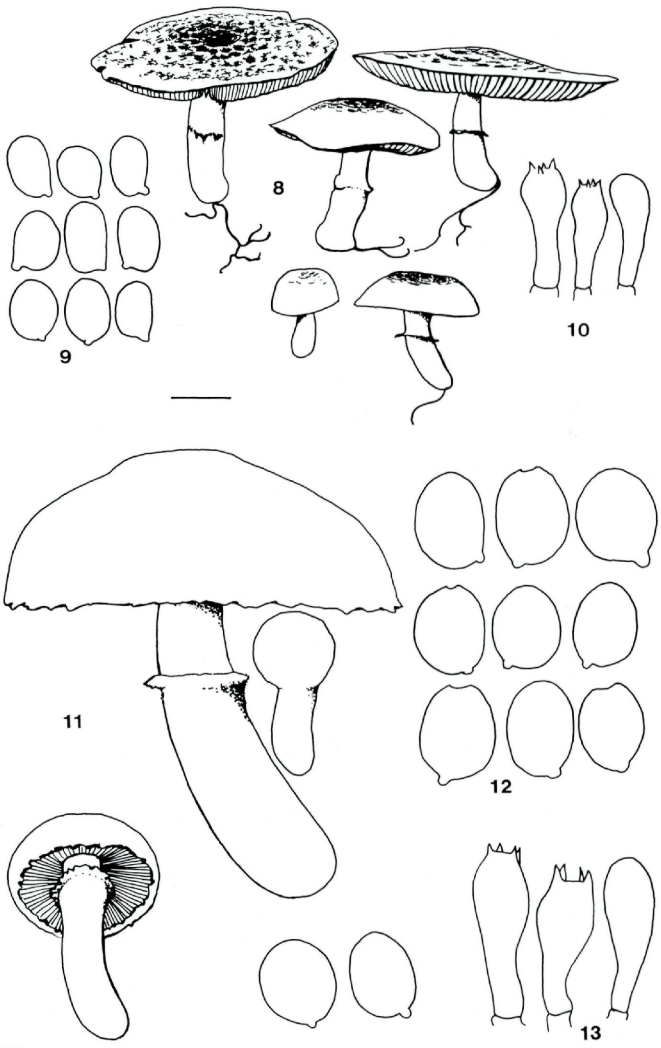
Selected descriptions and icones. – Wasser (1989: 21, pls. 1/c, 23/4, & 30/8–9); Kerrigan (1986: 25, pl. 6: 25); Cappelli (1984: 128, pl. 9); Essette (1964: pl. 26); Heinemann (1956b: 101, pl. 16/4); Pilát (1951: 30, Figs. 1–6 & 58/a); Møller (1950: 56, pl. 17); and Lange (1939: 59, pl. 138/c).

Pileus (Fig. 11) 45–100 mm diam., convex when young, becoming plano-convex, finally applanate in age; surface dry, usually glabrous, sometimes appressed fibrillose to appressed squamulose, fibrils white, sometimes brown, background white to grey in age, unchanging; context up to 3–10 mm thick, white, unchanging. – Odor and taste not distinctive. – Lamellae free, medium close to close with 4–6 series of lamellulae, up to 6–12 mm broad, pinkish white (8A2) when young, becoming dull red (8C3), then reddish brown (8D4), finally dark brown (7E8, 8F4) at maturity, rarely violet brown (10E5) at breaking of partial veil. – Stipe 40–80 × 9.5–20 mm, equal; interior white, unchanging, solid; surface glabrous or appressed fibrillose to appressed squamulose, white to light tannish orange, unchanging. – Veils forming an appendiculate to intermediate to pendant, thin, subapcal annulus.

Basidiospores (Fig. 12) 6.5–9.0 × 4.5–6.8 µm [$\bar{x}_r$ = 7.3–8.4 × 5.6–6.0 µm, $\bar{x}_m$ = 7.8 ± 0.6 × 5.7 ± 0.3 µm, Q = 1.1–1.7, $\bar{q}_r$ = 1.3–1.4, $\bar{q}_m$ = 1.4 ± 0.1, n = 25 spores per 4 collections], ellipsoid, smooth, dark brown, thick walled; hilar appendix not prominent; germ pore sometimes evident. – Basidia (Fig. 13) 17–29 × 7.5–12 µm, cylindroclavate to broadly clavate, hyaline, tetrasporic, with sterigmata up to 3 µm long. – Cheilocystidia absent. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 2.5–28 µm diam, slightly inflated, ± repent, interwoven, hyaline. – Pileus trama composed of hyphae 3–39 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 2.5–30 µm diam, inflated, hyaline. – Stipe

Figs. 8–13. *Agaricus azoetes* and *Agaricus campestris*. – Figs. 8–10. *Agaricus azoetes* (DEH 1461, Holotype). – 8. Basidiomata. – 9. Basidiospores. – 10. Basidia and basidiole. – Figs. 11–13. *Agaricus campestris* (DEH 872). – 11. Basidiomata. – 12. Basidiospores. – 13. Basidia and basidiole. – Scale bar: Figs. 8, 11 = 10 mm; 9, 12 = 5 µm; 10, 13 = 10 µm.

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tissue parallel, tightly packed; hyphae 1.5–30 µm diam, inflated, hyaline. – Partial veil hyphae 1.5–24 µm diam, uninflated to slightly inflated, hyaline, thin-walled. – Universal veil (from pileus margin and abundant remnants on stipe below annulus) hyphae 3–30 µm diam, highly inflated to subglobose, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH negative; aniline × glacial acetic acid (in exsiccata) negative.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered in montane pastures. Hawai'i and Maui (the latter per Arnold, 1944). July through November.

World distribution. – Cosmopolitan.

Specimens examined: – USA. HAWAI'I: Hawai'i, Parker Ranch Pastures, Keanakalu Rd., 9 Nov. 1993, DEH 321; same location, 29 Aug. 1995, DEH 872; same location, 2 Jul. 1996, DEH 1142; same location, 20 Aug. 1996, KRP 068.

Agaricus campestris (subgen. Agaricus, sect. Agaricus) is characterized in the Hawaiian Islands by its small to medium size basidiomata, unchanging context, fungal odor, white, glabrous pilei, preference for grasslands, and large spores with an apical germ pore. It is apparently the most common *Agaricus* of high elevation cattle pastures on Hawai'i and Maui but apparently absent elsewhere. No other species belonging to sect. Agaricus is found on the Islands. Microscopically, *A. campestris* is unique among the Hawaiian *Agaricus* species in having spores with an apical germ pore, and is one of the few to lack cheilocystidia.

Agaricus cheilotulus Heinem., Bull. Jard. Bot. Nat. Belg. 60: 346, Fig. 1. 1990. – Figs. 14–17.

Selected description and icones. – Heinemann (1990: 346, Fig. 1, a–c).

Pileus (Fig. 14) 45–55 (–90) mm diam., at first cylindrical becoming convex, then plano-convex to applanate in age, margin sometimes split; surface dry, sometimes appressed squamulose at disc, otherwise glabrous; disc ranging from yellow to reddish golden (6C7), yellowish brown to light brown (7D5), dark brown (7F6) or grey, white otherwise, unchanging; context up to 7 mm thick, white, unchanging. – Odor and taste slightly of almond extract. – Lamellae free, medium close to close with 3–4 series of lamellulae, up

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to 6 mm broad, pink when young, becoming greyish pink to greyish orange (6B3), then from brownish pink to dull red (9B4) to greyish brown, finally dark brown at maturity. – Stipe 25–60 (–90) × 6–12 (–15) mm, equal to tapering upward; interior at base sometimes becoming slightly yellow when cut, otherwise unchanging; surface glabrous, rarely longitudinal striate, whitish, unchanging. – Veils forming a thin, intermediate to pendant, median, white annulus.

Basidiospores (Fig. 15) 4.0–6.2 × 3.0–4.5 µm [$\bar{x}_r$ = 5.1–5.4 × 3.4–4.0 µm, $\bar{x}_m$ = 5.3 ± 0.5 × 3.8 ± 0.4 µm, Q = 1.1–2.0, $\bar{q}_r$ = 1.3–1.5, $\bar{q}_m$ = 1.4 ± 0.2, n = 25 spores per 4 collections (spores from *DEH 962* immature)], ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix not prominent; germ pore not evident. – Basidia (Fig. 16) 12–25 × 5–8 µm, cylindro-clavate to clavate, hyaline, tetrasporic, with sterigmata up to 3.5 µm long. – Cheilocystidia (Fig. 17) 5.5–26 × 3.5–15 µm, obovoid to oblong to globose, hyaline, thin-walled, at first abundant and nearly continuous, becoming apparently absent in age; lamellar margin at first nearly sterile, becoming apparently fertile in age. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 2–25 µm diam, inflated to highly inflated, ± repent, interwoven, hyaline. – Pileus trama composed of hyphae 1–28 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 1.5–22 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 1–34 µm diam, inflated, hyaline. – Partial veil hyphae 1.5–22 µm diam, slightly inflated to inflated, hyaline, thin-walled. – Universal veil (from stipe below annulus and at base) hyphae 1.5–32 µm diam, slightly to highly inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH yellow; aniline × glacial acetic acid (in exsiccati) scarlet.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered, clustered, or forming arcs in montane grassy areas. Kaua'i. October through March.

World distribution. – Hawai'i and Argentina.

Specimens examined: – USA. HAWAI'I: Kaua'i, Koke'e State Park, museum lawn, 3 Oct. 1994, DEH 601; Kaua'i, Koke'e State Park, Pihea Trail, 4 Oct. 1994, DEH 621; Kaua'i, Koke'e State Park, museum lawn, 4 Jan. 1995, DEH 684; same location, 9 Jan. 1996, DEH 962; same location, 2 Mar. 1997, DEH 1469.

Agaricus cheilotulus (subgen. Agaricus, sect. Arvenses, subsect. Minores) is characterized in the Hawaiian Islands by its small size, usually latent flavescence, almond odor, positive KOH and Schäffer's reactions, glabrous, white pileus with a yellow to brown, sometimes

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appressed squamulose disc, and preference for grassy areas of high elevation. The Hawaiian collections differ from the holotype in lacking a bulbous stipe base. In the Islands and elsewhere, the presence of cheilocystidia in *A. cheilotulus* is the primary feature that distinguishes it taxonomically from the otherwise similar *A. comtulus*.

Agaricus comptuloides Murrill, Mycologia 4: 297. 1912. – Figs. 18–21.

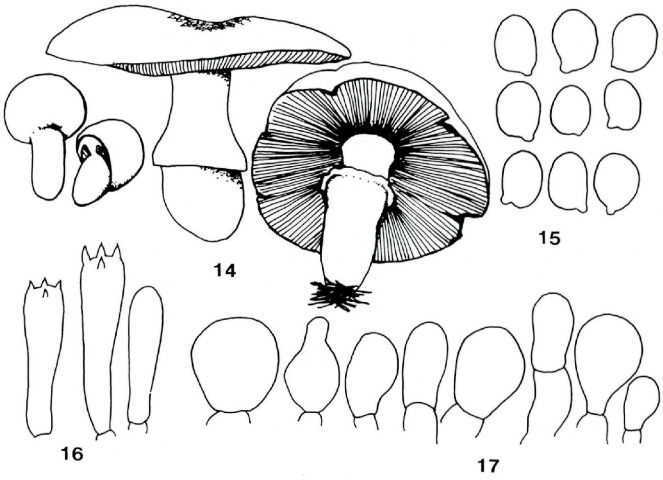
Selected descriptions. – Kerrigan (1986: 26); Murrill (1912: 297).

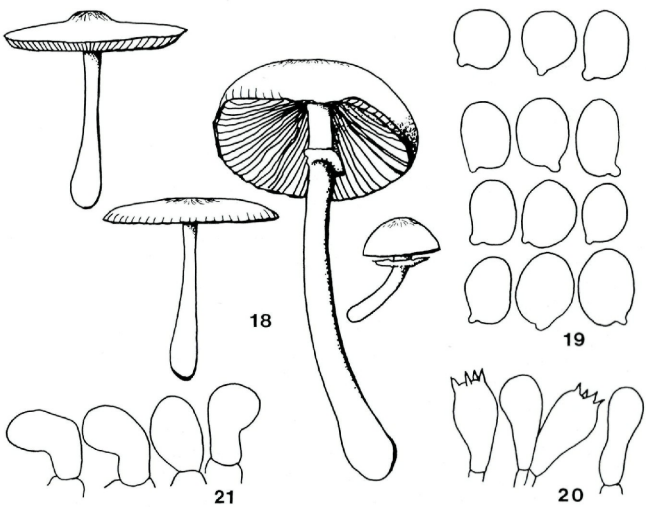
Pileus (Fig. 18) 30–35 (–55) mm diam., cylindrical when young, becoming hemispherical to convex, then truncately plano-convex, finally applanate in age, umbonate usually only after drying; surface dry, satiny in age; margin striate usually only after drying, appressed squamulose (disc smooth), squamules reddish brown (8E5) to violet brown (11F5) or dark brown (6F5, 7F8), background at first white, becoming greyish orange (5B3) to greyish brown (6–7D3) or silvery in age, unchanging or sometimes becoming yellow when bruised; context up to 2 mm thick, buff, unchanging. – Odor and taste of almond extract. – Lamellae free, medium close to close with 3 series of lamellulae, up to 5 mm broad, at first white, becoming light pink, then reddish brown (9D4–5), finally dark brown (6F5–8) and darker at maturity. – Stipe (30–) 45–60 × 3–5 mm (at median) × 6–7 mm (at base), tapering upward sometimes above a subbulbous base; interior buff, unchanging or sometimes becoming slightly yellow near the surface, hollow; surface satiny, longitudinally striate, white above, white to buff below, at base sometimes becoming yellow in age, otherwise unchanging. – Veils forming a tissue-like, intermediate to subapical annulus.

Basidiospores (Fig. 19) 4.3–7.2 × 3.0–4.8 µm [$\bar{x}_r$ = 5.4–5.9 × 3.8–4.2 µm, $\bar{x}_m$ = 5.7 ± 0.5 × 4.0 ± 0.3 µm, Q = 1.1–1.8, $\bar{q}$ = 1.4 ± 0.1, n = 25 spores per 5 collections], ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix not prominent to semiprominent; germ pore not evident. – Basidia (Fig. 20) 14–31 × 5–12 µm, clavate to broadly clavate, hyaline, tetrasporic, with sterigmata up to 4 µm

Figs. 14–21. *Agaricus cheilotulus* and *Agaricus comptuloides*. – Figs. 14–17. *Agaricus cheilotulus* (DEH 962). – 14. Basidiomata. – 15. Basidiospores. – 16. Basidia and basidiole. – 17. Cheilocystidia. – Figs. 18–21. *Agaricus comptuloides* (DEH 309). – 18. Basidiomata. – 19. Basidiospores. – 20. Basidia and basidioles. – 21. Cheilocystidia. – Scale bar: Figs. 14, 18 = 10 mm; 15, 19 = 5 µm; 16–17, 20–21 = 10 µm.

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long. – Cheilocystidia (Fig. 21) 14–45 × 7–17 µm, oblong to ellipsoid, hyaline, thin-walled, at first common and nearly continuous, becoming rare and scattered to absent in age; lamellar margin sterile to apparently fertile in age. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 2.5–15 µm diam, ± repent with scattered to clustered erect terminal cells, interwoven, hyaline. – Pileus trama composed of hyphae 2.5–22 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 1.5–23 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 2–19 µm diam, inflated, hyaline. – Partial veil hyphae 1.5–16 µm diam, inflated, hyaline, thin-walled. – Universal veil (from stipe below annulus) hyphae 1.5–19 µm diam, inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH yellow; aniline × glacial acetic acid (in exsiccata) scarlet.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered in lawns and in duff under trees, including common ironwood (*Casuarina equisetifolia* L.; Casuarinaceae), in coastal urban areas and in Common Ironwood Coastal Forest. Hawai'i. August through October.

World distribution. – USA: Hawai'i, Washington and California.

Specimens examined: – USA. HAWAI'I: Hawai'i, Hilo, University of Hawai'i campus, 25 Oct. 1993, DEH 309; Hawai'i, Hilo, tree nursery, 26 Oct. 1993, DEH 310; Hawai'i, Mackenzie Beach State Park, 20 Sep. 1994, DEH 561; Hawai'i, Hilo, University of Hawai'i campus, 27 Oct. 1995, DEH 903; Hawai'i, Mackenzie Beach State Park, 19 Aug. 1996, KRP 063.

Agaricus comptuloides (subgen. Agaricus, sect. Arvenses, subsect. Minores) is characterized in the Hawaiian Islands by its small, slender basidiomata, often latent flavescence, almond odor, positive KOH and Schäffer's reactions, and light pileus with reddish brown to violet brown, appressed squamulae. Locally, *A. comptuloides* can be distinguished from other similar small species by way of certain discrete characters: *A. comtulus* lacks red or violet pigments and cheilocystidia; *A. kiawetes* is smaller and lacks cheilocystidia; *A.* aff. *semotus* has a more robust stipe, is readily flavescent, and has much smaller cheilocystidia; and *A. arorae* is rufescent and has smaller spores. Like those populations reported from Washington and California, the Hawaiian entity possesses an umbo, sometimes only after drying; it, differs from continental specimens, however, in having a

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striate margin, which is usually evident only after drying, and in occurring in lawns and duff, rather than strictly in duff. Apparently, *A. comptuloides* is what Ueki (1973) reported as *A. diminutivus* Peck. The latter species differs, however, in forming smaller spores and (usually) lacking an umbo.

Agaricus comtulus Fr., Epicr. syst. mycol.: 215. 1838. – Figs. 22–24.

≡ *Psalliota comtula* (Fr.) Quél. [as *'comtulus'*], Mém. Soc. Emul. Montbéliard, Sér. 2, 5: 140. 1872.

≡ *Pratella comtula* (Fr.) Gillet, Tableaux analytiques des hyménomycétes de France, Hyménomycètes: 132 1874.

Selected descriptions and icones. – Kerrigan (1986: 27, pl. 6: 27); Cappelli (1984: 294, pl. 52); Essette (1964: 77, pl. between 44 and 45); Møller (1952: 185); and Lange (1939: 62, pl. 136/a).

Pileus (Fig. 22) 35–45 mm diam., cylindrical when young, becoming convex, then plano-convex, finally applanate in age; surface dry, glabrous, sometimes becoming appressed squamulose in age, disc sometimes becoming slightly brownish yellow to brownish orange (7C3) in age, white otherwise, unchanging; context up to 5 mm thick, white, unchanging. – Odor and taste slightly of almond extract. – Lamellae free, medium close to close with 3–4 series of lamellulae, up to 6 mm broad, pinkish white (10A2) when young, becoming reddish brown (8E4), finally dark brown (7F5) at maturity. – Stipe 40–50 × 5–6 mm, equal above an equal to slightly subbulbous base; interior unchanging; surface glabrous to longitudinally striate, white, unchanging. – Veils forming a tissue-like, intermediate to pendant, white annulus.

Basidiospores (Fig. 23) 5.0–7.2 × 3.0–5.0 µm [$\bar{x}_r$ = 5.7 × 3.8–4.2 µm, $\bar{x}_m$ = 5.7 ± 0.3 × 4.0 ± 0.4 µm, Q = 1.3–2.1, $\bar{q}_r$ = 1.4–1.5, $\bar{q}_m$ = 1.5 ± 0.2, n = 25 spores per 3 collections], ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix not prominent; germ pore not evident. – Basidia (Fig. 24) 11–23 × 5.5–8 µm, clavate, hyaline, tetrasporic, with sterigmata up to 4 µm long. – Cheilocystidia absent or basidiole-like; lamellar margin apparently fertile, or composed of cells oriented parallel to margin. – Pileipellis an enterocutis; hyphae 2.5–12 µm diam, inflated to highly inflated, ± repent with scattered erect terminal cells, interwoven, hyaline. – Pileus trama composed of hyphae 2–20 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 3–19 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 1.5–21 µm diam, inflated, hyaline. – Partial veil hyphae 2.5–21 µm diam, uninflated to inflated, hyaline, thin-

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walled. – Universal veil not observed. – Clamp connections absent in all tissues.

Chemical reactions. – KOH yellow; aniline × glacial acetic acid (in exsiccati) scarlet.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered or forming arcs in coastal lawns. Hawai'i. December through July.

World distribution. – Cosmopolitan.

Specimens examined: – USA. HAWAI'I: Hawai'i, Hilo, Keaukaha, Richardson's Ocean Park, 29 Mar. 1995, DEH 764; Hawai'i, Kailua/Kona, Keauhou Bay Hotel lawn, 28 Dec. 1995, DEH 944; Hawai'i, Hilo, Keaukaha, Richardson's Ocean Park, 6 Jul. 1996, DEH 1155.

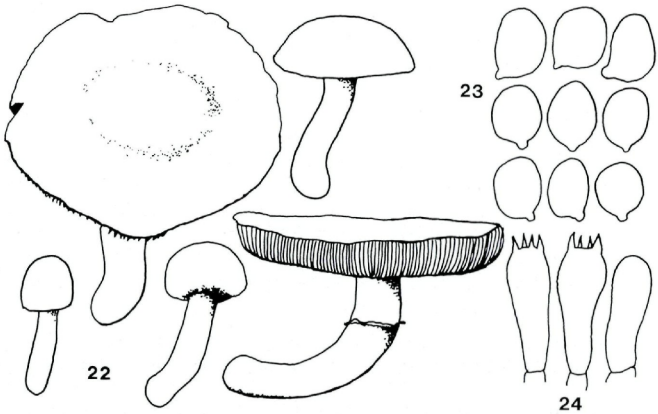
Agaricus comtulus (subgen. Agaricus, sect. Arvenses, subsect. Minores) is characterized in the Hawaiian Islands by its small size, latent flavescence, almond odor, positive KOH and Schäffer's reactions, glabrous, white pileus, lack of cheilocystidia, and occurrence in lawns. Locally, among members of subsect. Minores, its lack of cheilocystidia distinguishes *A. comtulus* from *A. cheilotulus*, and its lack of red or purple pigments distinguish it from the otherwise similar *A. comptuloides*. It may be superficially mistaken as a miniature *A. campestris*, but its almond odor, positive KOH and Schäffer's reactions, and smaller spores that lack a germ pore distinguish it.

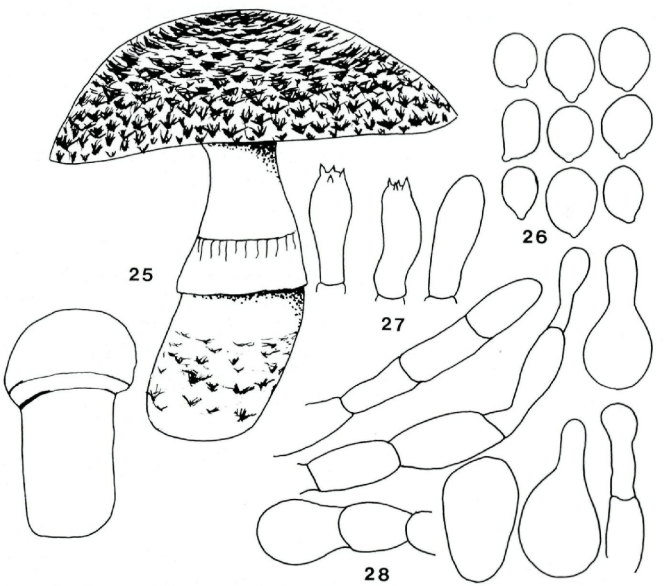
Agaricus entibigae K. R. Peterson, Desjardin, & Hemmes, **sp. nov.** – Figs. 25–28.

Pileus 30–70 mm latus, convexus vel planoconvexus, pallide aurantiacus, squamulis brunneis obtectus. Caro albus, immutabilis vel lutescens. Lamellae liberae, confertae, atrobrunneae. Stipes 25–55 × 4–19 mm, cylindraceus, albidus, appresse fibrillosus deorsum squamulosus. Annulus pendulus, membranaceus, albus, immutabilis vel rubrolutescens tactu. Odor amygdalinus. Basidiosporae 4.0–5.5 × 3.0–4.2 µm, ellipsoideae vel subglobosae, atrobrunneae. Cheilocystidia 8.5–20 × 5–14 µm, versiformia, interdum septata. Ad terram. Holotypus: HAWAII, Kaua'i, 4 Jan. 1994, D. E. Hemmes 347 (SFSU).

Figs. 22–28. *Agaricus comtulus* and *Agaricus entibigae*. – Figs. 22–24. *Agaricus comtulus* (DEH 764). – 22. Basidiomata. – 23. Basidiospores. – 24. Basidia and basidiole. – Figs. 25–28. *Agaricus entibigae* (DEH 347, Holotype). – 25. Basidiomata. – 26. Basidiospores. – 27. Basidia and basidiole. – 28. Cheilocystidia. – Scale bar: Figs. 22, 25 = 10 mm; 23, 26 = 5 µm; 24, 27–28 = 10 µm.

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Pileus (Fig. 25) 30–70 mm diam., convex when young, expanding in age, remaining convex or becoming plano-convex to uplifted; surface dry, squamulose (disc smooth), squamules brown (6E8, 7E6–7), background pale orange (5A3) to brownish orange (6C3), unchanging or becoming yellow when bruised; context up to 5 mm thick, white, unchanging or becoming yellow near center when cut. – Odor of almond extract. – Lamellae free, close with 3 series of lamellulae, up to 8 mm broad, dark brown (6F7) at maturity. – Stipe 25–55 × 4–19 mm, equal to slightly tapering upward; interior hollow, white, color change not recorded; surface squamulose at base, otherwise appressed fibrillose, squamules reddish, background and fibrils white to greyish orange (5B4), unchanging or becoming reddish yellow when bruised. – Veils forming a thin, membranous, pendant, supramedian, white annulus.

Basidiospores (Fig. 26) 4.0–5.5 × 3.0–4.2 µm [$\bar{x}_r$ = 4.4–4.7 × 3.8 µm, $\bar{x}_m$ = 4.5 ± 0.3 × 3.8 ± 0.3 µm, Q = 1.0–1.4, $\bar{q}_r$ = 1.1–1.2, $\bar{q}_m$ = 1.2 ± 0.1, n = 25 spores per 2 collections], broadly ellipsoid to subglobose, smooth, dark brown, thin-walled; hilar appendix not prominent; germ pore not evident. – Basidia (Fig. 27) 11–25 × 5.5–8 µm, cylindroclavate to clavate or narrowly utriform, hyaline, tetrasporic, with sterigmata up to 3 µm long. – Cheilocystidia (Fig. 28) 8.5–20 × 5–14 µm, cylindrical, conical, urn-shaped, broadly clavate, or light-bulb-shaped, sometimes two-celled, hyaline, thin-walled, at first abundant and nearly continuous, becoming rare and scattered in age; lamellar margin composed primarily of cells oriented parallel to margin, sterile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 3–13 µm diam, ± repent, interwoven, hyaline. – Pileus trama composed of hyphae 2–20 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 2–35 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 3–30 µm diam, inflated, hyaline. – Partial veil hyphae 1.5–26 µm diam, uninflated to slightly inflated, hyaline, thin-walled. – Universal veil (from abundant floccose remnants on stipe below annulus) hyphae 1.5–11 µm diam, slightly inflated to inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH (in exsiccati) yellow; aniline × glacial acetic acid (in exsiccati) scarlet.

Habit, habitat, and distribution in the Hawaiian Islands. – Solitary to grouped in soil and in woodchips in coastal botanical garden. Kaua'i. January.

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Specimens examined. – USA. HAWAI'I: Kaua'i, Allerton, National Tropical Botanical Garden, 4 Jan. 1994, DEH 347 (Holotype, SFSU; Isotype, BISH); same location, 8 Jan. 1997, KRP 102.

Etymology. – entibigae: phonetic spelling of NTBG, the National Tropical Botanical Garden on Kaua'i, honoring the type and only known locality.

Agaricus entibigae (subgen. Agaricus, sect. Arvenses, subsect. Minores) is characterized by its small to medium size, flavescence, almond extract odor, positive KOH and Schäffer's reactions, squamulose stipe base, orange pileus with brown squamules, cylindrical to urn-shaped or lightbulb-shaped, sometimes two-celled, cheilocystidia, and small spores. Locally, *A. entibigae* can be distinguished from other small species by its squamulose stipe base and tiny spores. Elsewhere, its squamulose stipe base and possession of two-celled cheilocystidia distinguish *A. entibigae* from other small but robust, pigmented species of subsect. Minores. Possibly of tropical origin, this species is known only from the National Tropical Botanical Garden on Kaua'i.

Agaricus kai K. R. Peterson, Desjardin, & Hemmes, **sp.prov.** – Figs. 29–32.

Pileus 70-90 mm latus, cylindricus vel convexus deinde expansus, glabrus vel appresse fibrillosus, albus vel cinerascens; caro albus, immutabilis. Lamellae liberae, confertae, roseae deinde atrobrunneae. Stipes 60-85 × 6-11 mm, ad basim bulbosus (15-20 mm crassus), glabrus, albidus; caro albidus deorsum flavescens tactu. Annulus subapicalis, pendulus, membranaceus, crassus, albus. Odor phenolicus. Basidiosporae 4.8-6.8 × 3.0-5.0 µm, ellipsoideae vel ovoideae, atrobrunneae. Cheilocystidia 6.5-38 × 4-7 µm, copiosa, cylindracea vel claviformia. Ad terram. Holotypus: HAWAII, Hawai'i, 12 Jul. 1996, D. E. Hemmes 1174 (SFSU).

Pileus (Fig. 29) (45–) 70–90 mm diam., cylindrical when young, becoming convex to truncately plano-convex, finally applanate in age; surface dry, glabrous to appressed fibrillose, often pure white when young, fibrils and disc showing grey tones when young or in age, entire surface sometimes becoming grey in age, unchanging; context up to 8 mm thick, white, unchanging. – Odor of phenol. – Lamellae free, close with 3–5 series of lamellulae, up to 7 mm broad, pinkish white (8A2) when young, becoming reddish grey (7B2) to brownish grey (7D3, 8E2), finally dark brown (7F5) at maturity. – Stipe (35–) 60–85 × (4–) 6–11 mm (at median) × (8.5–) 15–20 mm (at base), equal to slightly tapering upward above a bulbous to abruptly bulbous base; interior at base becoming light to bright yellow when cut, then often light brown, hollow; surface satiny, glabrous, whitish.

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– Veils forming a thick, pendant, subapical, white annulus, sometimes forming a marginal groove.

Basidiospores (Fig. 30) 4.8–6.8 × 3.0–5.0 µm [$\bar{x}_r$ = 5.4–5.7 × 3.5–3.9 µm, $\bar{x}_m$ = 5.6 ± 0.3 × 3.7 ± 0.4 µm, Q = 1.2–1.8, $\bar{q}_r$ = 1.4–1.6, $\bar{q}_m$ = 1.5 ± 0.1, n = 25 spores per 6 collections], ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix not prominent to semiprominent; germ pore not evident. – Basidia (Fig. 31) 14–22 × 5–7 µm, clavate, hyaline, tetrasporic, with sterigmata up to 3 µm long. – Cheilocystidia (Fig. 32) 6.5–38 × 4–7 µm, narrowly cylindrical to narrowly clavate, nearly repent, hyaline, thin-walled, abundant, nearly continuous; lamellar margin nearly sterile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 2.5–17 µm diam, ± repent, interwoven, hyaline. – Pileus trama composed of hyphae 2.5–20 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 3–24 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 1.5–24 µm diam, inflated, hyaline. – Partial veil hyphae 2–16 µm diam, inflated, hyaline, thin-walled. – Universal veil (from stipe below annulus and base) hyphae 3–22 µm diam, slightly inflated to inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH yellow; aniline × glacial acetic acid (in exsiccati) negative.

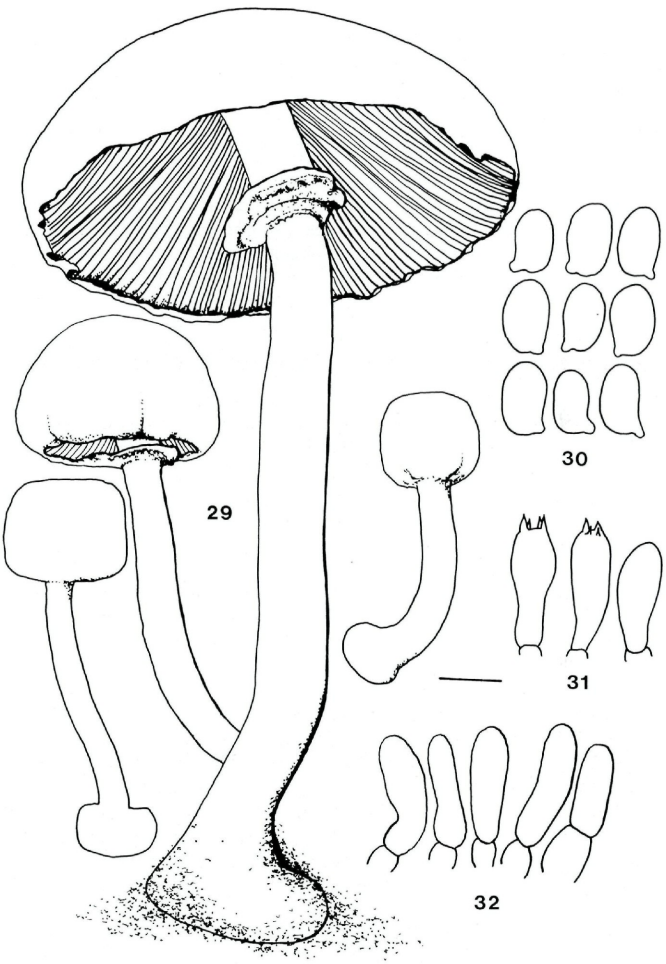
Habit, habitat, and distribution in the Hawaiian Islands. – Scattered, clustered, or forming fairy rings in black sand under common ironwood (*Casuarina equisetifolia* L.; Casuarinaceae) and coconut (*Cocos nucifera* L.; Arecaceae) in Coastal Mesic Forest. Hawai'i. June through December.

Specimens examined. – USA. HAWAI'I: Hawai'i, Mackenzie Beach State Park, 3 Aug. 1993, DEH 282; same location, 7 Dec. 1993, DEH 338; same location, 25 Jun. 1996, DEH 1109; same location, 12 Jul. 1996, DEH 1174 (Holotype, SFSU; Isotype, BISH); same location, 6 Aug. 1996, DEH 1197; same location, 19 Aug. 1996, KRP 062.

Etymology. – kai (Hawaiian): by the sea.

Agaricus kai (subgen. Agaricus, sect. Xanthodermatei) is characterized by its medium sized basidiomata, flavescent and bulbous stipe base, phenolic odor, positive KOH reaction, white, glabrous to appressed fibrillose pileus which may develop grey tones at the disc, and by its nearly sterile lamellar edge composed of cheilocystidia. The other two local species belonging to sect. Xanthodermatei, *A. praeclaresquamosus* and *A. rotalis*, have much darker pilei and

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Figs. 29–32. *Agaricus kai* (DEH 1174, Holotype). – 29. Basidiomata. – 30. Basidiospores. – 31. Basidia and basidiole. – 32. Cheilocystidia. – Scale bar: Figs. 29 = 10 mm; 30 = 5 µm; 31–32 = 10 µm.

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broader cheilocystidia. *Agaricus kai* is most similar to *A. xanthodermus* Genev., which differs in having strongly flavescent cuticles and broader cheilocystidia (*fide* Wasser, 1989; Kerrigan, 1986; Capelli, 1984; and Heinemann, 1977), and to *A. californicus* Peck, which has broader spores (on average) and broader cheilocystidia (*fide* Kerrigan, 1986 and Smith, 1940). The habitat of *A. kai* is uncommon for species of sect. Xanthodermatei; viz., basidiomata grow directly out of black sand under coconut and casuarina, sometimes close enough to the shoreline to be sprayed with water from the Pacific. *Casuarina*, a native of Australia, was first introduced to the Hawaiian Islands on Kaua'i in 1882 (Wagner et al., 1990) and has since become naturalized in coastal areas on all of the main islands. Although described here as new, *A. kai* may be a native of Australasia.

Agaricus kiawetes K. R. Peterson, Desjardin, & Hemmes, **sp. nov.** – Figs. 33–35.

Pileus 12–23 mm latus, convexus deinde expansus, ad discum squamulis rubrobrunneis vel purpureobrunneis instructus, marginem versus glabrus, albus. Caro alba, immutabilis. Lamellae liberae, subconfertae. Stipes 20–25 × 3–4 mm, cylindraceus, glabrus, albidus deorsum lutescens tactu. Annulus medianus. Odor mitis. Basidiosporae 4.3–7.0 × 4.0–4.5 µm, ellipsoideae vel ovoideae, atrobrunneae. Cheilocystidia nulla. Ad terram. Holotypus: HAWAII, Lana'i, 25 Jan. 1997, D. E. Hemmes 1460 (SFSU).

Pileus (Fig. 33) 12–23 mm diam., convex when young, becoming applanate in age; surface dry, squamulose at disc, otherwise satiny, squamules reddish brown to purplish brown, background white, becoming grey in age, otherwise unchanging; context up to 1 mm thick, white, unchanging. – Odor not distinctive. – Lamellae free, medium close with 3 series of lamellulae, up to 3 mm broad. – Stipe 20–25 × 3–4 mm, equal; interior unchanging; surface glabrous, white, becoming yellow at base when bruised, otherwise unchanging. – Veils forming an intermediate, subapical to median annulus.

Basidiospores (Fig. 34) 4.3–7.0 × 4.0–4.5 µm [$\bar{x}$ = 5.6 ± 0.5 × 4.1 ± 0.2 µm, Q = 1.1–1.5, $\bar{q}$ = 1.3 ± 0.1, n = 25 spores], ellipsoid-ovoid to broadly ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix not prominent to prominent; germ pore not evident. – Basidia (Fig. 35) 15–20 × 8–10 µm, clavate, hyaline, tetrasporic, with sterigmata up to 3 µm long. – Cheilocystidia not observed; lamellar margin apparently fertile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 2.5–15 µm diam, ± repent, interwoven, hyaline. – Pileus trama composed of hyphae 2–22 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 1.5–23 µm diam,

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inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 1.5–29 µm diam, inflated, hyaline. – Partial veil hyphae 2.5–9.5 µm diam, inflated, hyaline, thin-walled. – Universal veil (from fibrils on stipe below annulus) hyphae 1.5–12 µm diam, inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH yellow; aniline × glacial acetic acid (in exsiccati) scarlet.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered in soil under kiawe (mesquite; *Prosopis pallida* (Humb. & Bonpl. ex Willd.) Kunth; Fabaceae) in Kiawe Forest. Lana'i. January.

Specimen examined. – USA. HAWAI'I: Lana'i, Shipwreck Beach, 25 Jan. 1997, DEH 1460 (Holotype, SFSU; Isotype, BISH).

Etymology. – kiawe (Hawaiian) = Hawaiian name for *Prosopis pallida*; etes (Grk.) = to dwell.

Agaricus kiawetes (subgen. Agaricus, sect. Arvenses, subsect. Minores) is characterized by its small size, flavescence, white pileus with reddish brown to purplish brown squamules, and fertile lamellar margin. Locally, it may be confused with *A. azoetes*, which also occurs in Kiawe Forest. *Agaricus azoetes*, however, is larger and has squamules that are appressed and yellow to yellowish brown. *Agaricus kiawetes* more closely resembles *A. comptuloides* and *A. aff. semotus*, other species of subsect. Minores with red or purple pileus elements. It can be distinguished from them based on habitat and the following morphological features: both of the latter species are larger, have squamules that are appressed, and possess cheilocystidia. In addition, the pileus of *A. comptuloides* is umbonate, at least when dried. Worldwide, based on its tiny size, relatively large spores, and lack of cheilocystidia, *A kiawetes* is most similar to *A. comptuloides*. The presence of *A. kiawetes* (and congeners *A. azoetes* and *A. xeretes*) in such a dry habitat as Kiawe Forest is rare for *Agaricus* species and, therefore, noteworthy.

Agaricus kipukae K. R. Peterson, Desjardin, & Hemmes, **sp. nov.**– Figs. 36–39.

Pileus 70–110 mm latus, convexus vel planoconvexus deinde expansus, albus, immutabilis vel pallide roseus tactu, fibrillosus vel innate fibrillosus, fibrillis cinereoaurantiacis, brunneoaurantiacis vel atrobrunneis instructus; caro immutabilis. Lamellae liberae, confertae, roseae deinde atrobrunneae. Stipes 65–110 × 7–20 mm, cylindraceus, ad basim clavatus vel bulbosus (25–30 mm crassus),

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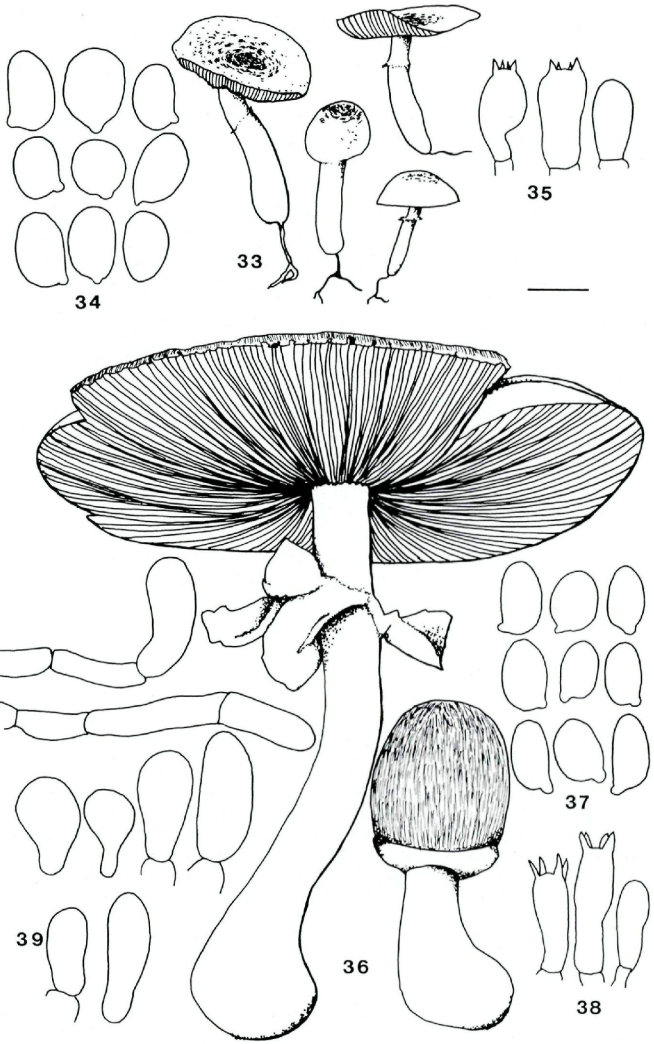
glabrus, albidus, immutabilis vel roseus tactu; caro alba, immutabilis vel rubescens fractu. Annulus pendulus, membranaceus, albus. Odor amygdalinus vel mitis. Basidiosporae 4.0–6.0 × 3.0–4.0 µm, ellipsoideae vel ovoideae, atrobrunneae. Cheilocystidia 6.5–29 × 5–25 µm, versiformia, interdum septata. Ad terram. Holotypus: HAWAII, Hawai'i, 10 Sep. 1994, D. E. Hemmes 558 (SFSU).

Pileus (Fig. 36) (50–) 70–110 mm diam., convex when young, expanding and remaining convex or becoming plano-convex, finally applanate to uplifted; surface dry, fibrillose to appressed squamulose, disc often nearly smooth, fibrils greyish orange (5B3) to brownish orange (6C4), brown (6D7, 6E5, 7E4) or dark brown (6F5–6, 7F4), background white to buff, sometimes becoming bronzed in age, unchanging or becoming pink when bruised; context up to (2–) 5–12 mm thick, white, unchanging. – Odor and taste of almond extract or indistinct. – Lamellae free, close with 4–5 series of lamellulae, up to 3–7 mm broad, at first white, becoming pinkish white (8A2) to reddish grey (7–11B2) when young, then reddish brown (8E4–F7) to greyish brown (8E3), finally dark brown (7F5) at maturity. – Stipe (50–) 65–110 × 7–20 mm (at median) × up to 25 (–30) mm (at base), equal above a clavate to abruptly bulbous base; interior white, when cut unchanging or becoming pink to brown or at base rarely becoming yellow; surface smooth to longitudinally striate, glabrous or covered with fine longitudinal fibrils, white to off-white, unchanging or becoming pink when bruised; sometimes subtended by mycelial strands. – Veils forming a large, flaring, peronate to pendant, white annulus, abaxial surface sometimes covered with cottony patches.

Basidiospores (Fig. 37) 4.0–6.0 × 3.0–4.0 µm [$\bar{x}_r$ = 5.1–5.3 × 3.3–3.4 µm, $\bar{x}_m$ = 5.2 ± 0.4 × 3.4 ± 0.3 µm, Q = 1.3–1.9, $\bar{q}_r$ = 1.5–1.6, $\bar{q}_m$ = 1.5 ± 0.1, n = 25 spores per 10 collections (spores from *DEH 345, DEH 363, DEH 459, DEH 674, DEH 705, DEH 975, and DEH 994* immature and not included in data provided)], ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix semiprominent to prominent; germ pore not evident. – Basidia (Fig. 38) 13–25 × 4.5–9 µm, cylindroclavate, hyaline, tetrasporic, with sterigmata up to 3.5 µm long. – Cheilocystidia (Fig. 39) 6.5–29 × 5–25 µm, versiform, at first cylindrical, becoming inflated in age and ranging from cylindroclavate to clavate, oblong, broadly ellipsoid, globose, napiform, pyriform, ovoid, lightbulb-shaped, or sphaeropedunculate, rarely catenulate, hyaline, thin-walled, at first common and nearly con-

Figs. 33–39. *Agaricus kiawetes* and *Agaricus kipukae*. – Figs. 33–35. *Agaricus kiawetes* (DEH 1460, Holotype). – 33. Basidiomata. – 34. Basidiospores. – 35. Basidia and basidiole. – Figs. 36–39. *Agaricus kipukae* (DEH 558, Holotype). – 36. Basidiomata. – 37. Basidiospores. – 38. Basidia and basidiole. – 39. Cheilocystidia. – Scale bar: Figs. 33, 36 = 10 mm; 34, 37 = 5 µm; 35, 38–39 = 10 µm.

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tinuous, becoming rare and scattered in age; lamellar margin composed primarily of cells oriented parallel to margin, nearly sterile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 1–23 µm diam, ± repent, interwoven, hyaline. – Pileus trama composed of hyphae 1.5–32 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 1.5–30 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 1.5–30 µm diam, inflated, hyaline. – Partial veil hyphae 1.5–14 µm diam, uninflated to slightly inflated, hyaline, thin-walled. – Universal veil (from abaxial surface of annulus, stipe below annulus, and stipe base) hyphae 1–29 µm diam, inflated to highly inflated or subglobose, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH (in fresh specimens) negative to very faintly yellow, (in exsiccati) yellow; aniline × glacial acetic acid (in exsiccati) equivocal (brownish).

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered to clustered in soil in and adjacent to pig wallows and in soil, duff, and grass under trees, including ohi'a (*Metrosideros polymorpha* Gaud.; Myrtaceae), ironwood (*Casuarina* sp.; Casuarinaceae), swamp mahogany (*Eucalyptus robusta* Sm; Myrtaceae), slash pine (*Pinus elliottii* Engelm.; Pinaceae), black wattle acacia (*Acacia mearnsii* De Wild.; Fabaceae), Christmas berry (*Schinus terebinthifolius* Raddi; Anacardiaceae), and strawberry guava (*Psidium cattleianum* Sabine; Myrtaceae), in Ohi'a Lowland and Montane Dry, Mesic, and Wet Forests. Hawai'i, Kaua'i, Lana'i, and Moloka'i. June through March.

Specimens examined. – USA. HAWAI'I: Hawai'i, Kalopa State Recreational Area, 5 Aug. 1993, DEH 285; Hawai'i, Hawai'i Volcanoes National Park, Sandlewood Trail, 5 Sep. 1994, DEH 545; Hawai'i, Saddle Rd. at 21 mi. kipuka, 21 Dec. 1993, DEH 345; same location, 6 Jun. 1994, DEH 459; same location, 10 Sep. 1994, DEH 558 (Holotype, SFSU; Isotype, BISH); same location, 20 Dec. 1994, DEH 674; same location, 29 Aug. 1995, DEH 873; Hawai'i, Manuka State Park (Natural Area Reserve System), 5 Mar. 1996, DEH 1061; Hawai'i, South Point Rd., 4 Jan. 1997, KRP 092; Hawai'i, Manuka (Natural Area Reserve System), 4 Jan. 1997, KRP 093; Kaua'i, Koke'e State Park, 'Awa'Awapuhi Trail, 8 Jan. 1994, DEH 363; Kaua'i, Koke'e State Park, Kuia (Natural Area Reserve System), Nualolo Trail, 4 Jan. 1995, DEH 681; Kaua'i, Koke'e State Park, Pu'u Ka 'Ohelo Berry Flat Trail, 7 Jan. 1995, DEH 705; Kaua'i, Koke'e State Park, Makaha Ridge Rd., 10 Jan. 1996, DEH 975; Lana'i, Koele, 12 Jan. 1995, DEH 730; Moloka'i, near Kamakou Forest Preserve, 12 Jan. 1996, DEH 978; Moloka'i, Pala'au State Park, 13 Jan. 1996, DEH nos. 993 and 994.

Etymology. – kipuka (Hawaiian): Hawaiian name for forest fragments formed by lava flows, in reference to 21 mi. kipuka, the most common site for this species.

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Agaricus kipukae (subgen. Agaricus, sect. Spissicaules) is characterized by its medium size, white pileus with orange to brown, appressed fibrils and squamules, clavate to bulbous stipe base, lamellae that are late in coloring, and sylvan habitat. Biochemical features of this species are variable: it often has a strong almond odor but sometimes the odor is indistinct; it is sometimes rufescent or rarely flavescent; the KOH reaction is usually negative in fresh basidiomata although it may be very weakly positive; and Schäffer's reaction is equivocal. In Hawai'i, *A. kipukae* may be confused with *A. subrufescens*, which can be distinguished by its redder pileus fibrils, larger spores, and the consistent presence of flavescent tissues, almond odor, and positive KOH and Schäffer's reactions. Worldwide, *A. kipukae* is unique among members of sect. Spissicaules. It is more slender than most, with *A. arorae* being an exception, and often has much broader cheilocystidia than the typical clavate form developed by other members of sect. Spissicaules.

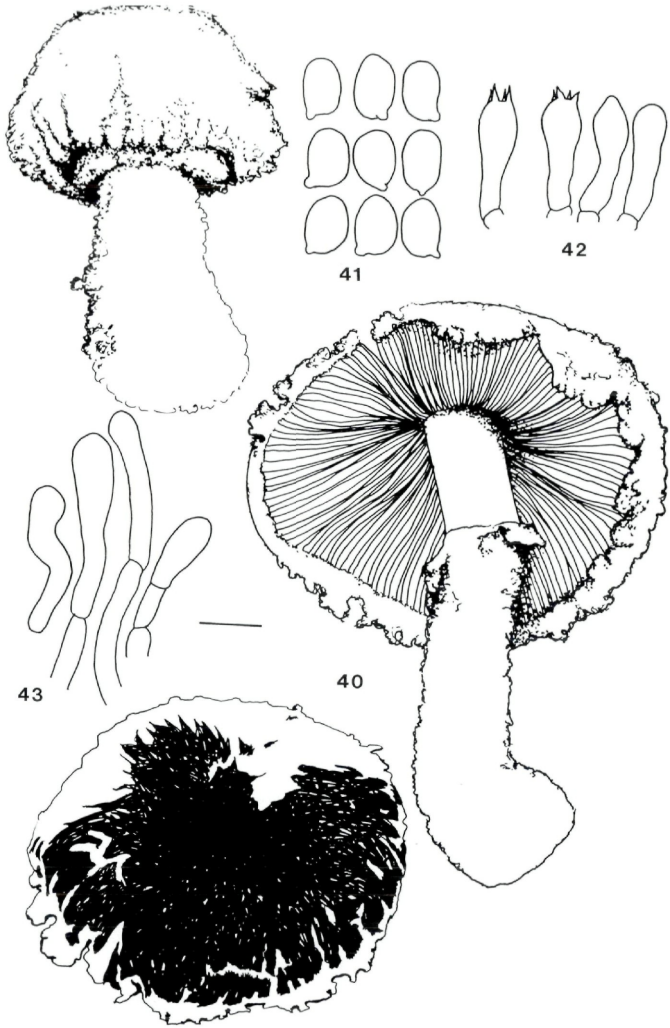
Agaricus kipukae is one of the more common and intriguing species of *Agaricus* in the Hawaiian Islands. It is the only species in the genus that has been found associated with native rain forests. More correctly, it is found in alien or disturbed habitats surrounded by native vegetation, and often in pig wallows in native rain forests. Whether *A. kipukae* represents a native species associated with disturbed habitats, or an alien species is unknown at present.

Agaricus lanatorubescens K. R. Peterson, Desjardin, & Hemmes, **sp. nov.** – Figs. 40–43.

Pileus 40–60 mm latus, cylindricus vel convexus, lanatus vel appresse squamulosus, albus deinde rubrobrunneus, rubescens tactu. Lamellae liberae, confertae, roseae deinde atrobrunneae, rubescens tactu. Stipe 60–80 × 8–13 mm, aequalis, ad basim bulbosus, apicaliter sericeus vel striatus, deorsum gossypinus, albus, rubescens vel rubrobrunnescens tactu. Annulus medianus, appendiculatus, floccosus. Caro alba, rubescens fractu. Odor amygdalinus. Basidiosporae 4.3–6.5 × 3.0–4.3 µm, ellipsoideae vel sublacrymoideae, atrobrunneae. Cheilocystidia 10–17 × 6.5–13 µm, cylindracea vel claviformia. Ad terram. Holotypus: HAWAII, Hawai'i, 26 Aug. 1994, D. E. Hemmes 542 (SFSU).

Pileus (Fig. 40) 40–60 mm diam., cylindrical when young, becoming convex in age; surface dry, at first densely cottony to wooly, becoming appressed squamose to appressed fibrillose, often becoming areolate at margin, at first white, remaining white or becoming dark reddish brown (8F6) in age, becoming pink when bruised; context up to 6 mm thick, white, becoming pink when cut. – Odor slightly of almond extract after cutting. – Lamellae free, close with 4 series of lamellulae, up to 6 mm broad, reddish grey (8B2) when young, becoming dark brown at maturity, becoming pink when

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Figs. 40–43. *Agaricus lanatorubescens* (DEH 542, Holotype). – 40. Basidiomata. – 41. Basidiospores. – 42. Basidia and basidioles. – 43. Cheilocystidia. – Scale bar: Figs. 40 = 10 mm; 41 = 5 µm; 42–43 = 10 µm.

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bruised. – Stipe 60–80 × 8–13 mm, equal above a bulbous base; interior white, becoming pink when cut; satiny and longitudinal striate above, densely cottony below, white, becoming pink, then dark reddish brown (8F6) when bruised. – Veils abaxially floccose, appendiculate and forming an intermediate, median annulus.

Basidiospores (Fig. 41) 4.3–6.5 × 3.0–4.3 µm [$\bar{x}$ = 5.3 ± 0.6 × 3.4 ± 0.4 µm, Q = 1.3–2.0, $\bar{q}$ = 1.6 ± 0.2, n = 25 spores], oblong-ovoid to ellipsoid-ovoid or sublacrymoid, smooth, dark brown, thin-walled; hilar appendix semiprominent; germ pore not evident. – Basidia (Fig. 42) 14–20 × 5.5–7 µm, clavate, hyaline, tetrasporic, with sterigmata up to 3 µm long. – Cheilocystidia (Fig. 43) 10–17 × 6.5–13 µm, cylindrical to clavate, sometimes contorted, hyaline, thin-walled, abundant, ± continuous; lamellar margin composed primarily of cells oriented parallel to margin, sterile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 3–8.5 µm diam, ± repent, interwoven, hyaline. – Pileus trama composed of hyphae 1.5–25 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 3–16 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 2–16 µm diam, inflated, hyaline. – Partial veil hyphae 4–12 µm diam, inflated, hyaline, thin-walled. – Universal veil (from pileus) hyphae 3–17 µm diam, inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH negative; aniline × glacial acetic acid (in exsiccati) equivocal (probably negative).

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered in duff under Monterey pine (*Pinus radiata* D. Don; Pinaceae) in an introduced montane pine forest surrounded by pasture. Hawai'i. August.

Specimen examined. – USA. HAWAI'I: Hawai'i, saddle area between Mauna Kea and Mauna Loa, Parker Ranch, 26 Aug. 1994, DEH 542 (Holotype, SFSU; Isotype, BISH).

Etymology. – lana (Lat.): wool, referring to the wooly universal veil; rubescens (Lat.) = becoming red, referring to both the rufescent nature of the tissues and to the pileus, which develops red pigments with maturity.

Agaricus lanatorubescens (subgen. Lanagaricus, sect. Lanosi) is characterized by its medium size, rubescence, negative KOH reaction, densely cottony to wooly, well developed universal veil that initially covers the entire basidioma, and cottony, white pileus that

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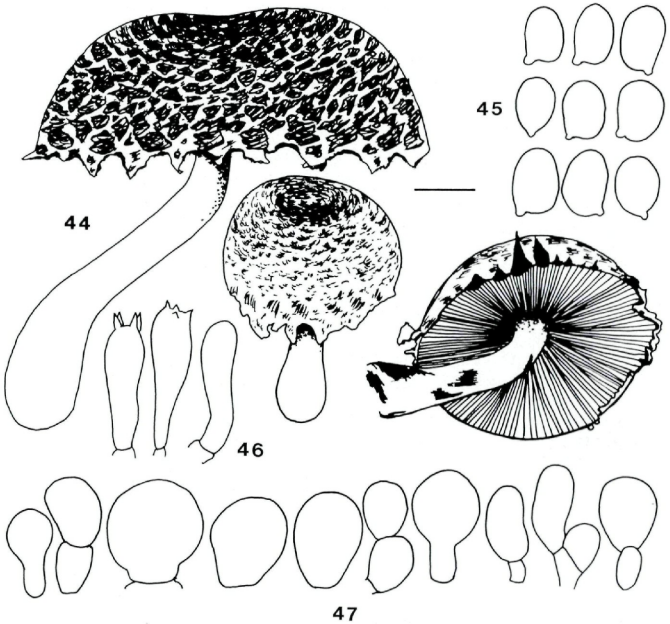
becomes squamose and dark reddish brown with maturity. No other local species resembles it. Subgenus Lanagaricus is distinguished from the more commonly encountered subgen. Agaricus based on the development of substantial universal veil in the former. Placement of this new species into a section within subgen. Lanagaricus is somewhat complicated by its equivocal (but likely negative) Schäffer's reaction. Based upon the data presently available, *A. lanatorubescens* belongs in sect. Lanosi, rather than in sect. Laeticolores, which accommodates comparable species with positive pileal Schäffer's reactions. Regardless of sectional placement within subgen. Lanagaricus, *A. lanatorubescens* is unlike other described species. It may be allied with the white, rubescent *A. haematosarcus* Heinem. & Goos.-Font, described from the Republic of the Congo. *Agaricus lanatorubescens*, however, has smaller spores and cheilocystidia and, although its pileus is white at first, it becomes dark reddish brown with maturity, whereas the pileus of *A. haematosarcus* becomes sordid ochraceous (*fide* Pegler, 1977; Heinemann, 1956a and 1956b). Other species with reddish brown pilei, such as *A. rufolanosus* Heinem. & Goos.-Font. and *A. carminescens* Heinem. & Goos.-Font., both also from the Republic of the Congo, produce longer cheilocystidia and are pigmented from primordium through maturation on both their pilei and on their stipes (*fide* Heinemann, 1956a; 1956b). The stipe of *A. lanatorubescens* is unpigmented throughout development. Furthermore, *A. rufolanosus* has larger spores (on average) [*fide* Heinemann, 1956a]. In a peculiar case of circumstance, *A. lanatorubescens*, which is probably of tropical or subtropical origin like the other members of subgen. Lanagaricus, is known only from temperate Hawai'i under Monterey pine, an introduced tree species native to California.

Agaricus nigrobrunnescens K. R. Peterson, Desjardin, & Hemmes, **sp. nov.** – Figs. 44–47.

Pileus 40–65 mm latus, convexus, centro depressus, velutinus vel squamulosus, albidus, squamulis brunneis instructus, brunnescens tactu. Lamellae liberae, confertae, atrobrunneae. Stipes 45–60 × 7–11 mm, subclavatus, farinosus, cinerascens, atrobrunnescens vel nigrescens tactu. Vela appendiculata. Caro alba. Odor mitis. Basidiosporae 4.2–5.8 × 3.3–4.5 µm, ellipsoideae vel ovoideae, atrobrunneae. Cheilocystidia 5.5–17 × 5.5–13 µm, copiosa, subglobosa vel pyriformia. Ad fimum cuniculum. Holotypus: HAWAII, Hawai'i, 3 Nov. 1994, D. E. Hemmes 632 (SFSU).

Pileus (Fig. 44) 40–65 mm diam., convex with a central depression; surface dry, velutinous to squamulose; squamules suedelike, large, brown (7E4); background buff, becoming brown when bruised; context up to 10 mm thick, white, color change not recorded. – Odor not distinctive, taste mildly fungal. – Lamellae

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Figs. 44–47. *Agaricus nigrobrunnescens* (DEH 632, Holotype). – 44. Basidiomata. 45. Basidiospores. – 46. Basidia and basidiole. – 47. Cheilocystidia. – Scale bar: Figs. 44 = 10 mm; 45 = 5 µm; 46–47 = 10 µm.

free, close with 5 series of lamellulae, up to 5 mm broad, dark brown at maturity. – Stipe 45-60 × 7 mm (at apex) × 8 mm (at median) × 11 mm (at base), slightly tapering upward; interior color not recorded, hollow; surface covered with a fine powder, slightly longitudinally striate near apex, greyish buff, becoming dark brownish black when bruised. – Veils appendiculate, consisting of a few tattered remnants.

Basidiospores (Fig. 45) 4.2–5.8 × 3.3–4.5 µm [$\bar{x}$ = 5.0 ± 0.5 × 3.8 ± 0.3 µm, Q = 1.1–1.7, $\bar{q}$ = 1.3 ± 0.1, n = 25 spores], ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix not prominent; germ pore not evident. – Basidia (Fig. 46) 16–22 × 5.5–6 µm, cylindroclavate, hyaline, tetrasporic, with sterigmata up to 3 µm long. – Cheilocystidia (Fig. 47) 5.5–17 × 5.5–13 µm, oblong to subglobose or pyriform, hyaline, thin-walled, abundant, nearly continuous; la-

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mellar margin sterile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 3.5–7 µm diam, ± repent, interwoven, hyaline with light brown spiral incrustations. – Pileus trama composed of hyphae 4–19 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 1.5–11 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 1.5–14 µm diam, inflated, hyaline. – Partial veil hyphae 3–9.5 µm diam, inflated, hyaline, thin-walled. – Universal veil (from pileus) hyphae 3–9 µm diam, inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH negative; aniline × glacial acetic acid (in exsiccati) negative.

Habit, habitat, and distribution in the Hawaiian Islands. – Clustered in domestic rabbit dung. Hawai'i. November.

Specimen examined. – USA. HAWAI'I: Hawai'i, Leilani Estates, 3 Nov. 1994, DEH 632 (Holotype, SFSU; Isotype, BISH).

Etymology. – nigro (Lat.): black; brunnescens (Lat.): becoming brown, referring to the brown to black color change exhibited by bruised cuticles.

Agaricus nigrobrunnescens (subgen. Agaricus) is characterized in the Hawaiian Islands by its medium size, brunnescence, negative KOH and Schäffer's reactions, indistinct odor, buff pileus with brown, velvety squamules, powdery stipe, spirally incrusted pileipellis elements, and growth on dung. Locally, no other species resembles it. The intense brown to black color change exhibited by tissues of *A. nigrobrunnescens* is apparently unique among known species of *Agaricus*. Furthermore, the velvety pileus, powdery stipe, spirally incrusted pileipellis elements, and coprophilous habit set this unusual species apart from known species and sections within *Agaricus*. Data currently available do not indicate a probable geographic origin for this unique coprophilous species.

We propose a new section within subgen. Agaricus to accommodate the species:

sect. Nigrobrunnescentes K. R. Peterson, Desjardin, & Hemmes, **sect. nov.**

Pileus velutinus vel squamulosus, brunnescens tactu. Stipes farinosus, atrobrunnescens vel nigrescens tactu. Odor mitis. Hyphae cuticulares pigmento brunneo spiralis incrustatae. KOH et Schäffer adficere nullae. Type species: *Agaricus nigrobrunnescens* K. R. Peterson, Desjardin, & Hemmes.

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Agaricus praeclaresquamosus A. E. Freeman, Mycotaxon 8: 90. 1979. – Figs. 48–51.

= *Psalliota meleagris* Jul. Schäff., Z. Pilzk. 4: 28. 1925.

≡ *A. meleagris* (Jul. Schäff.) Imbach, Mitt. Naturf. Ges. Luzern 15: 68. 1946, nom. illeg., non *A. meleagris* Sowerby, Col. Fig. Engl. fung. 2: pl. 171. 1799.

≡ *A. meleagris* (Jul. Schäff.) Pilát, Sborn. Nár. Mus. v Praze 7: 106. 1951, nom. illeg., non *A. meleagris* Sowerby, Col. Fig. Engl. fung. 2: pl. 171. 1799.

≡ *A. placomyces* Peck var. *meleagris* (Jul. Schäff.) M. M. Moser, Die Röhrlinge und Blätterpilze (Agaricales), Kleine Kryptogamenflora 2 (2): 193. 1967, nom. inval.

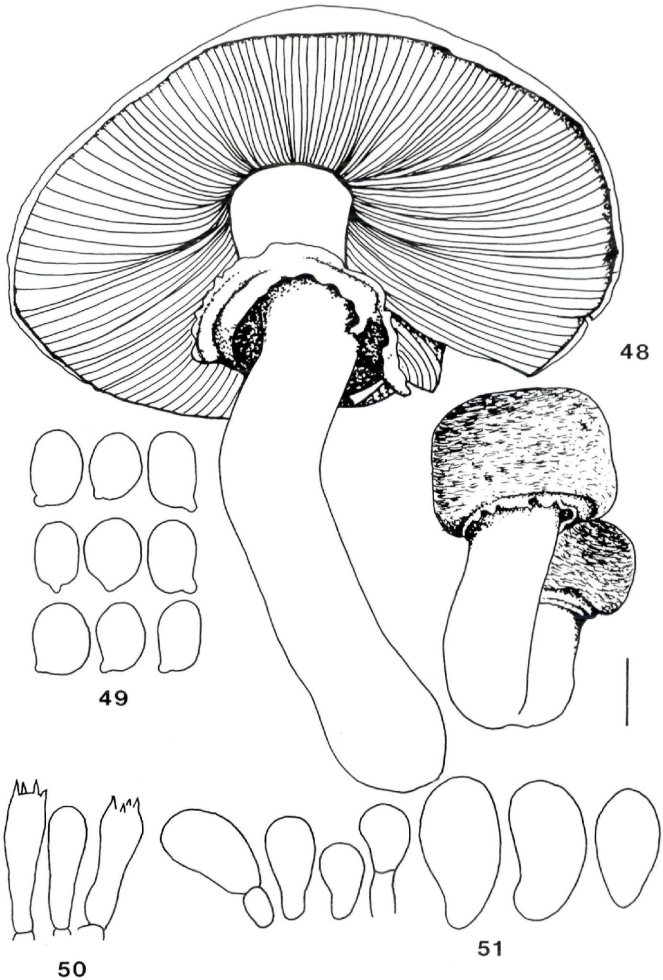
≡ *P. xanthoderma* Genevier subsp. *meleagris* (Jul. Schäff.) Michael, Führer Pilzfr. 1. 1939, nom. inval.

Selected descriptions and icones. – Wasser (1989: 95, pls. 20/a & 28/5); Kerrigan (1986: 42, pl. 6: 42); Cappelli (1984: 325, pl. 62); Essette (1964: pl. 41); Møller (1954); and Pilát (1951: 106, Figs. 61–62 & pl. 17).

Pileus (Fig. 48) 40–105 (–150) mm diam., cylindrical to convex when young, becoming convex to applanate in age; surface dry, appressed squamulose, sometimes areolate, squamules light grey to greyish brown (8F3), dark brown (7–8F4–6) or black, becoming lighter in age, background white to brownish grey (8C2), unchanging or slowly becoming light yellow, then reddish brown and fading, also often becoming pink when wet; context up to 4–8 (–17) mm thick, white, when cut unchanging or slowly becoming light yellow, then reddish brown and fading. – Odor and taste of phenol or sometimes indistinct. – Lamellae free, close with 2 series of lamellulae, 3–10 mm broad, at first white, becoming light pink, then reddish grey (8B2) to brownish grey (8D2, 8E3), finally dark brown (6F6, 7F5, 8F4). – Stipe 50–150 × (5–) 10–15 (–30) mm, ± equal, sometimes with the base tapered or subbulbous; interior white, base usually becoming yellow when cut, otherwise unchanging, stuffed, becoming hollow; surface glabrous, white to grey or black, unchanging or more often becoming yellow when bruised, sometimes yellowing only at base, sometimes very slowly and very lightly, after which often becoming reddish brown then fading; sometimes subtended by mycelial strands. – Veils forming a membranous to rubbery, broad, pendant to intermediate, subapical, white annulus.

Basidiospores (Fig. 49) 4.3–6.5 × 3.0–4.8 µm [$\bar{x}_r$ = 5.1–5.5 × 3.2–3.7 µm, $\bar{x}_m$ = 5.3 ± 0.4 × 3.5 ± 0.4 µm, Q = 1.2–1.9, $\bar{q}_r$ = 1.5–1.6, $\bar{q}_m$ = 1.5 ± 0.1, n 25 spores per 5 collections (spores from DEH 343 immature and not included in data provided)], ellipsoid-ovoid,

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Figs. 48–51. *Agaricus praeclaresquamosus* (KRP 091). – 48. Basidiomata. – 49. Basidiospores. – 50. Basidia and basidiole. – 51. Cheilocystidia. – Scale bar: Figs. 48 = 10 mm; 49 = 5 µm; 50–51 = 10 µm.

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smooth, dark brown, thin-walled; hilar appendix semiprominent to prominent; germ pore not evident. – Basidia (Fig. 50) 16–25 × 5–7.5 µm, cylindroclavate, hyaline, tetrasporic, with sterigmata up to 3 µm long. – Cheilocystidia (Fig. 51) 5.5–30 × 3–13 µm, clavate to truncately clavate, hyaline, thin-walled, abundant, continuous; lamellar margin sterile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 1.5–15 µm diam, ± repent, interwoven, often forming short uninflated to inflated, ± erect branches, hyaline, with dark brown vacuolar pigments. – Pileus trama composed of hyphae 2–25 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 2.5–17 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 0.5–20 µm diam, uninflated, hyaline. – Partial veil hyphae 1.5–10 µm diam, uninflated to slightly inflated, hyaline, thin-walled. – Universal veil (from pileus margin and on stipe below annulus) hyphae 1.5–9 µm diam, inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH yellow; aniline × glacial acetic acid (in exsiccata) negative.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered to caespitose in duff and soil under trees, including ironwood (*Casuarina* sp.; Casuarinaceae), ohi'a (*Metrosideros polymorpha* Gaud.; Myrtaceae), Christmas berry (*Schinus terebinthifolius* Raddi; Anacardiaceae), and strawberry guava (*Psidium cattleianum* Sabine; Myrtaceae) in Common Ironwood Coastal Forest and Ohi'a Lowland Mesic Forest. Hawai'i. November through March.

World distribution. – Cosmopolitan.

Specimens examined. – USA. HAWAI'I: Hawai'i, Mackenzie Beach State Park, 7 Dec. 1993, DEH 343; same location, 29 Nov. 1994, DEH 648; Hawai'i, Manuka State Park (Natural Area Reserve System), 5 Mar. 1996, DEH 1055; location and date not recorded, DEH 1253; Hawai'i, Manuka State Park (Natural Area Reserve System), 4 Jan. 1997, KRP nos. 090 and 091.

Agaricus praeclaresquamosus (subgen. Agaricus, sect. Xanthodermatei) is characterized in the Hawaiian Islands by its medium size, flavescence, phenolic odor, positive KOH reaction, white pileus with brown to black, appressed squamules, and sylvan habitat. The other two local species belonging to sect. Xanthodermatei, *A. kai* and *A. rotalis*, differ in having much lighter, smoother pilei, or more uniformly dark, radially rimose pilei, respectively.

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Agaricus rotalis K. R. Peterson, Desjardin, & Hemmes, **sp. nov.** – Figs. 52–55.

Pileus 55–95 mm latus, cylindricus vel convexus deinde expansus, umbonatus, appresse fibrillososquamulosus, radialiter rimosus, niger, deinde griseobrunneus vel atrobrunneus, pallescens; caro alba, immutabilis vel rubescens fractu. Lamellae liberae, confertae, albae vel roseae deinde atrobrunneae. Stipes 35–70 × 4–14 mm, subaequalis, ad basim clavatus vel bulbosus, glabrus, albidus deinde brunneus vel niger, deorsum lutescens tactu; caro lutescens fractu. Annulus subapicalis, pendulus, membranaceus, ad marginem nigromaculatus. Odor phenolicus. Basidiosporae 4.2–6.5 × 3.0–5.0 µm, ellipsoideae vel ovoideae, atrobrunneae. Cheilocystidia 6.5–22 × 4–14 µm, versiformia. Ad terram. Holotypus: HAWAII, Hawai'i, 27 Jun. 1996, D. E. Hemmes 1128 (SFSU).

Pileus (Fig. 52) (25–) 55–95 mm diam., cylindrical to convex when young, expanding in age, remaining convex or becoming plano-convex to applanate, often with a broad umbo; surface dry, appressed fibrillose to appressed squamulose, rarely subtomentose, radially rimose exposing white context, ± solid black when young, remaining black or becoming grey to greyish brown (8E2, 8F3) or dark brown (8F4–6) in age, background white, sometimes becoming yellow when bruised, sometimes becoming pink in age or when wet, otherwise unchanging; context up to 2–5 (–8) mm thick, white, often becoming pink where exposed when wet, otherwise unchanging. – Odor of phenol, of herbicide, or indistinct. – Lamellae free, close to medium close with 4–5 series of lamellulae, (2–) 4–5 (–7) mm broad, at first white, becoming pinkish white (7A2), then dull red (8C3) to reddish brown (8–9E4), finally dark brown (6-7F6–8, 8F4, 9F5). – Stipe 35–70 (–120) × 4–14 mm, equal or tapering upward above an equal to subbulbous or abruptly bulbous base; interior white, base becoming yellow when cut, hollow; surface rarely longitudinally striate, glabrous, white to brown (7E4), dark brown (6E6, 7F4–6), grey or black, often lighter above, sometimes becoming yellow below when bruised; often subtended by mycelial strands. – Veils forming a small, tissue-like, subapical, pendant annulus, abaxial surface sometimes covered with black, squamose spots along its perimeter.

Basidiospores (Fig. 53) 4.2–6.5 × 3.0–5.0 µm [$\bar{x}_r$ = 4.8–5.5 × 3.2–3.6 µm, $\bar{x}_m$ = 5.1 ± 0.4 × 3.4 ± 0.3 µm, Q = 1.0–1.9, $\bar{q}_r$ = 1.4–1.6, $\bar{q}_m$ = 1.5 ± 0.2, n = 25 spores per 12 collections], ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix semiprominent to prominent; germ pore not evident. – Basidia (Fig. 54) 12–25 × 5–9 µm, cylindro-clavate to clavate, hyaline, tetrasporic, with sterigmata up to 2.4 µm long. – Cheilocystidia (Fig. 55) 6.5–22 × 4–14 µm, ellipsoid to globose, napiform, obovoid, lightbulb-shaped or pyriform, hyaline, thin-walled, at first common and nearly continuous, becoming rare and scattered in age; lamellar margin nearly sterile to

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sterile, composed primarily of cells oriented parallel to margin. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 2–30 µm diam, highly inflated to subglobose, ± repent, interwoven, hyaline with dark brown vacuolar pigments. – Pileus trama composed of hyphae 1.5–55 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 1–36 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 1–61 µm diam, inflated, hyaline with dark brown vacuolar pigments. – Partial veil hyphae 1–19 µm diam, uninflated to inflated, hyaline, some with dark brown vacuolar pigments, thin-walled. – Universal veil (from rare fibrils on stipe below annulus) hyphae 1.5–15 µm diam, inflated to highly inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH yellow; aniline × glacial acetic acid (in exsiccati) negative.

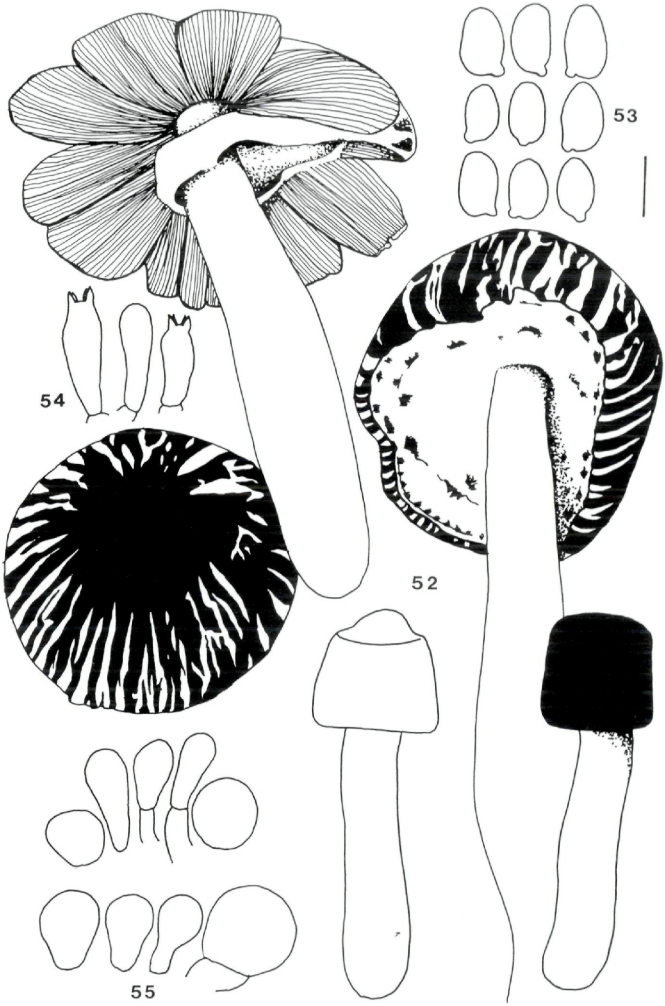
Habit, habitat, and distribution in the Hawaiian Islands. – Scattered to gregarious in soil, duff, woodchips, and on rotting logs under trees, including common ironwood (*Casuarina equisetifolia* L.; Casuarinaceae), monkeypod (*Samanea saman* (Jacq.) Merr.; Fabaceae), Formosa koa (*Acacia confusa* Merr.; Fabaceae), Norfolk Island pine (*Araucaria heterophylla* (Salisb.) Franco; Araucariaceae), and common guava (*Psidium guajava* L.; Myrtaceae), in Common Ironwood Coastal Forest, Alien Wet Forest, and lowland urban areas. Hawai'i, Maui, Moloka'i, and O'ahu. June through January (possibly fruiting year round).

Specimens examined. – USA. HAWAI'I: Hawai'i, Mackenzie Beach State Park, 3 Aug. 1993, DEH 283; same location, 7 Dec. 1993, DEH 340; same location, 20 Sep. 1994, DEH 560; same location, 26 Aug. 1995, DEH 868; same location, 25 Jun. 1996, DEH nos. 1111 and 1114; Hawai'i, Hilo, 27 Jun. 1996, DEH 1128 (Holotype, SFSU; Isotype, BISH); Hawai'i, Waipio Valley, 5 Jan. 1997, KRP 094; Maui, Waihe'e Ridge Trail on northwest coast of West Maui, 15 Jan. 1996, DED 6441; Moloka'i, Pala'au State Park, 13 Jan. 1996, DEH 995 and 996; O'ahu, St. Louis Heights, 14 Sep. 1996, DEH 1238.

Etymology. – rotalis (Lat.): wheel, referring to the pinwheel pattern formed by the split cuticle of the pileus.

The spectacular *A. rotalis* (subgen. Agaricus, sect. Xanthodermatei) is characterized by its medium size, strongly flavescent stipe base, indistinct to phenolic odor, positive KOH reaction, solid black pileus that with maturity becomes radially rimose and either remains black or lightens to grey or dark brown, and finally, by its often prolific fruiting. The other two local species belonging to sect.

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Figs. 52–55. *Agaricus rotalis* (DEH 1128, Holotype). – 52. Basidiomata. – 53. Basidiospores. – 54. Basidia and basidiole. – 55. Cheilocystidia. – Scale bar: Figs. 52 = 10 mm; 53 = 5 µm; 54–55 = 10 µm.

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Xanthodermatei, *A. kai* and *A. praeclaresquamosus*, differ in having much lighter pilei that are not rimose. *Agaricus rotalis* is similar to several other tropical species of sect. Xanthodermatei with radially rimose pilei, such as *A. endoxanthus* Berk. & Broome, *A. hypophaeus* Heinem. and *A. volvatulus* Heinem. & Goos.-Font. *Agaricus endoxanthus*, described from Sri Lanka, has a dramatically lighter pink to purple or brown pileus, even when young, that breaks up transversely as well as radially to produce a squamulose to rimose appearance at maturity (*fide* Pegler, 1986; Pegler, 1983; and Pegler & Rayner, 1969). *Agaricus hypophaeus*, described from Singapore, and *A. volvatulus*, described from the Republic of the Congo, are not flavescent. In addition, *A. volvatulus* differs in having a strongly marginately bulbous stipe base (*fide* Heinemann, 1980). Because of the diverse habitats and alien plants associated with *A. rotalis*, it is difficult to predict the geographic origin of the species, although we suggest Australasia or Indomalaysia as possibilities.

Agaricus aff. *semotus* Fr., Monogr. hymenomyc. suec. 2: 347. 1863. – Figs. 56–59.

≡ *Pratella semota* (Fr.) Gillet, Tableaux analytiques des hyménomycétes de France, Hyménomycétes: 129. 1884.

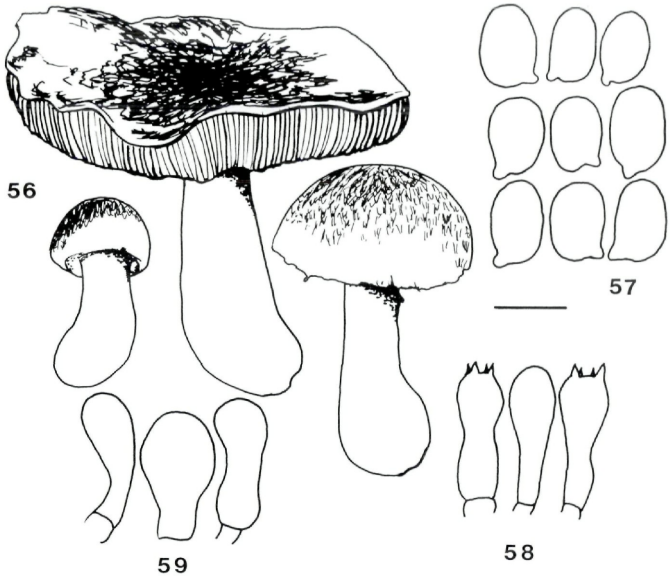
≡ *Psalliota semota* (Fr.) Essette, Atlas Mycologiques 1: pl. 48. 1964, nom. inval.

Selected descriptions and icones. – Wasser (1989: 104, pl. 20/c); Kerrigan (1986: 45, pl. 6: 45); Cappelli (1984: 300, pl. 54); Essette (1968: pl. 48); Møller (1952: 194, pl. 37); and Pilát (1951: 99, Fig. 59).

Pileus (Fig. 56) 45–55 mm diam., convex when young, becoming applanate in age; surface dry, appressed squamulose (disc smooth), squamules brown (7E7) to violet brown (10F7), background white, becoming yellow, then sometimes reddish brown when bruised; context up to 6 mm thick, white, color change not recorded. – Odor of almond extract. – Lamellae free, medium close with 5 series of lamellulae, up to 9 mm broad, reddish grey (7B2) when young, becoming greyish brown (7D3), finally dark brown at maturity. – Stipe 35–40 × 7–12 mm (at median) × 20 mm (at base), tapering upward above a subbulbous base; interior features not recorded; surface finely longitudinally striate, white, becoming yellow, then sometimes reddish brown when bruised. – Veils forming a tissue-like, ± intermediate annulus.

Basidiospores (Fig. 57) 4.8–6.2 × 3.0–4.3 µm [$\bar{x}_r$ = 5.6–5.7 × 3.7–4.0 µm, $\bar{x}_m$ = 5.7 ± 0.2 × 3.9 ± 0.3 µm, Q = 1.3–1.9, $\bar{q}_r$ = 1.4–1.5, $\bar{q}_m$ =

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Figs. 56–59. *Agaricus* aff. *semotus* (DEH 1504). – 56. Basidiomata. – 57. Basidiospores. – 58. Basidia and basidiole. – 59. Cheilocystidia. – Scale bar: Figs. 56 = 10 mm; 57 = 5 µm; 58–59 = 10 µm.

1.5 ± 0.1, n = 25 spores per 2 collections], narrowly amygdaliform to ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix semiprominent; germ pore not evident. – Basidia (Fig. 58) 19–23 × 6–7 µm, cylindroclavate to clavate, hyaline, tetrasporic, with sterigmata up to 3 µm long. – Cheilocystidia (Fig. 59) ca. 16 × 5.8 µm, clavate, hyaline, thin-walled, basidiole-like, scattered; lamellar margin nearly fertile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 3.5–10 µm diam, slightly inflated, ± repent, interwoven, hyaline. – Pileus trama composed of hyphae 3–17 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 3–32 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 2.5–32 µm diam, inflated, hyaline. – Partial veil hyphae 2.5–9 µm diam, slightly inflated, hyaline, thin-walled. – Universal veil (from tufted fibrils on stipe below annulus) hyphae 2–7 µm diam, uninflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

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Chemical reactions. – KOH yellow; aniline × glacial acetic acid (in exsiccati) scarlet.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered in duff under cypress (*Cupressus;* Cupressaceae) and gum tree *(Eucalyptus* sp.*;* Myrtaceae) in Montane Mesic Forest. Hawai'i. July.

Specimens examined. – USA. HAWAI'I: Location and date not recorded, DEH 1254; Hawai'i, Mauna Kea, Pu'u Lau'au Cabin, 4 Jul. 1997, DEH 1504.

This taxon is characterized by its small size, flavescence, almond odor, positive KOH and Schäffer's reactions, white pileus with violet brown to brown squamules, and preference for sylvan habitats. The Hawaiian taxon has larger spores (on average) and narrower cheilocystidia than the widely accepted concept of *A. semotus* (*fide* Wasser, 1989; Kerrigan, 1986; Capelli, 1984; and Heinemann, 1977). Locally, *A. comptuloides* is quite similar, however, *A.* aff. *semotus* differs in its more robust stipe, distinct flavescence, and smaller cheilocystidia. Other similar, small local species are more easily differentiated. *Agaricus arorae* is rufescent and has smaller spores, and *A. comtulus* lacks dark pileus pigments.

Agaricus subrufescens Peck, New York State Bot. Rep. 46: 105.'1892', 1893; non *A. subrufescens* sensu J. E. Lange, Dansk. Bot. Ark. 4: 55, pl. 136/b. 1926 (*fide* Capelli,1984 and Kerrigan, 1982). – Figs. 60–63.

≡ *Psalliota subrufescens* (Peck) Lloyd, Mycol. not. 1: 47. '1898,' 1900.

Selected descriptions and icones. – Kerrigan (1986: 51, pls. 6: 51); Boston Mycological Club (1904); and Peck (1895: 138, pl. 7).

Pileus (Fig. 60) 50–80 (–115) mm diam., cylindrical to cylindro-convex when young, sometimes misshapen, becoming convex to plano-convex, finally applanate in age, sometimes umbonate to truncately umbonate; surface dry, appressed fibrillose to appressed squamulose, disc nearly entire, fibrils dark reddish brown to violet brown (10F8) or dark brown (7–9F8, 8F4), or more pallid, background white to buff, becoming yellow when bruised; context up to 5–14 mm thick, white to buff, unchanging or becoming yellow. – Odor and taste of almond extract. – Lamellae free, close with 2–8 series of lamellulae, up to 2–7 mm broad, at first white, becoming light pinkish white (8A2, 12A2), then light brown (6–7D4), to brown (6–7E4), finally dark brown (6F5–6, 6–8F8, 7F6) at maturity. – Stipe 55–145 × 5–13 mm (at median) × 10–20 mm (at base), equal to tapering upward, sometimes above a bulbous base; interior white to buff, unchanging or becoming yellow when cut, fistulose to hollow with

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cavity up to 2 mm broad; surface glabrous, white above, buff below, becoming yellow when bruised; sometimes subtended by mycelial strands. – Veils forming a flaring, pendant, subapical, white annulus, abaxial surface sometimes covered with flesh colored patches.

Basidiospores (Fig. 61) 4.5–7.2 × 3.0–5.2 µm [$\bar{x}_r$ = 5.4–6.2 × 4.0–4.6 µm, $\bar{x}_m$ = 5.9 ± 0.4 × 4.3 ± 0.3 µm, Q = 1.0–2.0, $\bar{q}_r$ = 1.3–1.5, $\bar{q}_m$ = 1.4 ± 0.1, n = 25 spores per 12 collections], ellipsoid-ovoid, smooth, dark brown, thin-walled; hilar appendix not prominent; germ pore not evident. – Basidia (Fig. 62) 11–28 × 5.5–13 µm, cylindro-clavate to clavate, hyaline, tetrasporic, with sterigmata up to 3 µm long. – Cheilocystidia (Fig. 63) 4–37 × 4–17 µm, at first oblong and aseptate or multiseptate, inflating quickly to become catenulate or not, oblong to globose, pyriform, bottle-shaped or dumbbell-shaped, hyaline, thin-walled, abundant, continuous; lamellar margin sterile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 2–19 µm diam, ± repent with scattered clusters of erect terminal cells, interwoven, often forming short, ± erect branches, hyaline. – Pileus trama composed of hyphae 5.5–32 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 1.5–30 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 1.5–26 µm diam, inflated, hyaline. – Partial veil hyphae 1.5–20 µm diam, uninflated to highly inflated, hyaline, thin-walled. – Universal veil (from pileus and abaxial surface of annulus) hyphae 1.5–22 µm diam, inflated to highly inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

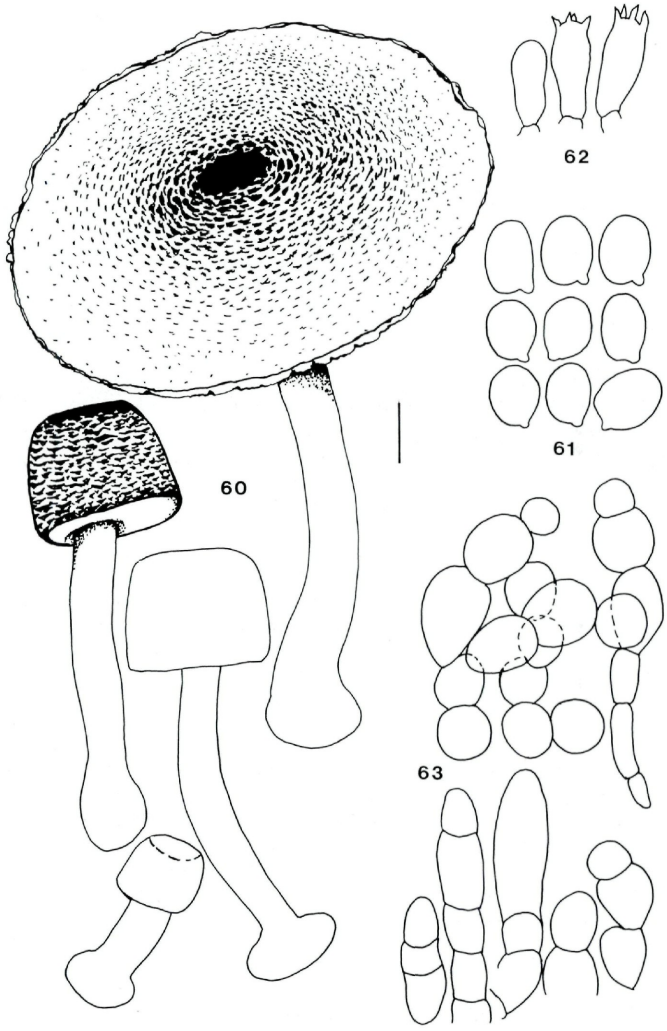
Chemical reactions. – KOH yellow; aniline × glacial acetic acid (in exsiccati) bright orange to scarlet.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered to clustered in compost, duff, on woodchips, in black sand, in lawns, gardens, and under various trees, including common ironwood (*Casuarina equisetifolia* L.; Casuarinaceae), monkeypod (*Samanea saman* (Jacq.) Merr.; Fabaceae), and coconut (*Cocos nucifera* L.; Arecaceae), in Coastal Mesic Forest, Alien Wet Forest, and coastal urban areas. Hawai'i and Maui. Year round.

World distribution. – Hawai'i, North and South America.

Specimens examined. – USA. HAWAI'I: Hawai'i, Hilo, University of Hawai'i campus, 28 Oct. 1993, DEH 313; Hawai'i, Mackenzie Beach State Park, 7 Dec. 1993, DEH 337; same location, 22 Jan. 1994, DEH 411; Hawai'i, Pahoa, Mike Au's farm, 27 Jul. 1994, DEH 513; Hawai'i, Mackenzie Beach State Park, 9 Aug. 1994, DEH 527; same location, 20 Sep. 1994, DEH 562; Hawai'i, Leilani Estates, 15 Dec. 1995, DEH 941; same location, 26 Dec. 1995, DEH 943; same location, 26 Mar. 1996, DEH 1073; Hawai'i, Hilo, bayfront, 27 Jun. 1996, DEH 1129; same location, 20 Aug. 1996, KRP 070; Maui, Koele Lodge, 25 Jan. 1997, DEH 1452.

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Figs. 60–63. *Agaricus subrufescens* (DEH 943). – 60. Basidiomata. – 61. Basidiospores. – 62. Basidia and basidiole. – 63. Cheilocystidia. – Scale bar: Figs. 60 = 10 mm; 61 = 5 µm; 62–63 = 10 µm.

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Agaricus subrufescens (subgen. Agaricus, sect. Arvenses, subsect. Augusti) is characterized in the Hawaiian Islands by its medium size, flavescence, almond odor, positive KOH and Schäffer's reactions, white pileus with red to brown appressed squamules, and abundant, catenulate cheilocystidia. Locally, *A. subrufescens* might be confused with *A. kipukae*, which can be distinguished by its orange to brown pileus fibrils, smaller spores, occasional rufescence, and lamellae that are late in coloring. Possibly of subtropical origin but more widespread apparently because of its association with cultivated ground, *A. subrufescens* is one of the more common species of *Agaricus* in Hawai'i, especially on the island of Hawai'i.

Agaricus xeretes K. R. Peterson, Desjardin, & Hemmes, **sp. nov.** – Figs. 64–67.

Pileus 30–40 mm latus, planoconvexus, cinereus, squamulis atrobrunneis obtectus. Caro albida, lutescens ad exsiccatum cum 3% KOH. Lamellae liberae, subconfertae, atrobrunneae. Stipes –35 × –5 mm, subaequalis, glabrus, albidus. Annulus subapicalis, pendulus, submembranaceus. Odor amygdalinus. Basidiosporae 4.3–6.0 × 4.0–4.5 µm, ellipsoideae vel ovoideae, atrobrunneae. Cheilocystidia 11–25 × 6.5–10 µm, oblonga vel globosa, interdum catenulata. Ad terram. Holotypus: HAWAII, Lana'i, 25 jan. 1997, D. E. Hemmes 1462 (SFSU).

Pileus (Fig. 64) 30–40 mm diam., plano-convex becoming uplifted in age; surface dry, tufted squamulose, squamules dark brown, background grey; context up to 5 mm thick, off- white, color change not recorded. – Odor slightly of almond extract. – Lamellae free, medium close with 4 series of lamellae, up to 7 mm broad, dark brown in age. – Stipe up to 35 × 5 mm, slightly tapering downward; interior features not recorded; surface glabrous, off-white, color change not recorded. – Veils forming a tattered, pendant, subapical annulus.

Basidiospores (Fig. 65) 4.3–6.0 × 4.0–4.5 µm [$\bar{x}$ = 5.5 ± 0.3 × 4.3 ± 0.2 µm, Q = 1.1–1.5, $\bar{q}$ = 1.3 ± 0.1, n = 25 spores], ellipsoid-ovoid to broadly ellipsoid, smooth, dark brown, thin-walled; hilar appendix semiprominent to prominent; germ pore not evident. – Basidia (Fig. 66) 17.5–23 × 6–8 µm, cylindro-clavate, hyaline, tetrasporic, with sterigmata up to 3 µm long. – Cheilocystidia (Fig. 67) 11–25 × 6.5–10 µm, oblong to globose or lightbulb-shaped, sometimes catenulate, hyaline, thin-walled, at first abundant and nearly continuous, becoming common and clustered in age; lamellar margin sterile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae 2–13 µm diam, ± repent, interwoven, hyaline. – Pileus trama composed of hyphae 3–36 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 3–36 µm diam, inflated, hyaline. –

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Stipe tissue parallel, tightly packed; hyphae 2.5–26 µm diam, inflated, hyaline. – Partial veil hyphae 2.5–12 µm diam, inflated, hyaline, thin-walled. – Universal veil (from stipe below annulus) hyphae 2.5–10 µm diam, inflated, hyaline, thin-walled. – Clamp connections absent in all tissues.

Chemical reactions. – KOH (in exsiccati) yellow; aniline × glacial acetic acid (in exsiccati) equivocal.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered in soil under kiawe (mesquite; *Prosopis pallida* (Humb. & Bonpl. ex Willd.) Kunth; Fabaceae) in Kiawe Forest. Lana'i. January.

Specimen examined. – USA. HAWAI'I: Lana'i, Shipwreck Beach, 25 Jan. 1997, DEH 1462 (Holotype, SFSU; Isotype, BISH).

Etymology. – xerós (Grk.): dry, in reference to the habitat; etes (Grk.): to dwell.

Agaricus xeretes (subgen. Agaricus, sect. Arvenses, subsect. Minores) is characterized by its small size, almond odor, latent flavescence, grey pileus with dark brown, tufted squamules, white stipe, and oblong to globose or lightbulb-shaped, sometimes catenulate, cheilocystidia. Due to the darkness of the dried tissues of the existing collection, Schäffer's reaction is difficult to determine. Because of the combination of its positive KOH reaction, almond odor, and catenulate cheilocystidia, however, it is possible to place *A. xeretes* in sect. Arvenses. Its small size further places it in subsect. Minores, but its catenulate cheilocystidia and distinctive grey pileus with dark brown squamules are unique among species of subsect. Minores, which typically have simple cheilocystidia and pilei that are whitish or whitish with yellow or pink to brown elements. Along with *A. azoetes* and *A. kiawetes*, the xerophytic *A. xeretes* grows in association with alien kiawe in arid habitats. Because kiawe is native to Peru, Colombia and Ecuador, and was first introduced to the Hawaiian Islands in 1828 (Rock, 1917), the progenitors of these three new species may have originated from South America.

Melanophyllum haematospermum (Bull.: Fr.) Kreisel, Feddes Repert. 95: 700. 1984. – Figs. 68–70.

≡ *Agaricus haematospermus* Bull. [as 'Agaric aimatosperme'], Herb. France 13: pl. 595/1. 1793.
≡ *A. haematospermus* Fr., Syst. mycol. 1: 282. 1821.
≡ *Lepiota haematosperma* (Bull. : Fr.) Quél., Champ. Jura Vosges: 536. 1875.
≡ *Pratella haematosperma* (Bull. : Fr.) Gillet, Hyménomycètes: 566. 1878.
≡ *Lepiota haematosperma* (Bull. : Fr.) Boud., Icon. mycol. 1: pl. 12. 1905, nom. illeg. (non Quél., ibid.)

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≡ *Psalliota haematosperma* (Bull. : Fr.) S. Lundell & Nannf., Fung. exs. suec., 7–8: 18. 1936.

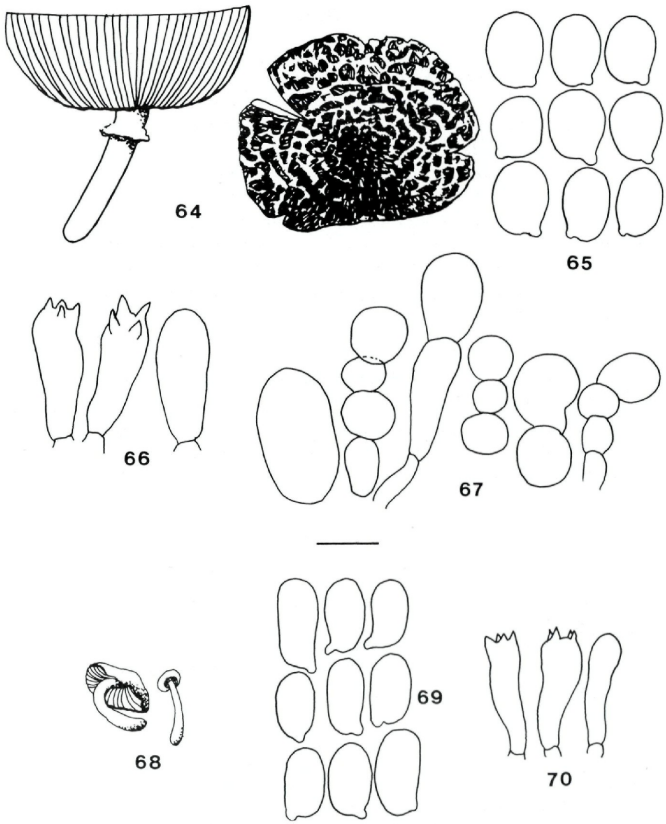
= *Agaricus echinatus* Roth, Catal. bot. 2: 255, pl. 9/1. 1800.
≡ *A. echinatus* Fr., Syst. Mycol. 1: 286. 1821.
≡ *Psalliota echinata* (Roth : Fr.) Kumm., Führer Pilzk.: 69. 1871.
≡ *Psalliota echinata* (Roth : Fr.) Quél., Champ. Jura Vosges: 536. 1875.
≡ *Pratella echinata* (Roth) Gillet, Hyménomycètes: 565. 1878.
≡ *Lepiota echinata* (Roth : Fr.) Quél.,Bull. Soc. Bot. France 26: 45. 1880.
≡ *Inocybe echinata* (Roth : Fr.) Sacc., Syll. fung. 5: 773. 1888.
≡ *Naucoria echinata* (Roth : Fr.) Schroet., Die Pilze Schlesiens 1: 607. 1889.
≡ *Psathyra echinata* (Roth : Fr.) Overh., Mycologia 25: 428. 1933.
≡ *Cystoderma echinata* (Roth : Fr.) Singer, Ann. Mycol. 34: 338. 1936.
≡ *Melanophyllum echinatum* (Roth : Fr.) Singer, Lilloa 22: 436. 1951.

Selected descriptions and icones. – Wasser (1989: 11, pls. 1/a, 23/1, & 29/4–5); Heinemann (1986: 250, Fig. 138 and pl. 47/6); Kerrigan (1986: 56); and Pilát (1951: 26).

Pileus (Fig. 68) 5–12 mm diam., hemispherical with an incurved margin, to broadly convex or applanate, with or without a small umbo; margin even; surface cottony when young, suede-like to glabrous in age, not hygrophanous, greyish red (9B–C5–6) to brownish red (9C7). – Odor farinaceous. – Lamellae deeply adnexed to nearly free, close with 1–2 series of lamellulae, up to 2 mm broad, uneven in outline but convex overall, relatively thick, dark reddish brown (9D–E7–8) when young, becoming darker reddish brown (9F7–8) at maturity. – Stipe $10–12 \times 0.75–1.25$ mm, central, terete, equal above a slightly larger base, firm, fibrous, silky to cottony above, tomentose at base, greyish red (9B–C5–6) to brownish red (9C7), tomentum pink (9A3–4).

Basidiospores (Fig. 69) $3.5–5.8 \times 2.5–3.0$ µm [$\bar{x} = 4.8 \pm 0.6 \times 2.8 \pm 0.2$ µm, $Q = 1.2–2.1$, $\bar{q} = 1.7 \pm 0.2$, $n = 25$ spores], oblong-lacrymoid to cylindrical-lacrymoid, minutely echinulate, light brown, thin-walled; hilar appendix prominent; germ pore not evident. – Basidia (Fig. 70) $17–19 \times 6–7$ µm, cylindro-clavate, hyaline with dark brown vacuolar pigments, tetrasporic, with sterigmata up to 3 µm long. – Cheilocystidia (Fig. 66) absent or basidiole-like; lamellar margin fertile. – Pleurocystidia and caulocystidia absent. – Pileipellis an enterocutis; hyphae up to 14 µm diam, highly inflated to globose, ± repent, interwoven, hyaline with dark brown vacuolar pigments. – Pileus trama composed of hyphae 3.5–17 µm diam, inflated, hyaline. – Hymenophoral trama at first regular, becoming subregular in age; hyphae 1.5–12 µm diam, inflated, hyaline. – Stipe tissue parallel, tightly packed; hyphae 3–16 µm diam, stipitipellis uninflated, hyaline with dark brown vacuolar pigments, context uninflated to inflated, hyaline. – Partial veil not observed. – Universal veil not observed. – Clamp connections present in stipitipellis, absent elsewhere.

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Figs. 64–70. *Agaricus xeretes* and *Melanophyllum haematospermum*. – Figs. 64–67. *Agaricus xeretes* (DEH 1462, Holotype). – 64. Basidiomata. – 65. Basidiospores. – 66. Basidia and basidiole. – 67. Cheilocystidia. – Figs. 68–70. *Melanophyllum haematospermum* (DED 5499). – 68. Basidiomata. – 69. Basidiospores. – 70. Basidia and basidiole. – Scale bar: Figs. 64, 68 = 10 mm; 65, 69 = 5 µm; 66–67, 70 = 10 µm.

Habit, habitat, and distribution in the Hawaiian Islands. – Scattered in debris under firetree (*Myrica faya* Aiton; Myricaceae) and kahili ginger (*Hedychium garderianum* Ker-Gawl.; Zingiberaceae) in Montane Dry Forest. Hawai'i. January.

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World distribution. – Cosmopolitan.

Specimen examined. – USA. HAWAI'I: Hawai'i, Hawai'i Volcanoes National Park, Pu'u Puai, 12 Jan. 1992, DED 5499.

M. haematospermum is characterized in the Hawaiian Islands by its tiny size, farinaceous odor, greyish red to brownish red basidiomata, dark reddish brown lamellae, clamp connections, and small, minutely echinulate spores. When fresh, the spore print of *M. haematospermum* is green but becomes brown with dehydration; furthermore, the young lamellae are red and become dark brown with drying or in age. Although locally rare, this species is widespread throughout the world, possibly due to its common association with cultivated ground.

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