

**Annotated Bibliography on the
Ecology and Management of Invasive Species:**

Common hawthorn (*Crataegus monogyna*)

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Bannister-N-R {a}; Watt-T-A, 1995.

Title: Effects of cutting on the growth of *Crataegus monogyna* (Hawthorn) in hedges.

Source: Journal-of-Environmental-Management. 1995; 45 (4) 395-410.

Publication Year: 1995

Language: English

Abstract: Effects of the position and timing of cutting on shoot growth of young *Crataegus monogyna* plants in newly-planted hedges were studied. Total shoot length was unaffected by cutting. In general, a combination of both vertical and horizontal cutting produced a tall hedge with long, bud-tipped shoots. The timing of cut was important: a horizontal cut in summer resulted in fewer but longer shoots whereas a vertical cut in summer produced more thorn-tipped shoots. A vertical cut in winter resulted in longer shoots than one in summer and reduced the number which were thorn-tipped. Management types of farm hedges could be characterised by various growth parameters. Hand-cut hedges had numerous short shoots and many older-wood branches per unit area, whereas unmanaged ones had a greater leaf area and longer shoots. Summerflailed hedgerows were characterised by a smaller leaf area although this may have been partly due to *Galium aparine* L. infestation. The use of the flail ! on the current season's growth did not significantly retard growth the following year.

Barnea-A; Harborne-JB; Pannell-C, 1993.

TITLE: What parts of fleshy fruits contain secondary compounds toxic to birds and why.

SOURCE (BIBLIOGRAPHIC CITATION): Biochemical-Systematics-and-Ecology. 1993, 21: 4, 421-429; 40 ref.

ABSTRACT: Saponins, flavonoids and cyanogenic glycosides were surveyed in pulps and seeds of wild, bird-dispersed fleshy fruits of hawthorn (*Crataegus monogyna*), ivy (*Hedera helix*), holly (*Ilex aquifolium*) and yew (*Taxus baccata*). Interactions between 3 of the 4 species (hawthorn, holly and yew) and their avian seed dispersers were studied in the field. Results indicated that when different bird species forage on the same fruit, they spend similar periods of time on the tree and eat a similar number of fruits at each feeding bout. Frugivorous birds stayed on all plant species for short periods of time (1.3-5.3 min) and consumed only a few fruits in each feeding bout (4.3-6.5 min). There is a differential occurrence of secondary compounds in fruit parts: in most cases allelochemicals were found in pulps but not seeds. These findings confirmed the hypothesis that mild toxicity in the pulp can prevent consumption of too many fruits in 1 foraging bout and regulate seed retention time. This, combined with short visits, ensures better seed dispersal, as only few seeds will be deposited on 1 site at any 1 time. In yew, cyanogenic glycosides were identified only in seed coats, while both the fleshy aril and seed content were free of this toxin. A possible ecological explanation is suggested for this finding. The concn of some compounds may change during fruit ripening.

DESCRIPTORS: Weeds-; Poisonous-weeds; Woody-weeds; toxicology-; biology-; composition-; saponins-; flavonoids-; cyanogenic-glycosides; fruits-; seeds-; seed-dispersal; Broadleaves-; toxins-; Wildlife-; Plant-composition; toxic-substances; glycosides-; cyanogens-; woody-plants; ornamental-plants; ornamental-woody-plants

Bass-DA, 1990.

TITLE: A comparative study of the invasiveness of two alien fleshy-fruited woody plants on the Northern Tablelands of New South Wales.

SOURCE (BIBLIOGRAPHIC CITATION): Proceedings of the 9th Australian Weeds Conference. 1990, 109-112; 10 ref.

ABSTRACT: The research methods and preliminary findings of a study made during 1987-89 on the dispersal ecology of 2 alien fleshy-fruited woody species, *Crataegus monogyna* and *Prunus mahaleb*, are discussed. Results of the study, which attempts to determine factors important to invasion strategies, indicated that the history of introduction and the degree of human assistance/management in moving plants around, were the main factors responsible for differences between the 2 species in their range expansion. *C. monogyna* was the more invasive due to widespread planting in hedges and gardens. For both species, animal dispersal was important for population expansion only at a local level.

DESCRIPTORS: ecology-; invasion-; Broadleaves-; Weeds-; woody-weeds; cherries-

Bass-D-A {A}, 1990

Title: Dispersal Of An Introduced Shrub *Crataegus-Monogyna* By The Brush-Tailed Possum *Trichosurus-Vulpecula*.

Source: *Australian-Journal-of-Ecology*. 1990; 15 (2): 227-230.

Publication Year: 1990

Language: ENGLISH

Abstract: The Brush-tailed possum *Trichosurus vulpecula* eats the fleshy fruits of the introduced shrub *Crataegus monogyna* and defaecates intact seeds at least 0-50 m away. Viability of seeds recovered from faeces was >73%, comparable to the viability of fresh seeds (87.6%). Seed dispersal by possums has been largely neglected and may have important implications for invasion by woody weeds in Australasia.

Billing-E; Bech-Andersen-J; Lelliott-RA, 1974.

TITLE: Fireblight in Hawthorn in England and Denmark.

SOURCE (BIBLIOGRAPHIC CITATION): *Plant-Pathology*. 1974, 23: 4, 141-143 + 2 pl.; ORE; 8 ref.

ABSTRACT: Reviews observations on fireblight [*Erwinia amylovora*] causing cankers and damage to shoots and flowers on hedges and wild trees of Hawthorn (*Crataegus monogyna* and *C. oxyacantha* [*C. oxyacanthoides*]), and discusses its economic significance as a reservoir of infection for Apple and Pear orchards. It is concluded that the eradication of Hawthorn from fruit-growing districts is not generally practicable, but may be considered as a long-term policy. Trimming of hedges is suggested as a compromise. [Cf. FA 36, 2146]

DESCRIPTORS: broadleaves-

Deckers-T, 1996.

TITLE: Fire blight: the present state of its occurrence in Belgium and phytosanitary measures to control the problem.

SOURCE (BIBLIOGRAPHIC CITATION): *Parasitica*. 1996, 52: 3, 127-131; 7 ref.

ABSTRACT: Fire blight (*Erwinia amylovora*) has been present in Belgium since 1972 and it is a continuous risk to professional nurseries, fruit growers and for nature lovers. In the nurseries there is not only an infection risk on apple and pear fruit trees but also on other host plants of the fire blight pathogen including *Crataegus monogyna* and *C. oxyacantha* [*C. laevigata*], *Cydonia*, *Cotoneaster* sp. and *Sorbus* sp. In orchards, there is an infection risk for apple and pear trees during the primary bloom period and during summer on secondary bloom structures, on shoots or on fruitlets. Phytosanitary measures to control disease development in nurseries, in orchards and on other host plants are discussed.

DESCRIPTORS: plant-diseases; plant-pathogens; plant-pathogenic-bacteria; apples-; pears-; plant-disease-control

Edwards-C; Morgan-J, 1997.

TITLE: Cut stump applications with imazapyr.

SOURCE (BIBLIOGRAPHIC CITATION): Research-Information-Note -Forestry-Commission. 1997, No. 293, 4 pp.; 3 ref.

ABSTRACT: Treatment of stump surfaces with herbicides is commonly used as a means of controlling shoot regrowth. Four herbicides currently approved for this method of application are, glyphosate (e.g. Roundup Pro), triclopyr (e.g. Timbrel), 2,4-D/dicamba/triclopyr (Broadshot) and ammonium sulfamate (e.g. Amcide). Field experiments in the UK show that a recently introduced herbicide, imazapyr (Arsenal 50), has potential as an improved means of cut stump treatment when compared with currently approved products. Tests were done with freshly cut stumps of *Rhododendron arboreum*, broadleaves on a railway embankment (*Acer pseudoplatanus*, *Fraxinus excelsior*, *Crataegus monogyna*), and birch [*Betula*].

DESCRIPTORS: herbicides-; glyphosate-; triclopyr-; 2,4-D; dicamba-; ammonium-sulfamate; imazapyr-; woody-weeds; stumps-; weed-control; chemical-control; felling-; manual-weed-control; forest-trees

Engel,-H, 1964.

TITLE: The control of Broom (*Cytisus scoparius*) by helicopter.

SOURCE (BIBLIOGRAPHIC CITATION): 1964, *Gesunde Pflanzen*, Bad Godesberg 16 (1), 1964 (15-9). From abstr. in *Weed Abstr.* 13 (5), 1964 (1341).

ABSTRACT: Broom infesting 34.3 ha. of degenerate hill pasture in W. Germany was completely killed 6-9 months after thorough wetting with U46 Special (2,4-D + 2,4,5-T esters) applied by helicopter at 5 litres in 35 litres spray/ha., during flowering in June 1962. *Calluna vulgaris*, *Rubus fruticosus*, *R. idaeus* and *Rosa* spp. were also virtually eliminated, but there was no effect on *Crataegus monogyna* or *Juniperus communis*, and male fern [*Dryopteris filix-mas*] and teasel [*Dipsacus* sp.] received only a check to growth. Cost of treatment was ca. DM. 103.2/ha. and removal of dead Broom cost DM. 296.25/ha.

DESCRIPTORS: Aircraft,-use-in-forestry-weedkillers; *Calluna-vulgaris*; *Crataegus-monogyna*; *Cytisus-scoparius*; Grazing-and-pasture; Heather-chemical-control; Helicopters-application-of-weedkillers; *Juniperus-communis*; *Rosa-spp.*; *Rubus-fruticosus*; *Rubus-idaeus*; Silviculture-; Weedkillers,-application,-effects-&c.-aerial-sprays; Weedkillers-2,4-D-and-2,4,5-T

Gilchrist-AJ, 1980.

TITLE: Control of woody weeds in forestry with triclopyr.

SOURCE (BIBLIOGRAPHIC CITATION): Proceedings of the Conference on Weed Control in Forestry, Nottingham, 1980. 1980, 249-256; 4 ref.

ABSTRACT: Results of trials in the UK from 1976 to '79 are discussed. Both amine and ester formulations of triclopyr were evaluated at two different application times and compared with the standard 2,4,5-T. The spectrum of activity was similar for the two herbicides although the initial effect was more rapid with triclopyr and the effect was longer lasting. Particularly good results

were obtained with triclopyr amine at 2.7 kg/ha (2.4 kg/ha for the ester formulation) against *Ulex europaeus* and *Sarothamnus [= Cytisus] scoparius*. Crop tolerance was marginal in pines with the July application but satisfactory in August; spruce and Douglas fir were more tolerant. Triclopyr ester was slightly more aggressive than the amine to the crop but could be used at a lower rate because of its superior effect on weeds.

DESCRIPTORS: triclopyr-; usage-; crops-; forests-; weeds-; woody-weeds; selectivity-; weed-control; HERBICIDES-; chemicals-; pines-; hazelnuts-

Good, J. E. G., Bryant, R., Carlill, P. 1990.

Title: Distribution, longevity and survival of upland hawthorn (*Crataegus monogyna*) scrub in North Wales in relation to sheep grazing.

Source: *Journal-of-Applied-Ecology*. 1990; 27 (1): 272-283.

Publication Year: 1990

Language: ENGLISH

Abstract: (1) Distribution of hawthorn (*Crataegus monogyna*) scrub in an upland area of North Wales, was surveyed. At three typical study sites, hawthorn occurrence was studied in relation to vegetation type and sheep densities. (2) Hawthorn scrub generally occurred as scattered stands on steep slopes with *Agrostis-Festuca* grassland, with or without bracken (*Pteridium aquilinum*). (3) Hawthorn bushes occurred as isolated individuals or in clumps. Some bushes in clumps were derived from root suckers, but most isolated bushes were from seeds. (4) The mean age of single-stemmed bushes was 55 years (range 10-115 years). There were very few bushes < 20 years old. However, the ability of bushes to spread by suckers may enable them to live indefinitely. (5) Growth rate of hawthorns varied considerably between and within sites, making it impossible to estimate their age from their girth with any useful degree of accuracy. (6) Sheep seem to control hawthorn equipment, which has decreased as sheep grazing has increased. Unless sheep numbers are halved for a prolonged period, probably at least 15 years, most of the remaining hawthorns will probably disappear in 60-70 years.

Gosler-A-G {a}; Kelly-C-K; Blakey-J-K, 1994.

Title: Phenotypic plasticity in leaf morphology of *Crataegus monogyna* (Rosaceae): An experimental study with taxonomic implications.

Source: *Botanical-Journal-of-the-Linnean-Society*. 1994; 115 (3) 211-219.

Publication Year: 1994

Language: English

Abstract: Many leaf characters are considered in the taxonomy of *Crataegus* in Europe, and several have been used in studies of the extent of hybridization in populations of northwest Europe. In such analyses it is assumed that the environmental component of phenotypic variation in such characters is

insignificant. We tested this assumption by analyzing the variation in the size and shape of leaves borne on clone cuttings of *Crataegus monogyna* maintained under identical conditions apart from the availability of soil nutrients. The resulting variation among leaves from this single genotype was as great as that observed previously across populations. Furthermore, although most of this variation could not be explained, a part could be attributed to differences in nutrient availability; of nine leaf characters investigated, eight showed significant variation due to this source, and in seven, the variation covaried significantly with nutrient level. The systematic implications of this are briefly explored.

Grubb-PJ; Kollmann-J; Lee-Working Group, 1999.

TITLE: A garden experiment on susceptibility to rabbit-grazing, sapling growth rates, and age at first reproduction for eleven European woody species.

SOURCE (BIBLIOGRAPHIC CITATION): *Plant-Biology*. 1999, 1: 2, 226-234; 29 ref.

ABSTRACT: Eleven European shrub and tree species have been grown for 13 years in a randomized array (with 2 or 3 provenances for 5 of 11 species) in an experimental garden in Cambridge, England. A plague of rabbits in the second year damaged a greater proportion of plants in species with faster height growth, including those that are the commonest colonizers of pastures; most plants recovered rapidly. Apparently, resilience rather than resistance enables these plants to be invaders of abandoned grasslands. Among the shrubs there was little evidence of a trade-off between initial rate of height growth and final height. The small tree *Crataegus monogyna* overtook the tallest shrub (*Cornus sanguinea*) in the twelfth year. Among the shrubs, after 12 years, there was a trend for basal area to be greater in taller species; the trees had notably low basal area for their height. Most individuals of the shrub species reproduced before those of *Crataegus* and *Sorbus aria* (in 3-6 years rather than 5-13).

Among the shrubs, the earliest to reproduce were fast-growing (*Rosa canina*, then *Ligustrum vulgare*, *Prunus spinosa* and *Rhamnus catharticus* [*R. cathartica*]), but then species with a wide range of growth rates all reproduced at the same time (*Euonymus europaeus*, *Juniperus communis* and *Viburnum opulus* slow-growing, *Cornus sanguinea* and *V. lantana* fast-growing). The results are discussed in relation to theories of resource allocation, and the behaviour of the particular species in the field.

DESCRIPTORS: woody-weeds; basal-area; grasslands-; pastures-; shrubs-; reproduction-; trees-; pests-; growth-; growth-rate

Guitian-Pablo {a}, 1998.

Title: Latitudinal variation in the fruiting phenology of a bird-dispersed plant (*Crataegus monogyna*) in western Europe.

Source: *Plant-Ecology*. Aug., 1998; 137 (2) 139-142.

Publication Year: 1998

Language: English

Abstract: A number of fleshy-fruit-bearing plants of temperate regions are dispersed by migratory frugivorous birds. It has been suggested that the more southerly populations of such species should produce ripe fruits later than more northerly populations, to ensure that fruit is available when the birds arrive. I will call this the 'adaptive delay' hypothesis. To test this hypothesis, I monitored fruiting phenology of *Crataegus monogyna* Jacq. at ten sites (in all of which fruit consumption is very largely by redwings, *Turdus iliacus*, and fieldfares, *Turdus pilaris*) between northern Spain (42degree N) and northern Scotland (59degree N). There was no negative correlation between latitude and date of fruit ripening (earliest recorded date on which ripe fruits had appeared, or earliest recorded date by which all fruits had ripened). My results thus argue against the adaptive delay hypothesis.

Guitian-J {A}; Fuentes-M, 1992.

Title: Reproductive Biology Of *Crataegus-Monogyna* In Northwestern Spain.

Source: *Acta-Oecologica*. 1992; 13 (1): 3-11.

Publication Year: 1992

Language: ENGLISH

Abstract: We studied the annual phenological cycle, mode of reproduction, and animal-mediated pollination and seed dispersal of *Crataegus monogyna* in northwestern Spain. Flowering was in April and May and fruiting from September to January or February. Cross-pollinated and freely-exposed flowers had similar fruit set, and these were about double those of bagged flowers and manually self-pollinated flowers. The main pollinators were *Apis mellifera* (52% of pollinator visits) and several other Apidae and Diptera. The main seed dispersers were fruit-eating birds of the genus *Turdus* (96% of visits). Fruits were damaged by fruitpulp-eating insect larvae (*Phagocarpus permundus* and an unidentified lepidopteran) and birds (*Pyrrhula pyrrhula*, *Fringilla coelebs* and *Phylloscopus collybita*), and seed-eating birds (*Coccothraustes coccothraustes*). The reproduction and seed dispersal of *C. monogyna* is mediated by a wide variety of animals throughout its geographical range.

Gut-L-J; Brunner-J-F, 1994.

Title: Parasitism of the apple maggot, *Rhagoletis pomonella*, infesting hawthorns in Washington.

Source: *Entomophaga*-. 1994; 39 (1) 41-49.

Publication Year: 1994

Language: English

Abstract: Five species of larval parasitoids were reared from *Rhagoletis pomonella* (Walsh) infested fruit of hawthorn, *Crataegus*, collected from several locations in southwest Washington over a four year period. A braconid, *Biosteres*

melleus (Gahan), parasitized larvae infesting fruits of a native hawthorn species, *Crataegus douglasii* Lindl. Another braconid, *Opius downesi* Gahan, emerged exclusively from *R. pomonella* pupae reared from fruits of an introduced species of hawthorn, *Crataegus monogyna* Jacq. A pteromalid, *Pteromalus* sp., and two eulophids, *Tetrastichus* spp., attacked *R. pomonella* larvae infesting fruits of both hawthorn species. No parasitoids emerged from a total of 4385 pupae reared from apple. Percent parasitism of *R. pomonella* was higher in *C. monogyna* compared to *C. douglasii* fruits. The highest average levels of parasitism of *R. pomonella* in *C. monogyna* and *C. douglasii* fruits were 90% and 23% respectively. The kinds of parasitoids, their relative abundances and timing of parasitization on the two hawthorns was related to differences in fruit ripening patterns and its effect on the development of *R. pomonella* on these two hosts. Parasitization of *R. pomonella* by *Tetrastichus* spp. is a new host record. The detection of these species and *Pteromalus* sp. in southwest Washington are the first records of ectoparasitoids attacking this tephritid.

Helliwell-DR; Buckley-GP; Fordham-SJ; Paul-TA, 1996.

TITLE: Vegetation succession on a relocated ancient woodland soil.

SOURCE (BIBLIOGRAPHIC CITATION): Forestry-Oxford. 1996, 69: 1, 57-74; 23 ref.

ABSTRACT: A total of 11 000 m² of topsoil was moved from an area of ancient woodland on the site of the Channel Tunnel terminal near Folkestone, Kent, UK, to a prepared receptor site nearby. The ancient woodland had 3 types, in about equal proportions - invasive elm woodland (dominated by *Ulmus carpiniifolia* [*U. minor*] with *Fraxinus excelsior* and *Acer campestre*), oak/ash/maple woodland (with dominant *Quercus robur*, *F. excelsior* and *A. campestre*), and disturbed ash/oak woodland (similar to the preceding type but with a dense shrub understorey of *Prunus spinosa*, *Crataegus monogyna*, *Sambucus nigra* and *Clematis vitalba*). The site was then overplanted with nursery-grown trees and shrubs (*Acer campestre*, *Alnus glutinosa*, *Betula pendula*, *Corylus avellana*, *Euonymus europaeus*, *F. excelsior*, *Malus sylvestris*, *Prunus avium*, *Q. robur*, *Viburnum opulus*), which in turn required weed control maintenance to aid tree establishment. Records of plant species and a study of the soil seedbank were made in the original wood before transference, after which species frequencies on the receptor site were recorded annually for 5 yr. The soil seedbank was sampled on 2 occasions. At the end of the recording period 16 of the original 99 species had not been re-recorded, but 93 additional (mainly ruderal) species had been found. Of the remaining original species, several ruderals and some woodland species in the soil seedbank increased, but wetland species tended to decrease. Vegetation composition was affected both by the position of collection from the original wood, and by the maintenance regime adopted. The exercise appears to have been at least partly successful in establishing the original species, and useful experience has been gained.

DESCRIPTORS: vegetation-; woodlands-; shrubs-; understory-; forest-trees; seed-banks; natural-regeneration; weed-control; establishment-; synecology-; botanical-composition; removal-; soil-types; woodland-soils; afforestation-; plant-succession; forests-; weeds-; hazelnuts-; cherries-

Hodge-SJ; Harmer-R, 1996.

TITLE: Woody colonization on unmanaged urban and ex-industrial sites.

SOURCE (BIBLIOGRAPHIC CITATION): Forestry-Oxford. 1996, 69: 3, 245-261; 41 ref.

ABSTRACT: Forty-six unmanaged urban and ex-industrial sites in Avon, South Staffordshire and the West Midlands, UK, were visited in 1992-93 during a survey which aimed to relate site factors with natural colonization by trees and shrubs. The factors observed included: type and texture of substrate; the predominant type of vegetation; aspect; the presence of parents in the near vicinity of the site and the numbers and species of colonizing woody plants. The extent of woody colonization was very variable and despite an average stocking density of 1500 stems ha⁻¹, only 19% of the land surveyed was colonized to an acceptable woodland standard. Woodland produced by natural colonization was species poor, with an average of 3 species per site; the most abundant species were ash (*Fraxinus excelsior*), birch (*Betula* spp.), goat willow (*Salix caprea*) and hawthorn (*Crataegus monogyna*), which made up 85% of the colonization recorded. A list of all the woody species found is included. Although there was variation between species, the presence of the parent was usually the most important factor associated with colonization; when potential parent trees were visible from the site there was, on average, a 58% probability of finding colonization of the corresponding species. In general, colonizing plants were positively associated with subsoil, small stony substrates such as gravel and ballast, and a weak grass sward. Conversely colonization was negatively associated with loam soils, sand, unfractured rock/concrete substrates, and sites with grazed sward or no vegetation.

DESCRIPTORS: plant-succession; plant-colonization; woodlands-; industrial-sites; site-factors; rehabilitation-; reclamation-; revegetation-; edaphic-factors; woody-plants; natural-regeneration; urban-areas

Hulme-Philip-E, 1997.

Title: Post-dispersal seed predation and the establishment of vertebrate dispersed plants in Mediterranean scrublands.

Source: Oecologia-Berlin. 1997; 111 (1) 91-98.

Language: English

Abstract: The post-dispersal fate of seeds and fruit (diaspores) of three vertebrate-dispersed trees, *Crataegus monogyna*, *Prunus mahaleb* and *Taxus baccata*, was studied in the Andalusian highlands. south-eastern Spain. Exclosures were used to quantify separately the impact of vertebrates and

invertebrates on seed removal in relation to diaspore density and microhabitat. The three plant species showed marked differences in the percentage of diaspores removed, ranging from only 5% for *C. monogyna* to 87% for *T. baccata*. Although chaffinches (*Fringilla coelebs*) fed on diaspores, rodents (*Apodemus sylvaticus*) were the main vertebrate removers of seed and fruit. Two species of ant (*Cataglyphis velox* and *Aphaenogaster iberica*) were the only invertebrates observed to remove diaspores. However, the impact of ants was strongly seasonal and they only removed *P. mahaleb* fruit to any significant extent. While removal of seed by rodents was equivalent to predation, ants were responsible for secondary dispersal. However, their role was limited to infrequent, small-scale redistribution of fruit in the vicinity of parent trees. Rodents and ants differed in their use of different microhabitats. Rodents foraged mostly beneath trees and low shrubs and avoided open areas while the reverse was true of ants. Thus, patterns of post-dispersal seed removal will be contingent on the relative abundance and distribution of ants and rodents. Studies which neglect to quantify separately the impacts of these two guilds of seed removers may fail to elucidate the mechanisms underlying patterns of post-dispersal seed removal. The coincidence of both increased seed deposition by the main avian dispersers (*Turdus* spp.) and increased seed predation with increasing vegetation height suggested that selection pressures other than post-dispersal seed predation shape the spatial pattern of seed dispersal. Rather than providing a means of escaping post-dispersal seed predators, dispersal appears to direct seeds to microhabitats most suitable for seedling survival. Nevertheless, the reliance of most vertebrate-dispersed trees on regeneration by seed and the absence of persistent soil seed banks imply that post-dispersal seed predators may exert a strong influence on the demography of the plants whose seeds they consume. Even where microsites are limited, the coincidence of the most suitable microhabitats for seedling establishment with those where seed predation is highest provide a means by which selective seed predators can influence community composition.

Johns,-DL, 1956.

TITLE: Hawthorn control.

SOURCE (BIBLIOGRAPHIC CITATION): 1956, Proc. 9th N.Z. Weed Control Conf. 1956 (22-4). From abstr. in Weed Abstr. 696), 1957(803).

ABSTRACT: Reports experimental work with the following as coverage sprays: (1) 2,4,5-T (oil-soluble butyl ester), (2) 2,4,5-T (same formulation) plus amino-triazole, (3) 2,4,5-TP (mixed polypropylene glycol butyl ether esters) (4) 2,4,5-TP (same formulation) plus amino-triazole and (5) amino-triazole alone. (1) (2) and (3) were applied in autumn in water at a dilution of 1/80, and all of them in early summer at dilutions of 1/100 and 1/500 in water. Fenuron and monuron at rates from 0.25 oz./bush were applied in water as basal application in the autumn and early summer, and NaClO₃, at 2-8 oz./bush in the same manner in autumn only.

2,4,5-T (oil-soluble butyl ester) in dieselene at a dilution of 1/20 was applied as a basal spray and on frilled stems in the autumn. In early August (late winter) the same mixture was applied as a basal spray, as a spray on cut stumps and on frilled stems. Results to date were somewhat inconclusive, but the 2,4,5-T in dieselene treatments appeared the most promising, as basal sprays or on cut stumps in the dormant period.

DESCRIPTORS: Crataegus-monogyna-control,-chemical; Protection-forest; Weed-trees-and-shrubs-chemical-control; Weed-killers; Weed-kill-ers-ammate

Jones-KG; Morgan-NG, 1978.

TITLE: Report 1977.

CORPORATE AUTHOR(S): UK, Long Ashton Research Station.

SOURCE (BIBLIOGRAPHIC CITATION): 1978, 243 pp.

ABSTRACT: P. 88. Application of herbicides to pruning cuts (K.G. Jones; N.G. Morgan). Long handled pruning shears were fitted with a spring-loaded valve which delivered 3 ml of herbicide emulsion to the cut surface. Good control of shoot regrowth was obtained by this method using 2,4-D + 2,4,5-T on species such as *Prunus spinosa*, *Crataegus monogyna*, *Rubus fruticosus* and *Rosa canina* in young tree or bush plantations where spraying is not permissible.

DESCRIPTORS: woody-weeds; 2,4-D; 2,4,5-T; usage-; mixtures-; application-; equipment-; weeds-; blackberries-

Jones-A-T; Evans-P-R, 1994.

Title: A comparison of the growth and morphology of native and commercially obtained continental European *Crataegus monogyna* Jacq. (Hawthorn) at an upland site.

Source: *Watsonia*-. 1994; 20 (2) 97-103.

Publication Year: 1994

Language: English

Abstract: 1. The growth and morphology of native *Crataegus monogyna* Jacq. (Rosaceae) obtained from an upland population in mid-Wales was compared with that of commercially obtained material of Hungarian provenance in an upland trial. 2. Six months after planting, the native plants were 35% taller, 70% more branched and had twice the total stem length and four times as many thorns per thorny plant than the commercial material. 91% of native plants were thorny compared with only 20% of commercial plants. Commercial plants had larger leaves, longer petioles and a greater severity of powdery mildew attack than the natives. 3. It was possible, using vegetative characters, to separate 88% of the natives from 80% of the commercial plants on the basis of their growth and morphology using discriminant analysis. Native seed was significantly smaller in size than the commercial seed which suggests that the measurement of reproductive characters would allow further discrimination between the two groups.

Jorgensen-Jorgen, 1997.

Title: Galls (zooecidia) collected on Laeso 1980-96.

Source: Entomologiske-Meddelelser. 1997; 65 (1) 1-15.

Publication Year: 1997

Language: Danish; Non-English

Abstract: Laes-vphi small island in the northern part of Kattegat. It is situated about 20 km from Jutland and 50 km from Sweden. Only two records of galls from Laeso appear in the literature. During the period from 1980 to 1996 galls have been collected every summer by the present author. The results include galls caused by 151 different gallmakers on 83 species of plants. Eight of the recorded galls were not formerly recorded as Danish. They are: *Pachypapa vesicalis* (Pemphigidae) on *Populus alba*, *Aphis praeterita* (Aphididae) on *Epilobium hirsutum*, *Polystepha malpighii* (Cecidomyiidae) on *Quercus robur*, *Placochela nigripes* (Cecidomyiidae) on *Sambucus nigra*. *Dasineura oxyacanthae* and *Contarinia anthobia* (Cecidomyiidae) on *Crataegus monogyna* (mutual in flowerbuds). *Micronematus monogyniae* (Tenthredinidae) on *Prunus domestica*. *Vasales dispar* (Eriophoidea) on *Populus tremula*. An unidentified gall midge (Cecidomyiidae) on *Cirsium arvense*. Some uncertain statements in the literature concerning identifications and host plants are also discussed: *Pontania viminalis* and *P. collactanea* on *Salix* spp., gall midges living in seeds of *Betula* spp. and gall midges causing flower-galls in *Sambucus nigra*. A few identifications need verification by rearing.

Khairi-SM; Preece-TF, 1978.

TITLE: Hawthorn powdery mildew: overwintering mycelium in buds and the effect of clipping hedges on disease epidemiology.

SOURCE (BIBLIOGRAPHIC CITATION): Transactions-of-the-British-Mycological-Society. 1978, 71: 3, 399-404; 2 fig.; 16 ref.

ABSTRACT: Clipping hawthorn hedges and trees intensifies attacks of *Podosphaera clandestina* on leaves during the growing season. Infected lateral buds are regularly produced on some plants as a result of clipping; these allow the disease to overwinter and provide the source of primary infections on hedges in spring each year. Infected buds have a characteristic open, tufted, reddish appearance, and arise laterally immediately below the cut ends of clipped shoots. Infected terminal buds are found only on some infected seedlings and more rarely on young succulent growths at the bases of tender trees. Heavily mildewed unclipped leafy shoots on hedges did not give rise to infected buds.

DESCRIPTORS: diseases-; pruning-; responses-; ornamental-plants; ornamental-woody-plants; forest-trees; broadleaves-; plant-pathology; plant-pathogenic-fungi; training-

Kleinert-J, 1978.

TITLE: Injury of foliage of woody plants by leaf eating insects.

SOURCE (BIBLIOGRAPHIC CITATION): Stepanovicova, O. : Quantitative analysis of an association of land bugs (Heteroptera) in the crowns of trees and bushes of an oak horn-beam forest. *Biologia, -Czechoslovakia*. 1978, 33: 2, 119-125; CIE; 17 ref.

ABSTRACT: [See preceding abstract] Leaves and defoliating insects were sampled in the canopy of an undisturbed *Querco-Carpinetum* near Nitra, SW Slovakia in 1972. Results (mainly published elsewhere) are briefly summarized and discussed. Larvae of Lepidoptera were the most important consumers. Losses of total leaf area were 30% in *Acer campestre* (preferred by *Melolontha melolontha*), 20-25% in *Carpinus betulus* (*Geometridae* and *Curculionidae*), 10-15% in *Quercus petraea*, 20% in *Prunus spinosa*, 10-14% in *Crataegus monogyna* and 3% in *Cornus mas*, mainly in the middle and lower parts of the canopy. The insects were most active in spring; damage to Lammas shoots was relatively slight. The overall degree of parasitization of the larvae in the field was 30% (70% in *Lymantria dispar*). In a laboratory study, adults of *Polydrosus cervinus* (*Col., Curculionidae*) preferred the leaves of *Betula [alba]* and *C. betulus* to those of other species.

DESCRIPTORS: insect-pests; damage-; foliage-; injuries-; pests-; defoliation-; woody-plants; forest-pests; trees-; agricultural-entomology

Kollmann-J; Pirl-M, 1995.

TITLE: Spatial pattern of seed rain of fleshy-fruited plants in a scrubland-grassland transition.

SOURCE (BIBLIOGRAPHIC CITATION): *Acta-Oecologica*. 1995, 16: 3, 313-329; 82 ref.

ABSTRACT: The seed rain of 13 fleshy-fruited species was investigated for one year along a transect from a 30- to 50-yr-old scrub stand (of *Frangula alnus* [*Rhamnus frangula*], *Salix* spp., *Cornus sanguinea*, *Crataegus monogyna*, *Rhamnus catharticus* [*R. cathartica*]) through a pioneer scrub (*R. frangula*) stand into abandoned wet grassland on the Mettnau peninsula, Lake Constance, SW Germany. Seed rain was greatest in the mature scrub, smaller in the pioneer scrub, and sparse in the grassland; bird-mediated seed rain reflected strongly the differences in abundance of fruit. Birds were the main dispersers of seeds; dispersal by carnivorous mammals was negligible. Mist-netting of migrant passerines revealed the greatest abundance of frugivorous birds (13 species) in mature scrub, thus explaining the spatial pattern of seed rain. Although the peak time of fruit abundance coincided with autumn migration of the birds, utilization of fruit was lower in this period than in the rest of the year, indicating satiation of the migrants. An experimental test of seed predation by rodents revealed highest losses of seeds beneath mature scrub and only slow disappearance in the grassland. It is suggested that seed dispersal by birds is a limiting factor in the colonization of abandoned agricultural grasslands by fleshy-fruited plants.

DESCRIPTORS: woody-plants; vegetation-types; forest-ecology; plant-colonization; pioneer-species; broadleaves-; land-diversion; spatial-distribution; stand-characteristics; seed-dispersal; plant-succession; old-fields; scrub-; grasslands-

Kollmann-Johannes {a}; Reiner-Susann-A, 1996.

Title: Light demands of shrub seedlings and their establishment within scrublands.

Source: Flora-Jena. 1996; 191 (2) 191-200.

Publication Year: 1996

Language: English

Abstract: Light demands, i. e. shade tolerance and response to light, of seedlings of six shrub species (*Berberis vulgaris* L., *Cornus sanguinea* L., *Crataegus monogyna* JACQ., *Ligustrum vulgare* L., *Rosa canina* L., *Sambucus nigra* L.) were investigated during establishment beneath scrub. Four methods were used: (1) microclimatic measurements in two patches of a scrub sere, (2) recording of density and survival of seedlings of the six species naturally occurring in this sere, (3) transplantation of seedlings of *Rosa* to these sites, and (4) gas exchange measurements on seedlings of all six species grown in a glasshouse. Penetration of light decreased strongly with scrub development whereas temperature and relative air humidity were only slightly different in old scrub compared to pioneer stages. Density and survival of naturally occurring seedlings were highest in an intermediate stage of scrub development, while growth and survival of transplanted seedlings decreased significantly with increasing cover of scrub. The seedlings of the six shrub species differed in their light demands, indicated by dark respiration, light compensation point, photosynthetic capacity, and quantum efficiency near light-saturated photosynthesis. *Cornus* and *Rosa* were slightly more shade-tolerant, whereas *Berberis*, *Crataegus*, *Ligustrum* and *Sambucus* apparently had higher light demands, but none of them was particularly adapted to establish in a strongly shaded environment. The differences among species in survival of the naturally occurring seedlings did not agree generally with the results of the gas exchange experiment. However, we conclude that light availability is a crucial factor for growth and survival of seedlings in old scrub, but additional factors (e.g. soil water content) have to be considered in order to explain the species-specific differences.

Korba-J; Patakova-S; Kudela-V, 1998.

TITLE: Fire blight resistance in hawthorns.

SOURCE (BIBLIOGRAPHIC CITATION): Ochrana-Rostlin. 1998, 34: 2, 53-58; 11 ref.

ABSTRACT: Since the first appearance of fire blight in Bohemia in 1986, shrubs and trees of the genus *Crataegus* are the most important hosts of *Erwinia amylovora*. Field observation of outbreaks of fire blight on hawthorn shrubs and

trees in 1994-1996 showed a wide individual variability in reaction. Susceptible and highly susceptible plants were prevalent among wild hawthorns. Seedlings growing under the relatively resistant and susceptible hawthorn shrubs were removed and transplanted to the experimental plot. Seed samples were collected from non-infected solitary plants adjacent to those showing severe infection. The seeds were germinated in the greenhouse and 1 year old seedlings established from the seed were inoculated. Shoot tops were cut off using scissors immersed in an *E. amylovora* suspension of c. 10⁹ cells/ml. A drop of inoculum was placed on wounded tissues. The degree of resistance was scored 30 days after inoculation by measuring the total length of the shoots and the visually blighted part. The majority of 63 seedlings tested were susceptible. No distinct difference in susceptibility was found between plants grown from seeds from naturally infected and from non-infected shrubs. Only 1 seedling was highly resistant. Its high level of resistance was confirmed by repeated inoculations (34 times) during 3 growing seasons in 1995-1997. The resistant seedling was identified as *C. monogyna* having some characteristics of *C. laevigata*.

DESCRIPTORS: susceptibility-; plant-disease-control; disease-resistance; plant-diseases; plant-pathogens; plant-pathogenic-bacteria; broadleaves-; forest-trees; trees-; fruit-crops; plant-pathology

Kostov-Kosta-D, 1996.

Title: On the resistance of the red oak (*Quercus rubra* L.) plantations and of the separate groups of introduced tree species in the region of the town of Byala Slatina during the extreme drought in 1993.

Source: *Nauka-za-Gorata*. 1996; 33 (1) 3-10.

Publication Year: 1996

Language: Bulgarian; Non-English

Abstract: The study on the effect of the drought in 1993 has been carried out in red oak plantations at the age of 32 to 37 but observations on the resistance of the natural tree and shrub vegetation and of separate groups of introduced tree species has been included as well. 6 tree and 2 shrub species from the natural forest vegetation and 20 tree and 3 shrub species from the introduced ones have been included into the investigation. The drought in 1993 is very close to the expected climate changes under the influence of the increasing of the greenhouse effect foreseen according to the Global circulation model of the meteorological service of Great Britain. As a result of the water stress caused by the low precipitation amount in June, July, August and September (table 4), the disintegration of the red oak forest ecosystem has begun. The natural self-thinning process has been changed by total withering of trees from all width sizes and in many cases these are trees over the average DBH including ones with maximal sizes. In the separate plantations the withered red oak trees are from 40 to 90%. Among the other introduced species only *Gleditschia triacanthos* L., *Tilia tomentosa* Moench, *Cotinus coggygia* Scop., *Ligustrum vulgare* L., *Corylus*

columna L. and *Siringa vulgaris* L. have survived almost at 100%. Most typical is the case with *Tilia tomentosa* Moench, whose leaves fall as during the fall of the leaves as the end of the growing period. The strong dehydration of the stem at the simultaneous withering and drying of the red oak leaves is a reason for the withering of the separate trees including these ones with maximum sizes. From the natural vegetation *Quercus pedunculiflora* C. Koch, *Crataegus monogyna* Jacq., *Pirus communis* L., *Rosa* sp. and *Prunus spinosa* L. have totally resisted. Drought-resistant species as *Quercus cerris* L. and *Q. pubescens* Willd. are damaged from 10 to 20%. It is considered that at a precipitations amount less than 50 mm !

for the months June, July and August, the red oak cannot form a stable ecosystem.

Larous-L; Losel-DM, 1996.

TITLE: The infection of vascular tissue of *Crataegus monogyna* by the monokaryotic stage of *Gymnosporangium clavariiforme*.

SOURCE (BIBLIOGRAPHIC CITATION): Arab-Journal-of-Plant-Protection. 1996, 14: 1, 62-57; 27 ref.

ABSTRACT: The fine structure of *C. monogyna* infected with the monokaryotic structures of *G. clavariiforme* was investigated. The distribution of thalli within host tissues, the types of infection structures and interactions with host cells are described with particular reference to vascular system infection. A large nucleus and the formation of a septum at the level of the penetration site was frequently observed. This stage of infection was characterized by extensive growth of fungal structures in the intercellular spaces of leaf mesophyll, with low frequency of penetration of mesophyll cells. The fungi invaded all types of cells in the host plant vascular system.

DESCRIPTORS: plant-diseases; plant-pathogens; plant-pathogenic-fungi; ultrastructure-; infection-; fungal-diseases; forest-trees; plant-pathology

Lavarenne-Allary,-S, 1965.

TITLE: Studies on the growth of buds on Oak and on some other woody species.

SOURCE (BIBLIOGRAPHIC CITATION): 1965, Ann. Sci. for., Nancy 22 (1), 1965 (1-203). 682 refs.

ABSTRACT: Essentially a study of the physiology of growth in Oaks (here taken to include *Quercus robur*, *Q. sessiliflora*, *Q. pubescens*, and their hybrids) based on a detailed study of the behaviour of vegetative buds, their dormancy, the occurrence of Lammas shoots, and the relation of these phenomena to the production and disappearance of growth-regulating substances, both auxins and inhibitors. The studies were made both on seedlings in controlled conditions of constant temperature and light, and on stool shoots out of doors, and on other woody species (*Prunus spinosa*, *Crataegus monogyna*, *C. oxyacantha*, *Tilia platyphyllos*, *Rhamnus frangula*, *Sorbus torminalis*, and *Carpinus betulus*) for

comparison. The outstanding characteristic of the Oaks is the succession of periods of activity and rest, which are largely independent of environmental factors, since they can be observed without interruption in air-conditioned chambers with constant light and temperature. In the open air, these alternations induce the formation of Lammas shoots at midsummer and in August, and are more numerous in seedlings than in young trees, and in young than in older trees. In stool shoots there is seldom a complete cessation of growth during the growing season, but an alternation of slow and rapid development. Growth curves of other woody species show a similar tendency. It is concluded that winter dormancy is the result of a different mechanism from that inducing this summer dormancy. Experiments showed that, whereas the distribution of developing buds on a twig is 'acrotonic' in nature, it is random in cut twigs, but that 'acrotomy' can be restored by apical injection of phenolic acids, kinetin, or gibberellic acid. Close connexions were found in Oak between the development of dormancy (of both kinds) and the development of growth-regulating substances-auxins occur at the time of flushing in spring and before every summer flush, and abundant inhibitors which are present during winter disappear a few days before bud swelling in spring, midsummer, or August, to reappear in large quantities as soon as the extremities of the buds become green. This pattern of dormancy and auxin evolution was not found in other species studied (Ash, Beech, Sweet Chestnut, Lilac, Privet, and Elder).

DESCRIPTORS: Buds-development; Buds-dormant; Carpinus-betulus-phenology; Crataegus-monogyna; Crataegus-oxyacantha; Ecology,-plant; Gibberellins-effect-on-meristematic-growth; Gibberellins-effect-on-seedling-growth; Growth-regulating-substances-effect-on-buds; Growth-physiology-of; Lammas-growth; Phenology-; Prunus-spinosa; Quercus-pubeszens-phenology; Quercus-robur-s.s.-phenology; Quercus-sessiliflora-Q.-petraea-phenology; Rhamnus-frangula; Sorbus-torminalis; Tilia-platyphyllos-T.-europaea-var.-p.

Losing-H, 1988.

TITLE: Defoliation of woody plants.

SOURCE (BIBLIOGRAPHIC CITATION): Deutsche-Baumschule. 1988, 40: 8, 358; 2 ref.

ABSTRACT: Trials were carried out in 1987 on chemical defoliation of nursery stock by applying a 2% copper chelate solution (Actiron CU 900 L) at 1000-2000 litre/ha. *Acer pseudoplatanus*, *Euonymus europaeus*, *Prunus spinosa*, *Viburnum opulus* and *Quercus robur* treated on 5 Oct. showed >90% defoliation 4 weeks after treatment, whereas 3 rose cultivars treated on 5 Oct. showed no defoliation by mid-Nov. *Crataegus monogyna* showed only 5% defoliation 4 weeks after treatment on 5 Oct., but 60% defoliation was observed within 2 weeks when the plant was treated on 4 Nov.

DESCRIPTORS: planting-stock; defoliation-; Roses-; Broadleaves-; Defoliant-; Nurseries-; ornamental-plants; ornamental-woody-plants

Marcu-O; Simon-D; Stoica-C, 1998.

TITLE: Diseases caused by mycoplasmas in woody plants.

SOURCE (BIBLIOGRAPHIC CITATION): Revista-Padurilor. 1998, 113: 3-4, 43-47; With English captions; 9 ref.

ABSTRACT: Data are tabulated, by species or genus, of symptoms of mycoplasma-induced diseases of woody plants and forest trees in Romania: *Ulmus* spp., *Fraxinus* spp., *Salix* spp., *Robinia pseudoacacia*, *Vaccinium* spp., *Ribes* spp., *Rubus* spp., *Alnus* spp., *Populus* spp., *Prunus* spp., *Sambucus* spp., *Corylus* spp., *Crataegus monogyna* and *Rosa* sp.

DESCRIPTORS: woody-plants; temperate-tree-fruits; forest-trees; mycoplasmal-diseases; plant-diseases

Marshall-EJP, 1989.

TITLE: Susceptibility of four hedgerow shrubs to a range of herbicides and plant growth regulators.

SOURCE (BIBLIOGRAPHIC CITATION): Annals-of-Applied-Biology. 1989, 115: 1, 469-479; 21 ref.

ABSTRACT: *Crataegus monogyna*, *Prunus spinosa*, *Fraxinus excelsior* and *Sambucus nigra*, common woody species of hedgerows, were grown in pots and treated in June with half and full recommended rates of 15 herbicides and 3 plant growth regulators (mefluidide, paclobutrazol and chlormequat). *C. monogyna* was affected by fewest compounds, while the other 3 species showed differing tolerances. Diclofop-methyl, flamprop-m-isopropyl and difenzoquat did not adversely affect the shrubs. Plant growth regulators used at rates recommended for cereals and grassland had only minor effects. Clopyralid killed only *S. nigra*, while mecoprop, fluroxypyr, chlorsulfuron, metsulfuron-methyl and glyphosate damaged most species. Height of *C. monogyna* was increased after treatment with diclofop-methyl, difenzoquat, ethofumesate, mefluidide and chlormequat.

DESCRIPTORS: Diclofop-; usage-; nontarget-effects; environmental-impact; Flamprop-; Difenzoquat-; Clopyralid-; Mecoprop-; Fluroxypyr-; Chlorsulfuron-; Metsulfuron-; Glyphosate-; Ethofumesate-; Mefluidide-; Paclobutrazol-; Chlormequat-; herbicides-; plant-growth-regulators; growth-retardants

McLaughlin,-JJA, 1956.

TITLE: Research notes on weed control.

SOURCE (BIBLIOGRAPHIC CITATION): 1956, Proc. 9th N.Z. Weed Control Conf. 1956 (83-8). From abstr. in Weed Abstr. 6(6), 1957(805).

ABSTRACT: (1) Some factors influencing the effect of 2,4,5-T on Gorse (*Ulex europaeus*). Dilution, time of application and age and growth form were considered. 2,4,5-T (butyl ester) at 3.6 lb. acid equivalent/gal. was applied at dilutions of 1 part in 80, 160, 240, 320, and 400 parts of water and treatments repeated on bushes of different ages at monthly intervals throughout the year.

Results indicated that dilutions of 1/80 and 1/160 were best over the whole series, but tended to vary with the time of application. High dilutions were unsatisfactory. Condition of the bushes in relation to flowering was of no importance. The most important factor appeared to be age; young undamaged bushes 3-4 ft. high were most easily killed. (2) Control of Hawthorn (*Crataegus monogyna*). The following treatments were carried out in winter 1955: (a) undiluted 2,4,5-T painted on cut stumps; (b) a 50/50 mixture of 2,4,5-T and dieselene painted on cut stumps; (c) basal spraying with 2,4,5-T and 1/20 dieselene; (d) monuron at 80 lb./acre sprayed on and around cut stumps; (e) monuron at 80 lb./acre sprayed at ground level round standing bushes. A second series was treated in the following summer with a 2,4,5-T/dieselene mixture, using basal, cut-stump and cover sprays. Results so far available indicate that basal spraying is the best and most economic treatment. DESCRIPTORS: *Crataegus-monogyna-control*,-chemical; Protection-forest; *Ulex-europaeus*; Weed-trees-and-shrubs-chemical-control; Weed-killers

Mihajlovic-LS; Glavendekic-MM, 1988.

TITLE: Lepidopteran defoliator of hawthorn hedge.

SOURCE (BIBLIOGRAPHIC CITATION): Glasnik-Sumarskog-Fakulteta, -Univerzitet-u-Beogradu. 1988, No. 70, 125-131; 11 ref.

ABSTRACT: *Neosphaleroptera nubilana* was identified as the major defoliator of hawthorn (*Crataegus monogyna*) hedges in new settlements of Belgrade in spring 1988.

DESCRIPTORS: hedges-; insect-pests; damage-; plant-pests; ornamental-woody-plants

Norton-DA; Spellerberg-IF (ed.); Goldsmith-FB (ed.); Morris-MG, 1991.

TITLE: Scientific basis for the conservation management of New Zealand plant communities.

SOURCE (BIBLIOGRAPHIC CITATION): The scientific management of temperate communities for conservation. The 31st symposium of the British Ecological Society, Southampton 1989. 1991, 349-381; 6 pp. of ref.

ABSTRACT: The botanical habitats of New Zealand are described. The effects of endemism and hybridization on the flora are discussed and habitat modification in historic times is outlined. A major factor affecting the flora is the invasion of species such as *Ammophila arenaria*, *Crataegus monogyna*, *Hieracium pilosella*, *Lagarosiphon major*, *Spartina anglica* and *Tradescantia fluminensis*. Many grasses were introduced for herbage production, and grazing suppressed highly palatable native species including *Elymus* spp. and *Gingidia montana*. The New Zealand flora evolved in the absence of grazing mammals and intensive control of introduced red deer [*Cervus elaphus*] was necessary for the recovery of woody forest understorey plants. Feral goats, rabbits and overgrazing by sheep have severely damaged native vegetation and lowland pastures. Management of small

populations of native plant species is discussed.

DESCRIPTORS: Nature-conservation; plant-introduction; Plant-communities; grazing-; overgrazing-; Aquatic-weeds; ecology-; invasion-; weeds-; plant-genetic-resources

Phipps-JB, 1998.

TITLE: Introduction to the red-fruited hawthorns (*Crataegus*, Rosaceae) of western North America.

SOURCE (BIBLIOGRAPHIC CITATION): *Canadian-Journal-of-Botany*. 1998, 76: 11, 1863-1899; 26 ref.

ABSTRACT: Howell's failure in 1898 to typify *Crataegus columbiana* Howell (the species is based on noncited discordant paratype elements) and the readiness of later authors to make new varieties in this species without resolving the type problem has been the cause of much confusion in the nomenclature of the western red-fruited hawthorns. This has been increased by the failure to recognize *Crataegus williamsii* Eggl. and compounded by almost a century of no revisionary study on western *Crataegus* with the further result that boundaries between taxa have been routinely misunderstood outside Colorado. In pursuit of a solution doing least violence to conventional usage, the author has lectotypified *C. columbiana* and resuscitated *Crataegus piperi* Britton (in a recent paper), realigned *C. piperi* as *Crataegus chrysocarpa* var. *piperi* (Britton) Eggl. and resurrected *C. williamsii*. There are thus five established native western N. American species of red-fruited hawthorns, the above two, and *Crataegus wootoniana* Eggl., *Crataegus macracantha* Lodd. ex Loud, and *Crataegus erythropoda* Ashe in addition to the introduced *Crataegus monogyna* Jacq., all of which have been recognized as occurring at least somewhere in this region for many decades. This paper also adds the first authenticated record for wild *Crataegus laevigata* (Poir.) DC. in North America. Separation of the two varieties of *C. chrysocarpa* is validated by numerical taxonomy. The taxa concerned are illustrated with line drawings and provided with detailed range maps. Colour photographs illustrate typical habitat types and show the development of fruit colour.

DESCRIPTORS: nomenclature-; numerical-taxonomy; taxonomy-; paratypes-; varieties-

Reid-DF, 1987.

TITLE: The evaluation of a mixed formulation of triclopyr, dicamba and 2,4-D for control of scrub species.

SOURCE (BIBLIOGRAPHIC CITATION): *Proceedings, Crop Protection in Northern Britain 1987*, Dundee University, 15-17 March 1987. 1987, 367-372; 3 ref.

ABSTRACT: In 1984-85 on 12 sites in Scotland with crops of *Picea sitchensis*, *Pinus sylvestris*, *Picea abies* or *Larix* spp. the performance of 3.5 kg SF 06406/ha (a mixture of 85 g dicamba + 65 g triclopyr + 200 g 2,4-D ester/litre) against a

wide range of scrub and woody weed spp. was evaluated. SF 06406 gave good control of *Alnus glutinosa*, *Betula pendula*, *Crataegus monogyna*, *Rubus fruticosus*, *Rubus idaeus*, *Salix* spp., *Sarothamnus scoparius* [*Cytisus scoparius*], *Ulex europaeus* and *Corylus avellana* when applied in the summer during the period of their active growth. Good crop tolerance was shown to directed applications.

DESCRIPTORS: weed-control; chemical-control; dicamba-; triclopyr-; 2,4-D; Herbicides-; WOODY-WEEDS; control-; weeds-; blackberries-; raspberries-; hazelnuts-

Richter-K, 1990.

TITLE: Application of chemical preparations to inhibit flowering in *Crataegus* hedges.

SOURCE (BIBLIOGRAPHIC CITATION): *Archiv-fur-Gartenbau*. 1990, 38: 2, 89-95; 2 pl.; 6 ref.

ABSTRACT: Flower buds of 5- to 10-year-old hawthorn (*C. monogyna*) roadside hedges were destroyed when sprayed with 3% C4 [fatty acids]-concentrate, or 1.5% C4-concentrate + 0.5% Falimorph [aldimorph], thus eliminating the risk of fireblight (*Erwinia amylovora*) infection. All inflorescences needed to be wetted evenly for complete success. Higher concentrations caused leaf and shoot damage. Of other compounds tested ammonium sulphate was only successful when applied at 25% and at this level it was also phytotoxic. NAA (at 0.015 or 0.03%) only killed the blossoms if sprayed early when the first buds were visible and was ineffective if applied just before flowering. Solutions of household salt (at 1, 4, or 10%) and sodium hydroxide (at 4%) were unsuitable.

DESCRIPTORS: Flowering-; disease-control; fungicides-; responses-; Ammonium-; Growth-regulators; NAA-; ornamental-plants; ornamental-woody-plants; plant-growth-regulators

Sallabanks-R, 1992.

TITLE: Fruit fate, frugivory, and fruit characteristics: a study of the hawthorn, *Crataegus monogyna* (Rosaceae).

SOURCE (BIBLIOGRAPHIC CITATION): *Oecologia*. 1992, 91: 2, 296-304; 49 ref.

ABSTRACT: The fate of fruits from a population of European hawthorn (*Crataegus monogyna*) in W. Oregon was examined from September 1989 to May 1991. Only one frugivore, the American robin (*Turdus migratorius*) foraged on the *C. monogyna* fruits. Dispersal efficiency (defined as the proportion of the initial fruit crop dispersed/dispersal success per propagule) was low, with an average of 21% of seeds being dispersed (carried away from parent plants) each year; most fruits fell to the ground. Robins dropped 20% of the fruits that they picked, and defecated/regurgitated 40% of the fruits (seeds) that they swallowed, beneath parent plants; they preferred bushes with larger fruit displays. Both absolute dispersal success (number of seeds) and dispersal

efficiency were also correlated with initial fruit abundance. Individual plant fecundity and fruit quality did not vary much between years. Larger (older) plants produced more fruits, and, therefore, had higher fitness.

DESCRIPTORS: Broadleaves-; Fruits-; ecology-; Seeds-; seed-dispersal

Sallabanks-R, 1993.

TITLE: Fruiting plant attractiveness to avian seed dispersers: native vs. invasive *Crataegus* in western Oregon.

SOURCE (BIBLIOGRAPHIC CITATION): Madrono. 1993, 40: 2, 108-116; 43 ref.

ABSTRACT: *Crataegus monogyna*, a hawthorn native to Europe, has successfully invaded much of North America since its introduction approximately 200 years ago. Successful dispersal by avian frugivores, relative to the native biota, may be one reason why *C. monogyna* is so invasive. To address this hypothesis, a comparison was made of the attractiveness of *C. monogyna* and *C. douglasii* var. *suksdorfii* (the native hawthorn) to their primary dispersal agent (American robins, *Turdus migratorius*) in western Oregon. A companion study at the same site identified three *Crataegus* traits which were correlated with pome removal by robins: pome crop size; mean pome size; and mean pome pulp-to-pyrene ratio. With respect to these dispersal-related traits, *C. monogyna* was found to be superior to its native counterpart, producing larger displays of higher quality pomes. These results offer an explanation for the observed patterns of distribution and abundance of *C. monogyna* and *C. douglasii* var. *suksdorfii* at the study site specifically, and in western Oregon in general. Suggestions are made for management against *C. monogyna* and for frugivorous birds.

DESCRIPTORS: broadleaves-; plant-succession; plant-colonization; seeds-; seed-dispersal; wildlife-

Sallabanks-Rex, 1993.

Title: Fruit defenders vs. fruit thieves: Winter foraging behavior in American robins.

Source: Journal-of-Field-Ornithology. 1993; 64 (1) 42-48.

Publication Year: 1993

Language: English

Abstract: The behavior of American Robins (*Turdus migratorius*) foraging on fruits of the nonnative European hawthorn (*Crataegus monogyna*) was studied in relation to territory ownership; individuals defending fruit supplies (owners) were compared with conspecifics introducing on defended territories (intruders). On average, owners had longer feeding bouts, ingested more fruits per bout and foraged for fruits more slowly than intruders. During the first minute after arrival at a fruit source, intruders attempted to pick fruits almost three times as fast and ingested twice as many fruits as owners. These results are important because most studies discussing differences in foraging behavior between

owners and intruders have been only anecdotal, and because reports of fruit defense are rare.

Schouten-HJ, 1992.

TITLE: Effectiveness of preventing flowering of hawthorn in protecting pear orchards from fire blight infection.

SOURCE (BIBLIOGRAPHIC CITATION): Netherlands-Journal-of-Plant-Pathology. 1992, 98: 1, 21-32; 13 ref.

ABSTRACT: To assess the effectiveness of control of fire blight (caused by *Erwinia amylovora*) in pear orchards by preventing flowering of hawthorn (*Crataegus monogyna* and *C. laevigata*), disease incidence was studied in 5 areas (c. 3 X 3 km) in the Netherlands over 3 years. Two of these areas were in protected regions (areas where flowering of hawthorn is prevented and blighted plants destroyed) and 3 in unprotected regions (fire blight inspection restricted to a 500 m zone around the orchards). During the 3 years, light to moderate epidemics of fire blight were observed in each region, with blight occurring in 2.3% of the protected sites and 19.8% of the unprotected areas at least once in 1987, 1988 or 1989. The prevention of hawthorn flowering in protected areas was well implemented, and a smaller proportion of these hawthorn sites had infected trees (4.1%) than those in unprotected areas (14%). Moreover, there were fewer infected sites/km² in the protected areas (13) than in the unprotected areas (26). Fire blight occurred in 53% and 59% of the pear orchards in protected and unprotected areas, respectively. This difference was not significant. Reasons for the ineffectiveness of the control methods are considered, including inadequate hygiene of the pear orchards in both types of region and time period for spread of the disease from hawthorn to pear. Spread of fire blight within and between pear orchards occurred frequently.

DESCRIPTORS: Pears-; control-; epidemiology-; disease-control; fruit-crops; temperate-fruits; plant-pathogenic-bacteria; ornamental-plants; ornamental-woody-plants; plant-pathology

Smith,-FD, 1956.

TITLE: Brush-killers.

SOURCE (BIBLIOGRAPHIC CITATION): 1955, Agriculture (J. Minist. Agric. Lond.) 1955 62 (5), (221-4).

ABSTRACT: Deals with the use of 2,4-D and 2,4,5-T. While winter spraying, using oil instead of water, kills indiscriminately, summer spraying in water checks bramble, but leaves most thorns, e.g. *Crataegus monogyna* and *Prunus spinosa*, little affected. A list shows degrees of susceptibility for 15 species.

DESCRIPTORS: Afforestation-; *Crataegus-monogyna*; Protection,-forest; *Prunus-spinosa*; Weed-trees-and-shrubs; Weed-trees-and-shrubs-chemical-control; Weedkillers-growth-regulating-substances-2,4-D-and-2,4,5-T

Smith,-FL, 1958.

TITLE: Control of roadside vegetation.

SOURCE (BIBLIOGRAPHIC CITATION): 1958, Pap.4th Brit.Weed Control Conf. 1958 pp.5. 2 refs. From abstr.in Weed Abstr. 8(6), 1959(1124).

ABSTRACT: Reports the successful and economic use of chemicals for roadside maintenance. Maleic hydrazide at 5 lb./acre + 2,4-D (acid in oil emulsion) at 3.75 lb./acre in 100 gal. water applied very early in spring as soon as grass showed signs of growing has given the best results; encouraging results have also been given by February and December applications. The treatment is only economic if 2 mechanical cuttings are saved. It is particularly useful on embankments and other areas difficult to cut. Woody weeds are dealt with by cutting down, burning and applying a drenching spray of 2,4-D + 2,4,5-T at 3.75 lb. in 60 gal. diesel oil or in 30 gal. diesel oil + 30 gal. sump oil, on and round the cut stumps in the winter. Fraxinus excelsior, Sambucus nigra and Crataegus monogyna may need 2 treatments; Prunus spinosa, Corylus avellana, Ulmus procera and Acer pseudoplatanus are easily killed.

DESCRIPTORS: Acer-pseudoplatanus-control,-chemical; Corylus-avellana-control,-chemical; Crataegus-monogyna; Fraxinus-excelsior-control,-chemical; Protection,-forest; Prunus-spinosa; Ulmus-procera; Weedkillers-growth-regulating-substances-2,4-D-and-2,4,5-T; Weedkillers-growth-regulating-substances-carriers; Weedkillers-growth-regulating-substances-season; Weedkillers-maleic-hydrazide; Weedkillers-mixtures; Weeds,-herbaceous-combined-chemical-and-mechanical-control

Sparks-TH; Robinson-KA; Downing-SL; Britt-CP; Boatman-ND (ed.); Clay-DV (ed.); Goodman-A (ed.); Marrs-RH (ed.); Marshall-EJP (ed.); Newman-JR (ed.); Putwain-PD (ed.); Pywell-RF, 2000.

TITLE: Hedgerow management and the yield of hawthorn Crataegus monogyna berries.

SOURCE (BIBLIOGRAPHIC CITATION): Vegetation management in changing landscapes, University of York, UK, 28-30 March 2000. Aspects-of-Applied-Biology. 2000, No. 58, 421-424; 7 ref.

ABSTRACT: Hawthorn (Crataegus monogyna) is the dominant hedgerow species in Britain. Its berries are considered to be a vital food supply for many animals in the first half of the winter. Whilst not nutritionally outstanding, the sheer bulk of the crop determines its importance. Here berry yields from three hedgerow experiments, at two sites in England, are evaluated. At Drayton hedgerows established in 1990 had one of 5 treatments: an unfenced control cut annually; a fenced control (to prevent grazing) cut annually; uncut and unfenced; coppiced and fenced; grubbed out and replanted with blackthorn (Prunus spinosa) and fenced. At Monks Wood, two trials of pure hawthorn hedgerows established in 1962 with treatments such as cutting, coppicing, laying or

pollarding to height 1.5 m. Results showed that the yield of berries was significantly higher in sections left uncut or laid, than in those from which fruit-bearing wood had been removed. There were no significant differences ! in berry weight in any of the treatments.

DESCRIPTORS: fruiting-; fruits-; yields-; hedges-; management-; wild-animals; wildlife-; conservation-; nature-conservation; agricultural-land

Wells, T. C., Phipps, J. B., 1989.

Title: Studies in *Crataegus* (Rosaceae: Maloideae). Interserial hybridization between *Crataegus monogyna* (series Oxycanthae) and *Crataegus punctata* (series Punctatae) in southern Ontario.

Language: English

Subjects: Hybridization/Plants, *Crataegus punctata*, English hawthorn
Feature Article.

Source: Canadian Journal of Botany.

ISSN: 0008-4026.

Volume/Issue: 67.

Pages: 2465-72.

Record Type: article.

Physical Description: bibl il.

Wheeler-A-G-Jr {a}; Stoops-Craig-A, 2001.

Title: *Cacopsylla peregrina* (Foerster) (Sternorrhyncha: Psylloidea: Psyllidae): First U.S. records of an Old World specialist on hawthorns (*Crataegus* spp.).

Source: Proceedings-of-the-Entomological-Society-of-Washington. [print] January, 2001; 103 (1): 103-109.

Language: English

Abstract: Known previously from British Columbia, Canada, the Palearctic *Cacopsylla peregrina* (Foerster) is reported from California, Oregon, and Washington as the first U.S. records for this psyllid. Detected in 1999 in Washington on English hawthorn (*Crataegus monogyna* Jacq.) which has been introduced and planted as an ornamental in North America, *C. peregrina* is thought to have been accidentally introduced with hawthorn nursery stock from Europe. A brief taxonomic description of the adult and this psyllid's Old World distribution and bionomics are provided.

Williams-PA; Buxton-RP, 1986.

TITLE: Hawthorn (*Crataegus monogyna*) populations in mid-Canterbury.

SOURCE (BIBLIOGRAPHIC CITATION): New-Zealand-Journal-of-Ecology. 1986, 9: 11-17; BL; 23 ref.

ABSTRACT: *C. monogyna* is classified as a noxious plant in several counties in E. South Island, New Zealand. Plants at 2 scrub sites and one forest remnant site in Canterbury were sampled by measuring stem diam. and counting growth rings

to determine the age structure and dynamics of *C. monogyna*. There was a close positive relationship between age, stem diam. and plant ht. Growth was impeded by grazing, but *C. monogyna* is spreading in clumps of the spiny shrub *Discaria toumatou* and in pastures that are only lightly grazed. If existing management continues, *C. monogyna* is predicted to increase as more of the bushes reach fruiting age. In the forest site, less *C. monogyna* is establishing now than when the forest was more disturbed, whereas seedlings and saplings of native trees are abundant. *C. monogyna* is predicted to decrease here. The management of *C. monogyna* should take account of these different situations. DESCRIPTORS: Succession-; plant-colonization; Weed-control; grazing-; WOODY-WEEDS; Poisonous-weeds; Weeds-; control-; management-; broadleaves-

Williams-PA; Karl-BJ; Bannister-P; Lee-Working Group, 2000.

TITLE: Small mammals as potential seed dispersers in New Zealand.

SOURCE (BIBLIOGRAPHIC CITATION): Thematic issue: Environmental weeds. Papers from a symposium at the first joint conference of the Ecological Society of Australia and the New Zealand Ecological Society, Dunedin, New Zealand, November 1998. *Austral-Ecology*. 2000, 25: 5, 523-532; 37 ref.

ABSTRACT: Weed invasion success is strongly influenced by availability of seed dispersal vectors, which may include animals. We examined the potential of several small introduced mammals (mice, kiore, ship rats and possums) to disperse germinable seeds in New Zealand. Captive animals were fed fleshy fruit of weeds (*Berberis glaucocarpa*, *Cotoneaster* spp., *Crataegus monogyna*, *Ilex aquifolium*, *Leycesteria formosa*, *Ligustrum sinense*, *Lonicera japonica*, *Passiflora mollissima*, *Pyracantha angustifolia*, *Sorbus hupehensis*) and native species (*Coprosma* spp., *Prumnopitys ferruginea* and *Solanum aviculare*). We recorded the percentage of fruit consumed, seed ingested and gut passage time. Faeces were collected and the seeds extracted and tested for germination potential in an unheated glasshouse (two weed species) or under controlled conditions (11 species). The smallest rodents (mice and kiore) generally destroyed all seeds eaten. Large numbers of viable seeds of the small-seeded (< 1 mg) species, *L. formosa* and *S. aviculare*, passed through ship rats. Possums consumed the seeds of all adventive and native fruits except *P. ferruginea*. The proportion of seeds recovered intact from possum faeces varied with plant species and ranged from 6 to 83%. The time required for 50% of all seeds to be passed by possums ranged from 2.5 to 5.5 days with an average of 3.7 days, and was generally unrelated to simple fruit parameters such as percentage pulp and moisture content. For seeds where germination also occurred in the uneaten controls, the germination of seed from possums ranged from 3 to 78%. Germination was mostly lower in seeds from possums than in the controls, where differences were significant. Possums have major potential to disperse a wide range of fleshy fruit-producing native and introduced plant species. Ship

rats have the potential to disperse those with very small seeds.

DESCRIPTORS: seeds-; seed-dispersal; weeds-; invasion-; seed-germination; conferences-

Wilson, M., Epton, H. A. S., Sigeo, D. C. 1990.

Title: Biological Control Of Fire Blight Of Hawthorn *Crataegus-Monogyna* With *Erwinia-Herbicola* Under Protected Conditions.

Source: *Plant-Pathology-Oxford*. 1990; 39 (2): 301-308.

Publication Year: 1990

Language: ENGLISH

Abstract: Isolates of *Erwinia herbicola*, obtained from flowers and leaves of hawthorn (*Crataegus monogyna*), were screened as potential control agents of fire blight disease (caused by *Erwinia amylovora*) using an immature pear fruit assay. Selected isolates were subsequently tested for disease control by infection of hawthorn blossom in the laboratory, and by shoot infection of hawthorn plants grown under controlled (glasshouse) and fluctuating (polythene tunnel) environmental conditions. Although the immature pear fruit assay provided a general screen for the selection of antagonists for the control of both blossom and shoot blight, it had two major limitations when quantitatively applied. Firstly there were inconsistencies in the relative effects of different isolates on the pear-slice surface, with some isolates being more suppressive than the standard antagonist Eh252 in the first screening and less in the second. Secondly the assay was not able to predict accurately the level of control in the intact plant-as no correlation occurred between the level of control in the pear assay and the percentage control of either blossom blight or shoot blight. Two isolates of *E. herbicola*, WL9 and WL40, reduced both blossom- and shoot-blight. WL9 provided over 80% control of blossom blight, equivalent to that provided by chemical agents, and also gave total control of shoot blight when applied at a WL9: pathogen of 10:1.

Wilson-M {A}; Epton-H-A-S; Sigeo-D-C, 1992.

Title: Biological Control Of Fire Blight Of Hawthorn *Crataegus-Monogyna* With Fluorescent *Pseudomonas-Spp* Under Protected Conditions.

Source: *Journal-of-Phytopathology-Berlin*. 1992; 136 (1): 16-26.

Publication Year: 1992

Language: ENGLISH

Abstract: Naturally-occurring epiphytic fluorescent pseudomonads were isolated and characterized in terms of their potential to control fire blight infection of hawthorn, caused by *Erwinia amylovora*. Preliminary testing and selection of antagonists using an immature pear fruit assay gave some inconsistency in the amount of pathogen suppression on the pear tissue and also in the prediction of biocontrol effectiveness on the intact plant. Selected antagonists provided

significant but variable control of fire blight under protected (polythene tunnel and glasshouse) conditions, with isolates HL83 and HL99 giving control of both blossom-blight and shoot-blight. In some cases the degree of control was equal to that of chemical treatments, including Agrimycin 17 and experimental bactericides, and was achieved without any numerical advantages of applied control agent over pathogen. The timing of pseudomonad application in relation to pathogen inoculation was found to have a significant effect on the level of control of blossom-blight.

Wilson-M {A}; Epton-H-A-S; Sigeo-D-C, 1992.

Title: Interactions Between *Erwinia-Herbicola* And *Erwinia-Amylovora* On The Stigma Of Hawthorn Blossoms.

Source: *Phytopathology*-. 1992; 82 (9): 914-918.

Publication Year: 1992

Language: ENGLISH

Abstract: *Erwinia herbicola* HL9N13 is an effective biological control agent of fire blight disease of hawthorn [*Crataegus monogyna*]. The interactions between *E. herbicola* and *E. amylovora* on the stigma of hawthorn blossoms were examined to assess the possible roles of competition and antibiosis in the mechanism of biological control of blossom blight. Preemptive and competitive colonization of the stigma by the biological control agent reduced the pathogen growth rate and final population. Scanning electron microscopy indicated that *E. herbicola* colonized the same sites on the stigmatic surface as *E. amylovora* in its epiphytic phase of development. The competitive advantage exhibited by *E. herbicola* may have resulted from antibiosis. Although *E. herbicola* HL9N13 produced a broad-spectrum antibiotic on potato-dextrose agar, it was not determined whether this antibiotic was produced in planta. The results suggest that stigma colonization by *E. amylovora* is prevented by preemptive or competitive occupation of colonization sites by *E. herbicola* and by the reduction in availability of a resource required by the pathogen for growth at these sites.

Xu-XM; Robinson-JD, 2000.

TITLE: Effects of temperature on the incubation and latent periods of hawthorn powdery mildew (*Podosphaera clandestina*).

SOURCE (BIBLIOGRAPHIC CITATION): *Plant-Pathology*. 2000, 49: 6, 791-797; 18 ref.

ABSTRACT: The effects of temperature on the length of the incubation and latent periods of hawthorn powdery mildew, caused by *Podosphaera clandestina*, were studied. At constant temperatures over the range 10-28°C, the incubation period ranged from 5 to 14 days and the latent period from 5 to 16 days; no visible colonies had developed at 30°C after 15 days. The relationships between temperature and the rates of fungus development within the incubation and latent periods were well described by a nonlinear model. The resulting curves

were asymmetrically bell-shaped with an optimum temperature of approximately 23°C. The lengths of the incubation and latent periods under fluctuating temperatures were also determined, and were used to evaluate the models developed from constant temperature experiments for their accuracy of prediction. The incubation and latent periods under fluctuating temperature regimes were predicted using a rate-summation scheme with a time step of 24 min, by integrating the respective incubation and latent rate functions obtained under constant temperatures. The predicted incubation or latent periods agreed well with the observed values. Under constant temperature the interval between the times when symptoms and sporulation on the same leaflet were first observed was very short, on average < 1 day, and was not significantly correlated with temperature. However, this interval was negatively correlated with mean temperature under fluctuating regimes.

DESCRIPTORS: fungal-diseases; plant-diseases; plant-pathogenic-fungi; plant-pathogens; prepatent-period; temperature-; environmental-factors; disease-course

Useful Websites

www.ddgi.es./espais/iarcblan.htm

Picture and general description.

www.british-trees.com/guide/hawthorn.htm

Britis Trees Guide.

www.encyclopedia.com/printable/21024.html

Uses of hawthorn

http://plants.usda.government/cgi_bin/plant_attribute.cgi?symbol=CRMO3

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Other sources:

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