WRITTEN FINDINGS OF THE
WASHINGTON STATE NOXIOUS WEED CONTROL BOARD
(Updated December 1999)

Scientific Name: *Isatis tinctoria* L.

Common Name: dyers woad

Family: Brassicaceae (Cruciferae)

Legal Status: Class A

Description and Variation: Dyers woad grows as a winter annual, biennial or short-lived perennial, ranging from 1 to 4 feet tall, from a 3-5 foot long taproot. The basal rosette produces stalked, bluish-green leaves covered with a fine hair. The rosette leaves range from 1 ½ to 7" long, and they are succulent. All leaves have a cream colored mid-rib from tip to base. When the rosette bolts, up to 20 stems can be produced. Usually 7-8 of these stems mature, producing many somewhat woody, flowering branches. The cauline leaves (growing along the stem) are lance shaped, alternate and they are sessile (not stalked), they clasp the stem with short basal lobes. The small yellow flowers are typical of the mustard family, they are cross-shaped with 4 sepals, 4 petals and 6 tetradynamous stamens (2 outer stamens shorter than the 4 inner stamens). The yellow petals are about 1/8" wide, and just over 1/8" long. The petals are twice as long as the sepals. Flowers are found in terminal clusters on the branch tips. The fruit is a flattened seed pod (silicle), 3/8" long and ¼" wide, winged and slightly pear shaped and it hangs from a small stalk. Initially the pod is hairless and green, but it matures to a black or dark purplish brown. The seed pod is a distinguishing characteristic, and it is used for plant identification after flowering. Because of the large and persistent, black seed pods, areas infested with dyers woad look like they've been charred by fire (Young 1988). Each pod produces 1 seed. The seeds are brownish yellow and cylinder shaped. The root system consists of a heavy taproot and lateral roots are found in the top foot of soil.

Economic Importance:
Detrimental: Dyers woad will originally establish along road sides, gravel pits, levees and railroad rights-of-way. From there this plant has the ability to spread by seed to well vegetated rangelands, pastures, forests, waterways, and crops lands – to include irrigated and non-irrigated alfalfa and winter wheat. Rotting seed pods are thought to be allelopathic. Dyers woad gets into hay fields, contaminating the hay and leading to further spread, and it lowers forage quality (Young 1988). In the northern counties of Utah, an estimated annual loss of $2 million is attributed to reduced crop yields and a loss of range production, and the rate of spread of dyers woad doubled from 1971 to 1981 (Evans 1981). Entire hillsides north of Salt Lake City, UT are covered with dyers woad (Young 1988); Dyers woad is unpalatable. It is not toxic to livestock, but it is closely related to several other toxic weeds, which makes it a candidate for toxicological studies (Lorenz and Dewey 1988).

Beneficial: Dyers woad is known as a source of blue dye (indigo) since the 13th century, and it was widely cultivated in England until 1930. Indigotine, the chemical producing the blue dye, is located in the leaves, and produced through fermentation (Varga and Evans 1978).

Habitat: Dyers woad will establish in rocky soils with minimum water holding capacity, and the highest threat of establishment is in rangelands, pastures and forest lands. (McConnell et al. 1998); thrives in light sandy and gravelly soils; dense stands on grazing and marginal farm lands in northern

CA; invaded grazing and cereal grain lands in northern UT and SE Idaho (Hawkes 1985). In Utah, dyers woad is found in loose alkaline bench soils and in ID it is most often found on south-facing canyon slopes (Roche' 1992). In ID it is found between 3,000 and 8,000 ft, in full sun.

Geographic Distribution: Native to southeast Russia. It is also known from wild populations in China, Western Tibet and Afghanistan (Varga and Evans 1978). Originated in central Asia, followed civilization to Europe, it was noticed by farmers after traveling dye-makers left an area (Young 1988). Common in southeastern ID, northern Utah, northern CA and spreading into southern OR from CA (Hawkes 1985).

History: In the colonial US, dyers woad was cultivated for dye-making properties (Varga and Evans 1978). The source of the western establishment is traced to the early 1900's as a contaminate in alfalfa seed from Ireland to a ranch in Siskiyou Co., CA (Young and Evans 1977), and as a contaminate in alfalfa seed in Utah. The first herbarium specimen from Utah is dated 1932, where it was found growing near the railroad. Early records indicate that dyers woad was reported from CA, ID, OR, MT, UT and WY (Varga and Evans 1978); it is considered a persistent weed in eight western states (McConnell et al. 1998). Dyers woad is classified as a noxious weed in CA, ID, OR, UT and WA.

In Washington, dyers woad was discovered in 1986 from Kittitas County, growing along a railroad. This site was eradicated in 1992, and it is monitored regularly. This was our only known field site. However, dyers woad is considered something of an ornamental species, and people are aware of its dye making properties. This species is sometimes offered for sale, or found in gardens.

Growth and Development:
Dyers woad is described as an annual, biennial or short lived perennial. It is common for the plant to persist for more than one year. Seeds germinate in the fall. Rosettes appear in early spring, and they overwinter. The following spring the rosette bolts, and the stems branch out to produce many flowering stalks. These stalks become stiff when mature. Dyers woad flowers from April to June, and until August in higher elevations. Flower production is related to temperature, and plants growing at higher elevations produce later flowers. The plant dies after seed production. However, resprouting will occur, for several years, from the taproot near the crown of the plant if it is mechanically injured.

The fruit of dyers woad contain a water soluble chemical that is a germination inhibitor and it limits the root elongation of seedlings. This chemical is flushed away with rains, and most seeds of dyers woad will remain dormant until then, although some seeds do germinate. This inhibitor can impact other plants growing nearby, until the chemical is flushed from the soil. This gives dyers woad seedlings the ability to outcompete other plants (Young and Evans 1977; Varga and Evans 1978). This germination inhibitor also contributes to seed bank formation of dyers woad, delaying germination until precipitation levels are favorable for plant growth.

Reproduction: Dyers woad spreads by seed. The seed pods fall to the ground intact. Winter chilling is necessary before flowering. Seeds develop anywhere between 4 to 6 weeks, and up to 8 weeks after the flowering stem appears, depending on site conditions. Each plant can produce from 350 – 500 seeds, and some plants produce as many as 10,000 seeds (James et al. 1991). The seeds lack dormancy, but they are affected by a water soluble germination inhibitor that leaches out over time. Seeds are viable in the soil for years. 1% of fall germinated plants flower the first spring, 35% of the plants survived the second winter, and half of these flowered the following spring, 12% flowered the third spring (McConnell et al. 1998). Seeds are dispersed along roadways, waterways and by animals. Seeds are spread as a contaminant in feed, crop seed and bedding. The seeds fall usually within 22" of

the parent plant, but wind can disperse seeds up to 8 feet, before snowfall. Seeds can travel farther across winter snowfields. (Roche' 1992).

Response to Herbicide:
Herbicide control is more effective before the plant bolts. For site specific control information, please refer to the annually updated *Pacific Northwest Weed Control Handbook.* Metsulfuron in combination with 2,4-D are most effective in pastures and rangelands (Evans and Gunnell, as cited in McConnell et al. 1998).

Response to Cultural Methods: In dryland alfalfa fields, dyers woad can be cultivated twice a year for control – once in the spring time before seed production, and again in late fall for the late germinating plants. An active mowing program will control orchard populations of dyers woad.

Response to Mechanical Methods: Hand pulling is the recommended control option - after the plant bolts, and before seed production. This is considered the only practical control method of hard to reach, or difficult terrain.

Biocontrol Potentials: The native rust pathogen *Puccinia thlaspeos* is effective in preventing seed or fruit production. The rust seems to be spreading naturally to new dyers woad populations, and it is controlling further spread (James et al. 1991). Sheep will not voluntarily graze the plant.

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***References available** *from the Washington State Noxious Weed Control Board Office in Kent, WA.*

Rationale for Listing:

Dyers woad is a non-palatable, aggressive weed with allelopathic properties. This species has a history of establishing across thousands of acres of western rangeland, and infestations are known from 8 western states. Dyers woad spreads by seed, with populations often starting along roadsides, or railroads, and spreading to well-vegetated rangelands or crops. Disturbance is not a requirement for dyers woad establishment, this species is capable of dominating intact grass and perennial plant communities. Dyers woad is known as a contaminant in alfalfa seed. It is also offered for sale because of its dye-making properties, and it is sometimes found as a garden ornamental.

Dyers woad is a Class A noxious weed in WA. In 1986, this plant was identified in Kittitas Co., growing along a railroad. That site was eradicated in 1992, and it continues to be monitored. In order to prevent long term impacts and costly control programs, prevention is necessary to keep dyers woad out of Washington. Preventative measures include the continued monitoring of susceptible habitat, stopping the spread through contaminated alfalfa seed and quarantines that prevent the sale of dyers woad.