

Marijuana, *Cannabis sativa* L.

Moraceae, Cannaboideae

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I. Nomenclature: A) *Cannabis sativa* L.; B) marihuana, hemp, Mary Jane; chanvre (Fr.); canamo (Sp.); konopli (Ru); Kanf (Gr.) (Fig. 1); C) synonyms: There are many names for the horticultural variants of *Cannabis sativa*. Some names have been validly published in accordance with the International Code of Botanical Nomenclature. Names used in the literature (valid and invalid) include: *C. ruderalis* Janischevsku, *C. indica* Lam., *C. himalayana* Zinger, *C. gigantea* Delile, *C. sativa* forma *gigantea* Voss, *C. chinensis* Vilmorin, *C. sativa* var. *atropurpurea* Lonachevsky and Kotov, *C. pedemontana* Camp, *C. americana* Houghton and Hamilton, *C. germanica* My, *C. erecta paludosa* Anders., *C. macrosperma* Stokes, *C. saliva* var. *vulgaris* Alefeld, *C. sativa* var. *culta* Czernj., *C. sativa* var. *praecox* Serebr., *C. sativa* var. *monoica* Hol., *C. generalis* Krause in Sturn., *C. sativa* var. *spontanea* Czernj., *C. sativa* subsp. *spontanea* Serebriakova, *C. sativa* forma *afghanica* Vavilov, *C. indica* var. *Kafiristanica* forma *afghanica*.

Artificial selection by man has resulted in a highly variable group with taxonomic status in dispute. Currently accepted nomenclature is cited under section III, Technical Characters, of this report.



Fig. 1. The cultivation of marijuana has produced an estimated 10 billion dollar illegal industry in the U.S.

II. History: The family Moraceae is a heterogeneous group of plants divided into four subfamilies (or tribes), including the one to which marijuana is assigned, the Cannaboideae. However, recent systematic studies support elevating this subfamily to familial status, the Cannabinaceae.

The taxonomy of the genus *Cannabis* has been passionately debated, especially in recent years. There are generally two views concerning the number of species contained in the genus. Several authors (e.g., Small et al. 1975, Small and Cronquist 1976) have argued that there is one highly variable species, *Cannabis sativa* L., all other names being synonymous. Another school of thought, characterized by Emboden (1974), suggests that the genus contains several valid species. For some members of this school, the view has been a revision of taxonomic judgments diverging from previous opinions. One major complication emerging from the taxonomic debate has been in law enforcement where legislation expressly prohibits use or possession of *Cannabis sativa*. Forensic arguments have involved reputable botanists from both viewpoints pitted, one against the other, in courts of law. If one subscribes to the polytypic concept of the genus, it might be impossible to determine the exact identity of *Cannabis* in a manicured collection (e.g., criminal drug sample). To submerge all names into a monotypic taxon nicely dissolves the problem.

Cannabis has been cultivated for 8,500 years (Schultes 1969). Since *Cannabis* is one of the oldest plants cultivated by man, it is difficult to determine its original homeland. Most authors place the indigenous distribution of marijuana to a restricted, primeval area in central Asia, although this is in dispute. It is the oldest known cultivated fiber plant. Hemp cloth estimated to be more than 6,000 years old is known from Europe. It has been cultivated for products other than the tough bast fibers used in making cloth, namely for seeds from which oil is extracted, and as a source of psychotomimetic chemicals (narcotic). There are no references to *Cannabis* in hieroglyphic texts or sacred scriptures of Egyptian or Hebrew origin. However, early (2737 BC) Chinese materia medica list *Cannabis* as a plant useful for its pharmacological properties. The Lu Shi, a Chinese literary piece of the Sung Dynasty (500 AD), states that Emperor Shen Nang taught the people how to make hemp cloth in the twenty-eighth century BC. Greek and Romans extracted fiber from the stems but apparently never indulged in its drug properties, which perhaps were unknown to them. Herodotus (450 BC) points to hemp use by the Scythians and Thracians. The westward migration of the Scythians around 1500 BC probably brought *Cannabis* to Europe. The name itself is an ancient Greek appellation, perhaps derived from the Arabic *Kannab*.

The advent of *Cannabis* to America (Chile) came in 1545 AD from Spain (Dewey 1914). It was among the plants introduced into New England from Great Britain about 1632 and found at Puritan settlements. In 1649 it was planted in Colonial Virginia. However, the French record it from Port Royal, Acadia, Nova Scotia (New France) in 1606.

It is apparent that early American botanists were not certain if *Cannabis sativa* was native or naturalized. This is undoubtedly due to early, multiple introductions into America. Muhlenberg (1813), in an early catalogue of plants, designated only naturalized foreign plants: ". . . Of plants properly foreign none are received in the Catalogue, if they are not, as it were, naturalized. They are distinguished by the mark C." This annotation appears with a questionmark (C?) after *Cannabis sativa* in the catalogue. The word "common" also is included. Barton (1815) follows the *Cannabis* entry with a "C?" as well; however, in the introduction to his *Florae Philadelphicae Prodrromus*, he intimates that "C" is the designation for cultus (cultivated), whereas he uses "Cic" for *cicur* (tame or naturalized). It seems rather unlikely that Barton was questioning whether *Cannabis* was cultivated. Perhaps the symbols were unintentionally confused. In a paper concerning European taxa that had become naturalized in the United States, de Schweinitz (1832) itemized *Cannabis sativa* under the heading "Introduced by cultivation, for agricultural or other purposes." The entry is followed by ". . . very common, but not in quantities." Darlington (1826), who enumerated the flora of West Chester, PA, believed that marijuana was possibly cosmopolitan, indicating that it was native to "Persia, and North America? . . .", the question-mark being his annotation. He interestingly adds the note: "This plant, beside being an auxiliary of some consequence in the penal systems of vindictive lawgivers, is one of immense importance in the concerns of all commercial and civilized nations. . . . In some portions of the adjoining county of Lancaster, it is raised to a considerable extent." Cultivation of hemp was a flourishing industry in Lancaster Co., PA in pre-Revolutionary war time. An elaborate account of methods employed was published in 1905 (New Era, Lancaster, PA, June, 24) as an historic document. This was originally written in 1775 by James Wright of Columbia, PA. Kummer (1839) reported marijuana from around Bethlehem (Northampton Co.), in 1837, collected by the botanists J. Wolle and A.L. Huebener.

III. Technical Characters: Ordinarily *Cannabis sativa*, an annual, produces two kinds of plants; one type producing female (pistillate) flowers, the other bearing male flowers (staminate). The term for this dimorphic sexual system is dioecious. The unisexual, small, green, greenish-yellow or purple flowers of marijuana lack petals. *Male flowers* have a calyx of five imbricate sepals and five stamens. The *anthers* are nearly sessile. Staminate flowers are numerous in small axillary clusters forming a *leafy panicle*. Staminate plants die after pollen is shed. *Female*

flowers: the calyx is barely lobed, short; stigmas 2, elongate, filiform, pistillate flowers in small clusters on shorter lateral branches from the upper axils; often crowded and appearing spikelike; each flower closely surrounded by an abruptly acuminate *bract*, the bract enlarging after flowering (accrescent) and enclosing the thick-lenticular, dry, indehiscent fruit (seed) called an achene; *achenes* (Fig. 2a): 2.5-4.0 mm wide, 3.0 to 6.0 mm long, dark gray to light brown and mottled; *leaves* (Fig. 3): petiolate, dark green above and light green beneath, palmately compound with 5-9(11) leaflets (frequently 7), opposite toward the base, becoming alternate upward with fewer leaflets; *leaflets*: pubescent, 5.0-15.0 cm long, linear to narrowly lanceolate, toothed; *plants*: 1 .0-2.0 m (6ft) or more tall (known to grow to 12 m, cf. Simmonds 1979). The stem is fluted or channeled, with well-marked nodes, having a rough "bark" near the base; *chromosome number*: $2n = 20$ (some experimentally induced polyploids exist). Artificial selection has resulted in a highly variable group with formal taxonomic delimitation in dispute. Two phases or classes of plants are, however, discerned by some authorities; a northern group of limited drug potential cultivated for fiber or seed-oil properties, called *C. sativa* subspecies *sativa*, growing north of latitude 30°N, and a southern group of considerable (psychoactive) intoxicant potential, named *C. sativa* subspecies *indica*. Further taxonomic fracturing has been suggested for these subspecies. *Cannabis sativa* ssp. *sativa* var. *sativa* refers to oil and fiber cultivars, whereas var. *spontanea* designates their naturalized offspring. *Cannabis sativa* ssp. *indica* var. *indica* is reserved for narcotic cultivars; var. *Kafiristanica* refers to the naturalized drug plants. Thus, within the subspecies two parallel lines exist: one cultivated, the other escaped and naturalized (Small and Cronquist 1976). The practical usefulness of this delimitation has been questioned (Emboden 1977).

Fig. 2. (a) Achenes (seeds) of marijuana. Achenes from (b) common hop and (c) Japanese hop might readily be confused with marijuana seeds.

Fig. 3. The compound leaves of marijuana contain 5 or 7 leaflets radiating from a single point.

Seedlings (Adapted from Kummer 1951): *cotyledons* (seed leaves): 3.0 mm x 9.5 mm (11.5), short, rough hairs above on margins, smooth beneath; *hypocotyl*: dull green with downwardly projecting hairs which become harsh with age; *leaves*: opposite, rough pubescent over the crinkly surface, veiny beneath; folded together closely in the bud, the sides plaited upon the mid-vein; first pair of true leaves toothed, simple (lanceolate); second pair frequently trilobed or tri-parted, third and subsequent pairs palmately compound, 5-7 leaflets; *stipules*: free from the base of the deeply grooved petiole. *Stem* (above the cotyledon): tough, fibrous, densely bristly with downward projecting hairs.

IV. Diagnostic characters. Pyramidal-shaped plants with compound leaves; the leaflets radiating from a central point (digitate), usually numbering 5-9, each bearing teeth along the edges; plants (Fig. 4) (leaves and stems) producing a pungent odor when crushed. *Forensic identification*: secretory and cystolith hairs on the abaxial surface of floral bracts. Cystoliths are unicellular and contain calcium carbonate.

Fig. 4. Narrowly lanceolate leaflets of marijuana detailing serrations of leaflet margins.

V. Confused Taxa: Several plants bear compound leaves that resemble *Cannabis sativa*. Two house plants of superficial similarity are *Dizygotheca elegantissima* (Araliaceae, Spider Aralia also erroneously called "Splitleaf Maple") and *Anthurium polychistum* (Araceae). The former is a shrub to 10 feet with leaves parted into 7-10 dentate (toothed) leaflets, threadlike in juvenile plants, up to 2 inches broad in mature specimens. The latter is a small plant with palmately lobed leaves that have undulating edges but are not toothed. The leaves of *Acer palmatum* (Aceraceae, Japanese maple) can resemble marijuana; however, the plant is arborescent (woody tree). In *Acer palmatum* the leaflets are broadest at the middle, unlike *Cannabis* leaflets which gradually taper from apex to base. *Acer palmatum* has opposite leaves and serrate (small) teeth. The variety *dissectum* has finely cut foliage with long teeth. *Datisca cannabina* L. (Datiscaceae), especially male plants of this dioecious taxon, is a remarkable mimic of *Cannabis sativa*. There are, however, a plethora of technical differences. One easily recognized differentiating character is the pinnately compound leaves of *Datisca* (Small 1975).

Of plants growing in the wild in Pennsylvania only *Potentilla recta* L. (sulfur cinquefoil, Rosaceae), *P. norvegica* L. (rough cinquefoil) and perhaps *Dentaria laciniata* Muhl. (toothwort, Cruciferae) have leaves that might be mistaken for marijuana. The former two are plants with narrowly oblanceolate, deeply toothed leaflets numbering 5 to 7, digitately compound. These plants of waste places bear showy yellow flowers, unlike hemp. *Dentaria* is a small (to 1 foot tall) spring-flowering plant of deciduous woods. Four showy pink petals distinguish it, as does the whorl of 3 leaves, each 3-foliolate. The segments are linear to lanceolate, nearly entire to laciniately toothed. The lateral segments may be deeply bifid, the whole leaf therefore appearing 5-parted. Two other plants, not in our range, may look like marijuana: *Hibiscus cannabinus* L. (Malvaceae) and *Urtica cannabina* L. (Urticaceae). Achenes of both *Humulus Lupulus* L. and *H. japonicus* Sieb. & Zucc. (hops) resemble the achenes of *C. sativa* (Fig 2b,c).

VI. Natural History: The annual plant *Cannabis sativa* is wind pollinated with no internal barriers to successful hybridization (Small and Cronquist 1976). The copiously produced pollen is 25 microns in diameter, suitable for long distance genetic interchange. As a cultivated plant it readily escapes, becoming established as an element of the local flora. Drug resin is highest in floral bracts, flowers, and younger and smaller leaves. Drug content is under genetic control with environmental conditions contributing some effects. Diurnal and seasonal parameters alter the quality and quantity of drug produced. Flower production is induced by short day lengths. For plants grown under 16 hours illumination, a 10-day period of light each day initiates bud formation (Paris et al. 1975).

The variability seen within the species is due in part of hybridization and introgression (back crossing) between progenitors, cultivars, and weedy escapes.

The best fiber appears to be produced at the end of approximately a four month frost-free period, with optimal temperatures of 60 F- 80 F. Sufficient rain to establish a good root system during the first six weeks of growth will allow the plants to endure drier soil conditions.

Cannabis sativa has a few disease problems. *Dendrophoma marconii* Cav. And cutworms have been reported to attack it. Chilean dodder, *Cuscuta racemosa*, troublesome on alfalfa, also is known to attack hemp plants. The only problem on significance is the root parasite broom rape (*Orobanche ramosa* L.) which is a nonphotosynthetic plant that is parasitic on tomato (*Lysopersicon*) and tobacco (*Nicotiana*) as well. Other diseases reported include *Botryosphaeria marconii* (Cav.) Charles and Jenkins, stem canker (MD, VA); *Botrytis cinerae* Pers. Ex Fr., gray mold (OR, VA); *Cylindrosporium* sp., leafspot (MD); *Fusarium* sp., canker, stem rot (IL, IN, VA, WI) and the conidial stage of the following: *Gibberella saubinetii* (Mont.) Sacc., stem rot (IN, VA); *Heterodera marioni* (Cornu); Goodey; *Hypomyces cancri* (Rutgers) Wr., root rot (MD); *Marcophomina phaseoli* (Maubl.) Ashby (IL); *Meloidogyne* sp., root knot nematode (TN); *Phomopsis cannabina* Curzi, stems (IL); *Phymatotrichum omnivorum* (Shear) Dug., root rot (AZ, TX); *Sclerotinia sclerotiorum* (Lib.) d By., stem rot, wilt (MT); *Sclerotium rolfsii* Sacc., southern blight (SC, TX) an *Septoria cannabina* (Lasch) Sacc., leafspot (MD to KY, IA, MN, FL, TX) (From the Index of Plant Diseases in the US, USDA Handbook 165, Washington, DC, 1960).

VII. Economic Importance: A) Beneficial. *Cannabis sativa* has been the source of a medicinal drug for centuries. It appears as bhanga (Sanskrit) in the Indian Atharva Veda around 1400 BC. And as a common medicinal in the Susruta before 800 AD. As a drug, cannabis was introduced into the west in 1839 and remained in the United States Pharmacopoeia and National Formulary until 1941 when it was removed, a victim of the 1937 Marijuana Tax Act. In recent years there has been a renewed interest to reintroduce the drug into medicine. Properties attributed to it include analgesic – hypnotic; antiepileptic – antispasmodic; appetite stimulant; prophylactic and treatment of the neuralgia's, including migraine; anti-depressant – tranquilizer; psychotherapeutic aid; antiasthmatic oxytoxic; antitussive; topical anesthetic; withdrawal agent for opiate alcohol addiction; childbirth analgesia; and even an antibiotic (Mikuriya 1969). Drug varieties, previously described, are numerous.

Fiber, from bast, is another product of hemp plants, although in recent years synthetic materials have reduced its importance. Yields of 2.0-2.5 tons/hectare (Simmonds 1979) are considered average. Many varieties have been bred

for fiber.

Another product from *Cannabis* is the fruit (achenes or seeds). They contain oil that is similar to linseed oil and therefore used in making soap and paints. The pressed cake resulting from oil extraction is fed to cattle. Bird seed mixtures often contain *Cannabis* seeds. Roasted achenes are eaten by some Europeans. Finally, the seeds are used as a culture medium in microbiology laboratories for water molds. The antibiotics extracted from these molds are active against gram-positive bacteria.

B) Detrimental. *Cannabis sativa* can become a weedy escape but has not been a weed problem in Pennsylvania. The smoked, crude cannabis drug preparation contains approximately 1% THC (Mikuriya 1969) taken in hand-rolled cigarettes joint, reefer) containing about 500 mg manicured marijuana. This yields a dose of about 5 mg of tetrahydrocannabinol. The drug, produced primarily in new growth and inflorescences, is secreted as a resinous exudate. Some of the chemicals, terpenoid compounds, called cannabinoids (or cannabinols) are psychoactive, especially delta-8-THC and delta-9-THC. On 24 March 1982 the U.S. Department of Health and Human Services submitted to Congress a report summarizing the consequences of marijuana use (MMWR 1982). The data are summarized from several recently conducted, comprehensive scientific reviews by the Institute of Medicine of the National Academy of Sciences, the Canadian Addiction Research Foundation, and the World Health Organization. Health hazards associated with marijuana use include acute intoxication which interferes with many aspects of mental functioning which effects perception and skill-performance, including driving and other complex tasks involving judgement or fine motor skills. Known (or suspected) chronic effects are slowness of learning; impaired lung function (similar to that found in cigarette smokers), including cancer and other lung disease potential; decreased sperm count and sperm motility; interference with ovulation and pre-natal development; impaired immune response; possible adverse effects on heart function; and long term storage of drug by-products in body fat. Of special note is the long term developmental effects in children and adolescents who are particularly vulnerable to the drugs behavioral and psychological effects. The lethargy or amotivational syndrome is characterized by a pattern of energy loss, poor school performance, harmed parental relationships, and other behavioral disruptions.

VIII. Control. *Cannabis sativa* is not a weed problem in Pennsylvania. The practical recommendation for destruction of illicitly cultivated plants is application of a broadleaf weed killer. The herbicide 2,4-D can be effectively applied in the seedling stage. The herbicide paraquat (trade names¹ for paraquat dichloride include Dextron X, Esgram, Gramoxone, and Weedol) has been used by law enforcement agents in controlling mature marijuana plants. In recent court cases there have been attempts to suspend paraquat application since the chemical acts as a desiccant that dries plant material, thus making it suitable for smoking. Pesticide residue remains on the desiccated material. Paraquat is toxic for lung tissue, regardless of the means administered. In 1978 Dr. Richard Hawks, Chemist for the U.S. Health, Education and Welfare Office, estimated that a burning marijuana cigarette would produce relatively innocuous bipyridine but also release free paraquat ranging in concentrations from 50 to 250 nanograms per joint. Daily heavy smoking (3-5 joints/day) could produce irreversible lung impairment. In a very preliminary study it was concluded that even an occasional smoker (1-2 cigarettes on a weekend) will experience microscopic fibrosis of the lung. The data were derived from smoke (chemical) analysis only; no biological studies were performed. Although there is an absolute risk, it appears that the U.S. government considers the risk of paraquat poisoning less significant (relatively) to the social benefits obtained from the destruction of field-grown marijuana.

Lithate (11thium salt of 2,4-D) (rate/treated acre: 0.25-0.5 lb product in field corn, 1-3 lb product in rangeland and pastures) is labeled for wild hemp control.

¹ Disclaimer: When trade names are used no discrimination is intended and no endorsement by either the author or the Pennsylvania Department of Agriculture is implied.

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