IMPACT OF COPPER-NICKEL DEVELOPMENT IN NORTHERN MINNESOTA ON TERRESTRIAL VEGETATION

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Final Report

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TABLE OF CONTENTS

INTRODUCTION

The regional copper-nickel study pertains to an area predominantly composed of a forest ecosystem (Lake State forest) in terms of the terrestrial vegetation. Some of the major tree species consist of red pine, jack pine, white pine, black spruce, aspen, birch and fir. These species are susceptible to both biotic (parasites) and abiotic stress factors.

Plants often suffer from more than one disease at a time. However, dwarf mistletoe on spruce, white pine blister rust, *Scleroderris* canker on conifers, and *Hypoxylon* canker on aspen are considered to be the most important plant diseases in the study area. In the following sections the biology, etiology and control of some of these diseases are discussed.

More than one species of parasite can interact to cause disease. Consequently, pathologists are beginning to study the etiology of multiple-pathogen diseases. There is another type of multiple pathogen interaction that one must consider: the interaction between parasites (biotic pathogens) and air pollutants (abiotic pathogens).

The proposed copper-nickel mining and smelting is considered to generate coarse particles, aerosols, gaseous pollutants such as sulfur dioxide, fluorides, etc.

Table 1 summarizes some of the information on the effects of sulfur dioxide and fluoride on parasite-induced plant diseases.

Table 1. Effects of sulfur dioxide and fluoride on some parasite-induced plant diseases.

Pollutant	Disease affected	Effects
sulfur dioxide	tree rusts	decreased
	wood rots	decreased or increased
	needle cast on juniper	decreased

Table 1 (cont'd.)

Pollutant	Disease affected	Effects
	Armillaria on trees	increased
	Dwarf mistletoe on larch and pine	decreased
	Needle cast on spruce	increased
Fluoride	Bean rust	decreased

Information is also presented in this report on the chemical analyses of total foliar concentrations and available soil concentrations of several elements in the study area with samples gathered over a temporal and a spatial basis. Statistical analysis of the results are also included.

A total of 34 field plots were established in the study area. Within these plots both vegetation and soil were sampled for elemental analysis. Sampling was done on both temporal and spatial basis. A stand of trees were considered as a sample rather than an individual tree, since the objective of our study was to address the elemental characteristics of a given species.

For procedures used for the elemental analyses of foliage and soil the reader is referred to our literature survey submitted to the Regional Copper-Nickel Study.

Figure 1.

Top: Trunk of an aspen tree infected by *Hypoxylon*. Note the loss in the Strength of the trunk.

Bottom: Black knot on cherry. Note the black cankerous growth.

Figure 2.

Top: White pine blister rust. Note the whitish reproductive structures (aecia) of the fungus.

Bottom: Broom rust on balsam fir. Note the brooming in the central portion of the tree.

Figure 3.

Top: Jack pine tip borer. Note the flagging and death of the two middle branches.

Bottom: *Armillaria mellea* root rot on jack pine. Note the white fungal mycelial strands (rhizomorphs) on the roots.

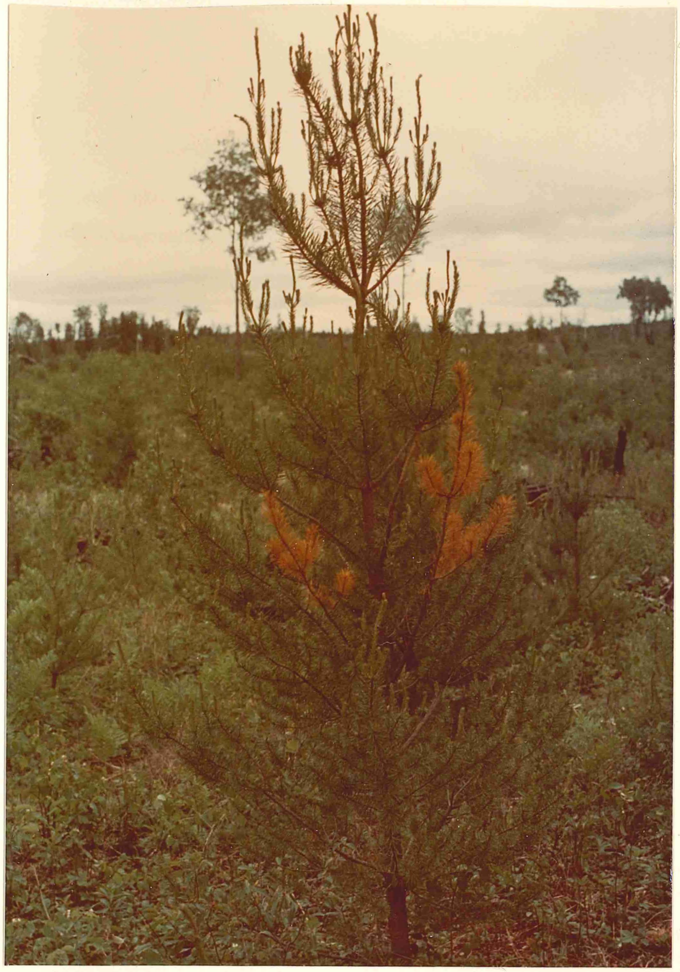


Figure 4.

Top: Genetic broom at the apex of a black spruce tree.

Bottom: Dwarf mistletoe on black spruce. Note the brooming and vegetative growth of the mistletoe.

Figure 5.

Dwarf mistletoe on jack pine.

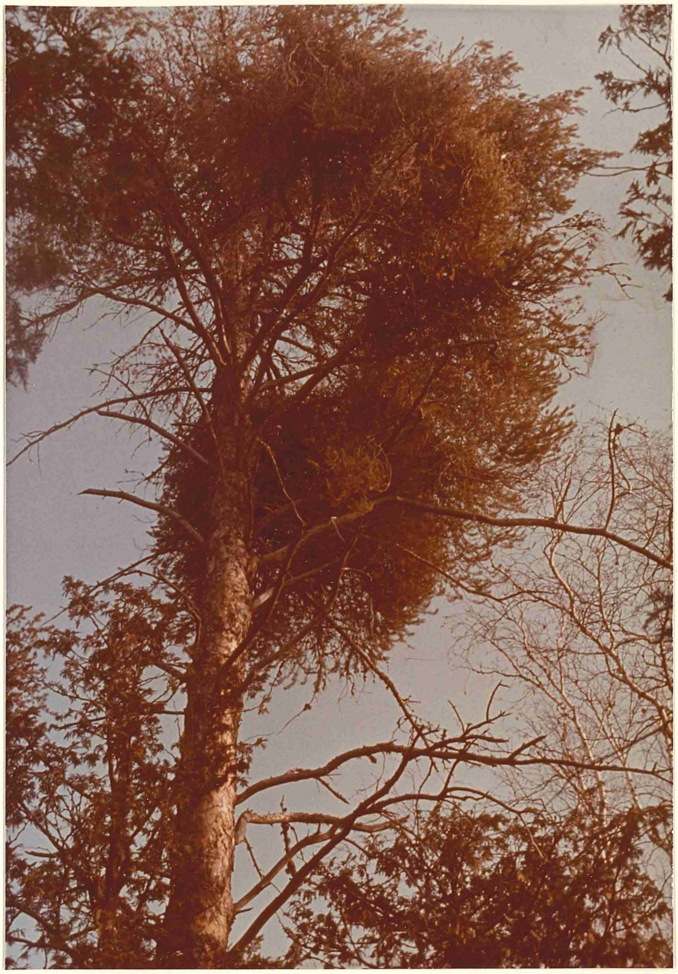


Figure 6.

Spruce bud worm damage.
Note the browning and death of the spruce trees.

Figure 7.

Top: Drought stress on red pine. Note the browning and death of the apical portions of the trees.

Bottom: Highway salt injury on balsam fir. Only branches facing the highway are injured.

HYPOXYLON CANKER (HYPOXYLON MAMMATUM) ON ASPEN (POPULUS TREMULOIDES)

Introduction

Quaking aspen is the most widely distributed tree species in North America, being one of the few with a transcontinental range from the Atlantic Ocean to the Pacific. It occurs from Newfoundland to Alaska and southward at increasingly higher elevations in the Sierra Nevada and in the Rocky Mountains to Mexico. East of the Great Plains it extends southward to a line from above Iowa to Virginia, and it is abundant in the Lake States and Northeast. Northeastern Minnesota supports a higher percentage of aspen than any other hardwood species growing in the region.

One of the most damaging diseases on aspen is Hypoxylon canker (Hypoxylon mammatum) which infects approximately 12 percent of all quaking aspen in Michigan, Wisconsin, and Minnesota (see Figure 1). This disease can be considered the most destructive canker on aspen and probably one of the most important tree diseases in the Lake States. It kills 1-2 percent of the standing aspen volume each year, which is approximately 112 million board feet.

Damage

Pole-size trees succumb in 3 to 7 years; younger ones may be killed more quickly. Decay fungi enter the trees through the cankers and weaken the stems, subjecting them to windthrow. The disease also reduces stand density far below that desired, thus seriously lowering the final yield. It also kills trees that could have otherwise been harvested in thinnings. Many young stands have so many infected trees that they have lost all or most of their prospective value.

Etiology

The fungus cause conspicuous cankers on the trunk. The fungus enters the tree through or around branch stubs and in turn, over 90% of the cankers begin at the branch stub. In some instances, cankers seem to be associated with insect wounds.

Life History

Once the fungus invades the host, conidial fructifications appear as blisters of various sizes at the end of the first or during the second growing season of the cankers. These conidia are formed around the margins of all but the youngest cankers. The fungus produces hyphal pegs or pillarlike structures that separate the superficial periderm from the underlying cortical tissue. The periderm ruptures, exposing a grayish layer of conidiophores and conidia solidly covering the outer surface of the cortex and sides of the pillars. Once exposed, these spores are wind disseminated. The first perithecial stromata appear when the cankers are 3 or more years old as erumpent, flattened, hard black layers covered by a white pruinose coat through which protrude the black ostioles of the sunken perithecia. These stromata are produced each year. The perithecia fill with asci and ascospores during wet weather and discharge spores for 18 hours after a rain. These ascospores are wind disseminated. Spores are produced and dispersed from cankers on dead trees and numbers of spores are not significantly reduced until 2 years after the trees have been felled. Ascospores are dispersed throughout the growing season and during the dormant season as well. Some spores are ejected during the winter when air temperatures are near zero.

Symptoms

The first evidence of the disease is small yellow to reddish-brown slightly sunken areas with irregularly lobed advancing margins, centered around some wound. These areas increase in size until they coalesce to form a canker, delimited by vertical cracks. As the canker develops, the affected bark becomes mottled, taking on a grayish color in which occur black patches owing to the superficial periderm flaking off to expose the blackened cortex. Alternating light and dark colored zones are apparent when the bark is sliced open, the dark layers are masses of mycelium and the light layers are decayed host tissue. This particular symptom is very useful in detecting young cankers. Conidia form under the outer bark near the margins of the canker and these can be seen with a hand lens. On the 3 years or older canker the stromata appear black and crumbly. Trees often break at the point of the cankering. Callus tissue does occur in some instances.

Control

No suitable control measures are known. High density stands with the minimum of other tree species will result in less loss to hypoxylon cankers. In areas where the incidence of the disease is characteristically high other species should be grown if possible. Eradication apparently is not feasible and felling cankered trees to reduce available inoculum is of little value. For the future, resistant aspen may be the answer. Thus far, however, hybrids involving *Populus tremula* and other species and selections from *P. tremuloides* have not resulted in resistant trees with good form. Even if a superior tree is developed it will be a major task to convert millions of acres of the aspen type.

Quarantine measures could protect the aspen in the interior region of Alaska from invasion by *H. mammatum*. The disease is in Canada but seems to be limited in its northerly spread, probably because of climate.

BLACK KNOT (APIOSPORINA MORBOSA = DIBOTRYON MORBOSUM) ON BLACK CHERRY (PRUNUS SEROTINA)

Introduction

This tree species makes its best growth on rich, deep, moist soils where it may occur in pure stands. In the northeastern United States this species often reaches commercial proportions in virgin forests of red spruce, white pine, northern hardwood association on sandy soils. In northeastern Minnesota, black cherry is at the northern extent of its range and although it is of no economic importance for lumber, it does serve as a benefit to wildlife. The black knot disease is caused by *Apiosporina morbosa* = *Dibotryon morbosum* (Figure 1) and although most prevalent on cherry and plum trees in orchards, it has been shown to cause losses in commercially important stands of black cherry in the northeastern United States.

Damage

The fungus causes cankers which weaken branches and stems and predispose the tree to other insect or disease organisms. Cankerous swellings more than 2 feet long occur on trunks of large trees, and where several such lesions are scattered along the bole, the tree is worthless for lumber (Figure 1).

Etiology

Practically all new infection originates on twigs of the current year and invasion of the trunk or larger branches takes place from small infected laterals.

Life History

Primary infection occurs mainly on current year's growth from ascospores or conidia around the time of full bloom. In most cases the ascospores are discharged from 2 year old knots, otherwise they are produced from infection of the previous spring.

The fungal hyphae grow inward to the cambial layer and later along the medullary rays in the xylem portion of the twig. After infection of the cambial region the formation of excessive quantities of parenchyma cells occurs, which are pushed outward, thus forming the basis for the knots. Swelling becomes evident toward the end of the growing season and in some cases a crop of conidia are produced in the fall, but further development doesn't usually occur until the following spring.

During fall and winter the hyphae spread internally and give rise to secondary galls at some distance from the original knot. During the second summer the knots enlarge very rapidly and the fungus develops the stromatic surface layer in which the perithecia develop during the winter. Ascospores are discharged in the spring resulting in infection of developing shoots.

Symptoms

Elongated, rough black galls up to 2 inches across appear abundantly on infected twigs and branches. Early in the spring a swelling appears on shoots and becomes progressively darker. By summer they take on pale-green velvety pile over the surface of the gall. Soon this disappears and the knot blackens.

Control

All small twigs and branches showing swelling should be removed. Cankers should be removed by cutting out diseased area down to the wood and for a distance of 2 or 3 inches surrounding infected area. This canker removal can be done during the course of improvement work.

WHITE PINE BLISTER RUST (CRONARTIUM RIBICOLA) ON EASTERN WHITE PINE (PINUS STROBUS)

Introduction

Eastern white pine has long been considered the finest of the eastern pines. The species grows throughout the Northeast, the Lake States, and into Canada, and extends in fingers or patches into the Central States and down the Appalachian Mountains as far as Georgia.

The most important disease of white pine is blister rust (*Cronartium ribicola*), a major problem in the Northeast, the Lake States, and the Northwest. It causes damage wherever highly susceptible species of the alternate host genus *Ribes* occurs. In Minnesota and the other Lake States, it has been only locally destructive so far, but in the Inland Empire it is one of the most important factors with which the foresters must contend. By 1952, 30 years after the introduction of the disease, annual losses amounted to 90,000,000 bd. ft. of saw timber and 75,000,000 bd. ft. of younger trees.

Damage

The damage by blister rust is proportional to the number and susceptibility of Ribes within and around a stand. Seedlings and small saplings are infected and killed quickly, while poles and larger trees succumb slowly. Consequently a white pine stand where blister rust is epidemic may appear little affected for many years, judging by the larger trees, but there will be an almost complete absence of seedlings or small saplings. The successive crops of seedlings succumb after a few years and nothing is left to perpetuate the stand when the mature trees are cut or finally killed.

Etiology

The fungal spores alight on the needles of white pine in the summer and fal' ~erminate, the germ tubes penetrate the needles, apparently through the stomata, mycelium grows through the leaves into the bark of the twigs, and this mycelium continues to advance as long as the host is alive. Spots on the needles are evident 4-10 weeks after infection and the fungus penetrates the bark 12-18 months after infection.

Hosts

The blister rust fungus lives alternately on the white pine and Ribes hosts. Wild and cultivated Ribes are susceptible to the disease and capable of transmitting the rust to pines. The so-called European black currant (Ribes nigrum) is especially susceptible, and field observations have demonstrated that this species is largely responsible for initiating new centers of infection and for firmly establishing the disease over extensive areas that otherwise have remained free from the rust for many years.

Life History

Fungal spores of the blister rust are wind disseminated. After spore germination and invasion of the host tissue, an incubation period of 3½ years is necessary before the canker develops on the infected stems. The pycnidial stage of the fungus is characterized by spindled-shaped swelling of the bark and a yellowish discoloration at the advancing edges of the canker. In this stage, tiny drops of clear sweet-tasting liquid exude from dark spots which develop in the region of the discolored bark. These drops contain the pycniospores which function in the reproduction of the fungus. When the pycnial drops dry up, dark reddish-brown pycnial scars persist. Early in the spring, at the close of the incubation period, orange-yellow blisters appear protruding from the diseased bark. These blisters contain aeciospores which when liberated, come in contact with the underside of the Ribes leaves and when favorable conditions exist, germinate and grow into the leaf tissue. Aeciospores are long-lived and have been known to infect Ribes at distances of more than 100 miles.

About the middle of May, small patches of yellowish pustules appear on the underside of infected Ribes leaves. These pustules contain the urediospores, which transmit the disease on Ribes leaves. Since seven generations of these spores may be produced in a single season, there is a rapid spread on the Ribes host in this stage. In midsummer, structures called telial columns appear as brown horn-like projections and these columns contain the teliospores from which the pine-infecting sporidia develop, thus completing the life cycle of the fungus. Sporidia are delicate and short-lived, and are therefore effective only within relatively short distances.

Symptoms

Infected twigs of pine become swollen and orange-brown in color; large stems frequently become ridged when the mycelium has been present for some years. Cankers are formed on the stems; the bark in the cankered area cracks and resin flows down the stem and hardens in masses providing a characteristic symptom. See Figure 2. Branches girdled by the fungus will have dead, brown needles; the dead branch is called a flag and can be spotted for a distance. In May and June, blisters filled with yellow-orange spores will appear on infected branches. The infection on Ribes leaves result in the formation of spots sometimes so numerous that they cover the entire leaf. Orange masses of urediospores are produced on the underside of the leaf on these spots, in early summer, and later the characteristic telial columns are formed, which appear as brownish hairs on the under surface of the leaves.

Control

Ever since the introduction of white pine blister rust to the United States Ribes eradication has been the primary control measure for the disease. Unfortunately, the effectiveness of eliminating Ribes has not been adequately evaluated and thus the success of such a program is not actually known. Economists have shown that Ribes eradication is feasible, returning $4 for each $1 invested, but their study was based on the questionable premise that eradication of the alternate host prevented infection of the pine. This premise might be true if eradication programs did eliminate all the Ribes plants but this is not the case. Currants and gooseberry plants are missed and a great deal of inoculum can be generated by a few small plants. In areas with a recent fire history pulling Ribes plants actually resulted in more plants. The use of certain chemical silvicides is likely to be curtailed making it even more impractical to eliminate these alternate hosts from extensive regions where white pine exist. As of 1968 the Ribes eradication program was discontinued on national forests in the northern Rocky Mountain region (Ketcham, 1968). Ribes eradication may be used in the future only in localities where the white pine are of high value, especially in recreation areas and where populations of the alternate hosts can be effectively reduced to a level which reduces incidence of white pine blister rust. Chemical silvicides such as 2, 4-D and 2, 4, 5-T are more effective than mechanical removal.

The most promising control measure for the future is the development of resistant white pine. In the Pacific Northwest resistant western white pines have been located, vegetatively propagated, and established in seed orchards. Newly located resistant trees are being added to the original numbers and hybrids of these resistant trees are being produced and evaluated for their resistance to the fungus. In early work with eastern white pine vegetatively reproduced trees from original resistant selections were resistant, while seedlings from these same trees were quite susceptible. When resistant trees of western white pine are crossed a portion of the seedlings are resistant and it has been estimated that a 20% gain will result between the F1 and F2 generations. The eventual production of more resistant seedlings will take time, especially if founded on a reasonable broad base of resistance. C. ribicola, like all fungi, has the ability to vary and thus new strains, more virulent strains, may attack the resistant trees. Only time will tell how effective resistant white pine will be in reducing losses to blister rust.

Most infections occur within 6 feet of the ground and in well stocked stands, as well as plantations, pruning is a feasible control measure. Infected branches should be removed allowing 6 inches of what appears to be healthy tissue between canker and main stem. However, for pruning to be economical all the lower branches should be removed thus insuring more complete elimination of the rust and improving wood quality. Infections can be carved out of the main stem but this would be applied only to trees with very high values.

Rust infection can be avoided by planting white pine in low hazard areas such as South and Central Wisconsin instead of the northern part of the state. White pine, however, are not likely to be grown extensively on land more suited to agriculture and this tree species, as is the case with other conifers, can be grown and managed more effectively in the more northern regions. Thus we need to consider other control measures for these geographic areas where white pine does well and where the hazard from blister rust is high. It is important to avoid areas where, because of the terrain, the microclimatic conditions will favor infection. A closed canopy should be maintained, which keeps the air dry below the canopy and the more susceptible and cankered branches are killed because of the shade. White pine should not be planted in small openings. Openings in crown canopy with a diameter less than the height of the surrounding trees are cool, wet and ideal for blister rust infection.

Direct treatment of cankers and infected trees has been tried extensively using, among other chemicals, cycloheximide (Actidione) and Phytoactin. The two latter compounds are antibiotics produced by one of the Actinomycetes, Streptomyces griseus. These materials were applied in oil or water to excised cankers, basal portion of trees with cankers and to the foliage by aerial applications. Although it appeared at first that the fungus had been stopped and there was evidence that the antibiotics were translocated away from point of application, the fungus survived the treatment and later continued normal development. Apparently these first attempts at a direct chemical control of blister rust have not succeeded but for the future this remains a most worthwhile possibility.

In the Western United States a fungus, Tuberculina maxima, occurs on blister rust cankers and parasitizes C. ribicola thus inactivating the pathogen. Approximately 67% of the lethal type cankers had been inactivated by T. maxima and aecial production was 18% of normal in 1965. Studies are underway to use T. maxima for controlling blister rust.

YELLOW WITCHES' BROOM (*MELAMPSORELLA CERASTII*) ON BALSAM FIR (*ABIES BALSAMEA*)

Introduction

Balsam fir is a tree of cold climates, extending from the Northeast and the Lake States into Canada and southward along the crests of the Appalachian Mountains to southcentral Virginia. It inhabits cold, moist, but well-drained situations from sea level to high elevations. It also occurs in and around swamps, flats and lower hardwood slopes in the North. It is shallow-rooted and therefore easily windthrown. It is also particularly sensitive to fire because of the flammable foliage and resin blisters in the bark. Highly resistant to damage by cold, this tree cannot stand hot, dry summers.

The fungus causing the witches broom on balsam fir (Figure 2) is *Melampsorella cerastii*. Although present on many trees in northeastern Minnesota, the disease is not considered a major forest problem.

Damage

Yellow witches' broom on fir is of minor importance in the United States but on engelmann spruce occasionally decay and mortality are observed.

Hosts

On balsam fir this disease is caused by the heteroecious rust fungus. The telial hosts are chickweed (*Stellaria* spp.) and mouse-ear chickweed (*Cerastium* spp.).

Life History

In the spring or early summer the pycnia appear as small raised round orange spots on both surfaces of dwarfed leaves. By midsummer the aecia develop on the undersurface of the leaves as two rows of orange-yellow blisters. These blisters rupture, discharging the orange-yellow aeciospores, which are wind borne to infect leaves of chickweed. Small orange-red pustules, the uredia, quickly develop, releasing urediospores to infect other chickweeds. Telia appear later as whitish to pale reddish spots. The teliospores do not germinate and infect firs until the following spring, thus completing the life cycle.

Symptoms

Infected fir branches develop numerous upright lateral shoots from one point, forming a compact witches' broom. Infected twigs are dwarfed, the leaves are dwarfed and yellowish, and they shrivel and drop by the following spring leaving the brooms bare until the new shoots develop. The brooms are conspicuous during the growing season since their yellow foliage stands out in striking contrast to the dark-green normal foliage. In addition to witches' brooms, pronounced swelling of the trunk or branches occasionally occur. The fungus is perennial in the stems; consequently in the following season new shoots with peculiar yellowish leaves develop again.

Control

In North America the disease is not considered serious enough to justify special control measures. Eradication of chickweed from the vicinity of firs would ultimately eliminate the disease, but chickweed is so abundant that this is not feasible.

EASTERN DWARF MISTLETOE (ARCEUTHOBIUM PUSILLUM) ON BLACK SPRUCE (PICEA MARIANA)

Introduction

Black spruce is an abundant boreal species that spans the North American continent in Canada from Newfoundland to the Bering Strait. However, its commercial range in the United States is virtually confined to far-northern New England and northern Michigan, Wisconsin, and Minnesota, with minor extensions southward. The superior black spruce stands in the United States are around bog margins, and on the Laurentian Shield in northeastern Minnesota.

The most damaging stem disease on black spruce is the eastern dwarf-mistletoe caused by *Arceuthobium pusillum*. See Figure 4. The incidence of the disease in spruce stands in Minnesota has been estimated at as much as 11 percent, which would involve approximately 154,000 acres of commercial black spruce type.

Damage

The losses from dwarf mistletoes are not only measured by mortality but also growth reduction, poorer quality, less seed production, wind breakage and predisposition to insects and decay.

Etiology

There are more than 20 species of dwarf mistletoes. Most of these occur in North America. Areas containing the highest concentrations of different species are in Durango, Mexico and in the Mt. Shasta area of northern California.

Parasite

Dwarf mistletoes are seed plants belonging to the genus *Arceuthobium* of the family *Loranthaceae*. The ovoid olive-green to dark-blue fruits or berries, each containing a single seed are embedded in a mucilaginous pulp called viscin. On ripening the berries develop a considerable inside pressure, which increases until a slight disturbance causes them to explode. The seeds are expelled an average horizontal distance of about 15-30 feet. Seeds shooting from branches of trees may have a dispersal radius of 100-200 feet, depending on height of origin and, to a certain extent, wind. New infection centers probably result from seed dissemination by birds on which the seed adhere and is carried. The seeds may germinate within a few weeks or, as is true for most species, germination is delayed until the following spring. After germinating, the radicle comes in contact with the needle fasicle or other irregularity in the bark surface where a holdfast forms and the primary haustorium penetrates the bark.

Once established in the cortex of its host the parasite develops a more extensive absorption system, a portion of which is gradually included in the xylem of the host as a result of the xylem growing around structures called sinkers. Vessel elements in these sinkers connect with tracheids in the host xylem, and the parasite derives most of its nourishment from the host.

Symptoms

The most apparent symptom of the disease is the stimulated growth and malformation of the tree at the site of infection. These bushy, compact masses of branches and twigs are called "witches' brooms" and may grow to several feet in diameter (Figure 4). A less conspicuous symptom is a swelling of the branch at the branch at the point of infection.

Brooms develop and grow rapidly for 5 to 10 years. Aerial shoots are usually present on infected branches 3 years following initial infection. On older portions of branches where aerial shoots have died, basal cups remain. These basal cups are not only an important characteristic in identifying older brooms but also, along with aerial shoots, help distinguish this disease from spruce broom rust, Chrysomyxa arctostaphyli.

Control

Eradication is one possible method of reducing losses caused by dwarf mistletoe. The most practical means of eradication is to clear cut infection centers as part of a logging operation followed by prescribed burning to eliminate latent infections. In black spruce in Minnesota, clear cutting infected trees and 1-2 chains into the surrounding healthy trees may be effective. Infected trees should not be cut during the seed dispersal season. Because of latent infections it is necessary to re-examine control areas at 5 year intervals. In harvesting stands with dwarf mistletoe it is advisable to have the cut over area surrounded by healthy trees. In high value stands and where the amount of infection is light, pruning may be feasible. Infected branches should be removed allowing 6 inches between swelling and main stem for small branches and 12 inches for larger branches.

Chemical and biological controls are of only limited value at present but have some promise for the future. Chemical controls such as the use of herbicides have not killed the entire parasite without killing the host. Some fungi that are parasitic on the mistletoe itself, as well as insects, birds and mammals reduce the amount of seed available for dispersal but their total effect is localized and usually not significant. No serious attempt has been made to use some of the fungi, such as Colletotrichum gloeosporioides, Septogloeum gillii and Wallrothiella arceuthobii, in controlling dwarf mistletoe. Among the many insects that attack mistletoe plants those that may reduce amount of seed are a spittlebud (Clastoptera obtusa), a plant bug (Neoborella tumida) and larvae of certain species of Lepidoptera.

ARMILLARIA ROOT ROT (*ARMILLARIA MELLEA*) ON JACK PINE (*PINUS DIVARICATA*)

Introduction

Jack pine is a species mainly of the northeast and Lake States, and thrives on light, sandy soils in the heavy snow country. It extends farthest north of all the North American pines, and is almost transcontinental in its range. In the Lake States jack pine attains its potential and grows to a sizable tree of good form.

The fungus causing the rot root on jack pine is *Armillaria mellea* (Figure 3). This disease is one of the more common in our forests. In Minnesota, losses in red pine have been as high as 45%.

Damage

The fungus does not cause disease of thrifty trees, and, since there are strains and races within the species, any susceptibility rating is uncertain. Its attacks are not often of an epidemic nature, although during and after periods of drought they occasionally may appear to be, due to the predisposition of the trees because of insufficient moisture. Trees of all ages, from seedlings to overmature individuals, are attacked by this fungus but the damage is likely to be more severe on older or weakened trees. Trees infested by defoliating or bark-boring insects, infested by other fungi, injured by lightning, or weakened in any other way are commonly attacked by *Armillaria mellea*. The disease is most prevalent in plantations because artificially reproduced stands in general are growing under unnatural conditions. In addition to killing, loss also results from the fungus causing butt rot in trees of merchantable size.

Etiology

The fungus attacks the root systems of trees and the success of the fungus depends probably on the condition of the host as well as the amount and kind of inoculum. Initial infection can result from basidiospores which are wind disseminated but undoubtedly the fungus is so well-distributed that it already exists in many stands in the form of mycelium or as rhizomorphs. The fungus can grow through the soil between trees in the form of rhizomorphs and as mycelium can move from root to root when these are in close contact.

Life History

In general the fungus lives as a saprophyte on stumps and roots of dead trees, particularly roots with high carbohydrate content, but often becomes parasitic. The fructifications (honey mushrooms) develop in clusters on stumps at the base or on the butt of dead and dying trees, or on the ground coming up from infected roots. It is on these mushrooms that the basidiospores are borne.

After the fungus has developed for some time in a stump or dead tree, rhizomorphs are formed. These are of two kinds - subcortical and subterranean or free - both of which grow in length apically. These rhizomorphs consist of a dark-brown outer layer of closely compacted fungous tissue enclosing a central core of hyaline hyphae arranged in longitudinal rows. Subterranean rhizomorphs grow through the soil close to the surface, and are the usual, if not the only, means by which living trees are infected. The subcortical rhizomorphs are flattened black anastomosing structures formed beneath the bark and wood. Penetration of the rhizomorphs seem to be a combination of mechanical and chemical means, since several enzymes are secreted.

Symptoms

The fungus forms mats of mycelium called mycelial fans in the inner bark and between the bark and sapwood of the infected roots, and mycelium may extend to a height of several feet in the phloem and cambium of the trunk. These fans of mycelium are an unmistakable indication of the presence of the fungus. The mycelium does not grow as abundantly under the bark of some hardwoods as in pines, but often in hardwoods a network of rhizomorphs is found between the wood and the bark. These rhizomorphs are reddish-brown to black in color and may be somewhat round or flattened depending on whether they are growing beneath the bark or are outside of roots. Resin is exuded by the infected roots of the pines and some other conifers and solidifies in the soil, causing masses of soil to adhere to the roots. The fruit bodies are mushrooms which have a central stem and ring (which sometimes disappears quickly), and white spores (normally very evident on the caps of the mushrooms and surrounding vegetation). The cap and stem usually are honey colored, although the color varies considerably. Fruit bodies are produced in the fall in clumps around the stumps of infected trees, and above decayed roots; 500 fruit bodies were found in an area 12 feet square around stumps in a hardwood stand in central Minnesota, which indicates the prolific fruiting of the fungus.

The crown of an attacked tree may die either gradually, one limb at a time or rather suddenly, depending on the extent of injury to the roots and the abundance of water. If there is sufficient water, the crown of a tree may remain green and apparently alive for a year or two after practically all of the roots have been killed by the fungus, but it is likely to die suddenly when the water supply becomes insufficient. This is the reason that periods of drought accentuate the damage done by the fungus. Bark beetles frequently attack coniferous trees after they have been weakened by root rot, and the death of the trees may be ascribed to the beetles, whose presence often is obvious, rather than to the fungus, the presence of which is not always so easy to detect. Naturally it sometimes is very difficult to find the exact cause of death of a tree which has been attacked by root rotting fungi or bark beetles and subjected to drought or other unfavorable growing conditions. Young pines affected by A. mellea turn color, to an off-green, growth stops and the entire tree seems to die uniformly. Reduced leaders and poor color indicate the presence of root rot.

Control

No control measures are known though it is reasonable to avoid or delay planting on sites originally occupied by oaks, aspen and other trees on which large amounts of inoculum can develop. Certain sites may result in conifers being predisposed to infection by A. mellea and possibly these sites should be in hardwood species. Chemical controls which indicate some success in the laboratory have not been tested in the field and thus none are available at this time.

SPRUCE BUDWORM (*CHORISTONEURA FUMIFERANA*) ON BLACK SPRUCE (*PICEA MARIANA*)

Introduction

The spruce budworm probably has been the most serious insect pest of the fir and spruce forests of eastern North America, and also on Douglas fir and white fir forests in the West. It is a native species and is distributed throughout practically the entire range of its food plants on this continent. Outbreaks have occurred at irregular intervals and usually have extended over a long period of years in a region. In Maine serious outbreaks on record began in about 1807 and again in 1878, causing enormous mortality of balsam fir and spruce. One of the most serious outbreaks on record began in northern Quebec about 1909. This spread southward through New Brunswick to Nova Scotia and into northern Maine. A similar outbreak occurred in northeastern Minnesota between 1912 and 1925.

More recent outbreaks occurred in the western part of the United States and Canada, and in Quebec and Ontario. Infestations of less intensity exist in Maine, New Brunswick, and the Lake States.

Hosts

In the Lake States the insect shows preference for Scotch pine, jack pine, larch, and black spruce.

Nature of Injury

In the spring the larvae first mine old needles, and later bore into swelling vegetative buds. At this time the budworm may also feed on staminate flowers. The larvae continue to feed on the expanding buds and web together those at the tips of the branches. This allows the larvae to move freely between expanding buds and shoots without exposure. New growth is preferred and is entirely destroyed before the old foliage is eaten. Defoliation is usually heaviest on the upper portion of the tree; in a severe infestation the tree commences to die at the top. The trees in a heavy infestation become scorched in appearance at first, later turning grayish as the brown, webbed foliage disappears. See Figure 6.

In general the intensity of feeding by the budworm on its food plant is directly related to the time of opening of the buds and development of the new growth. Black spruce with its late and slow growing shoots suffers less from budworm attacks than red spruce and balsam fir.

In the Lake States Scotch pine is more susceptible to attack than jack pine, and red pine and white pine are much less susceptible to attack than jack pine. In jack pine the heaviest infestations occur where they are open-crown trees, or in overmature stands. This is because staminate flowers are most abundant on such trees and the young larvae are dependent on this food source until new foliage emerges.

After three or four years of severe defoliation some tree mortality occurs, and some trees will die one or more years after budworm infestation has subsided. Secondary insects and fungi may play an important role in killing trees weakened by heavy defoliation.

Life Cycle

The moths are active in the Lake States during July and early in August. The eggs hatch in from 7 to 10 days, and the young larvae crawl about until they find a suitable place to spin tiny silken cases in which they overwinter. The larvae become active in the spring generally just prior to budbreak. The larvae mine into old needles and then feed on new growth. These larvae become fully grown in June and pupate among the loose silken webs on the twigs.

Control

Natural Control: Adverse weather conditions, diseases, predators, and many species of insect parasites normally play an important role in the control of this pest. When conditions are favorable for its increase, however, the combined effects of all natural enemies do not prevent outbreaks.

Forest Management: The following are suggestions for preventing serious budworm injury in spruce-fir forests.

(1) Removal of overmature, slow-growing stands of fir.

(2) Utilize fir on a short-term rotation to avoid slow-growing stands.

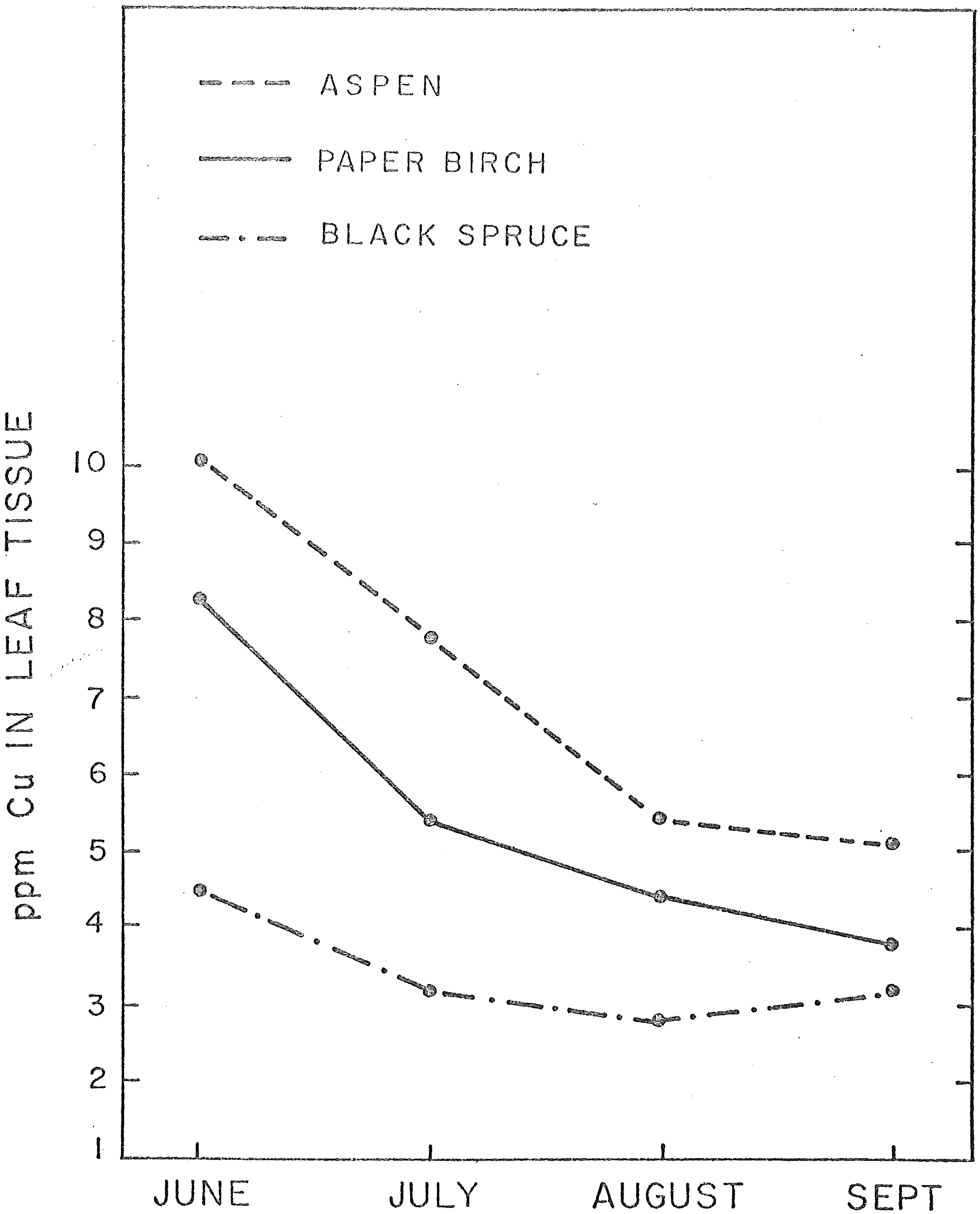
(3) Develop mixed hardwood - softwood stands if possible.

Direct Control: Good results can be obtained with sprays if application is made when larvae are feeding on expanding new growth, at which time the larvae are more exposed. This normally occurs during the last two weeks in June.

3. Foliar tissue chemical and statistical analyses data.

Figure 8.

Average foliar concentrations of copper in some plant species and ~~its~~ their relationship to temporal changes.



ASPEN
PAPER BIRCH
BLACK SPRUCE
ppm Cu IN LEAF TISSUE
10
9
8
7
6
5
4
3
2
1
JUNE
JULY
AUGUST
SEPT

Figure 9.

Average foliar concentrations of iron in some plant species and its relationship to temporal changes.

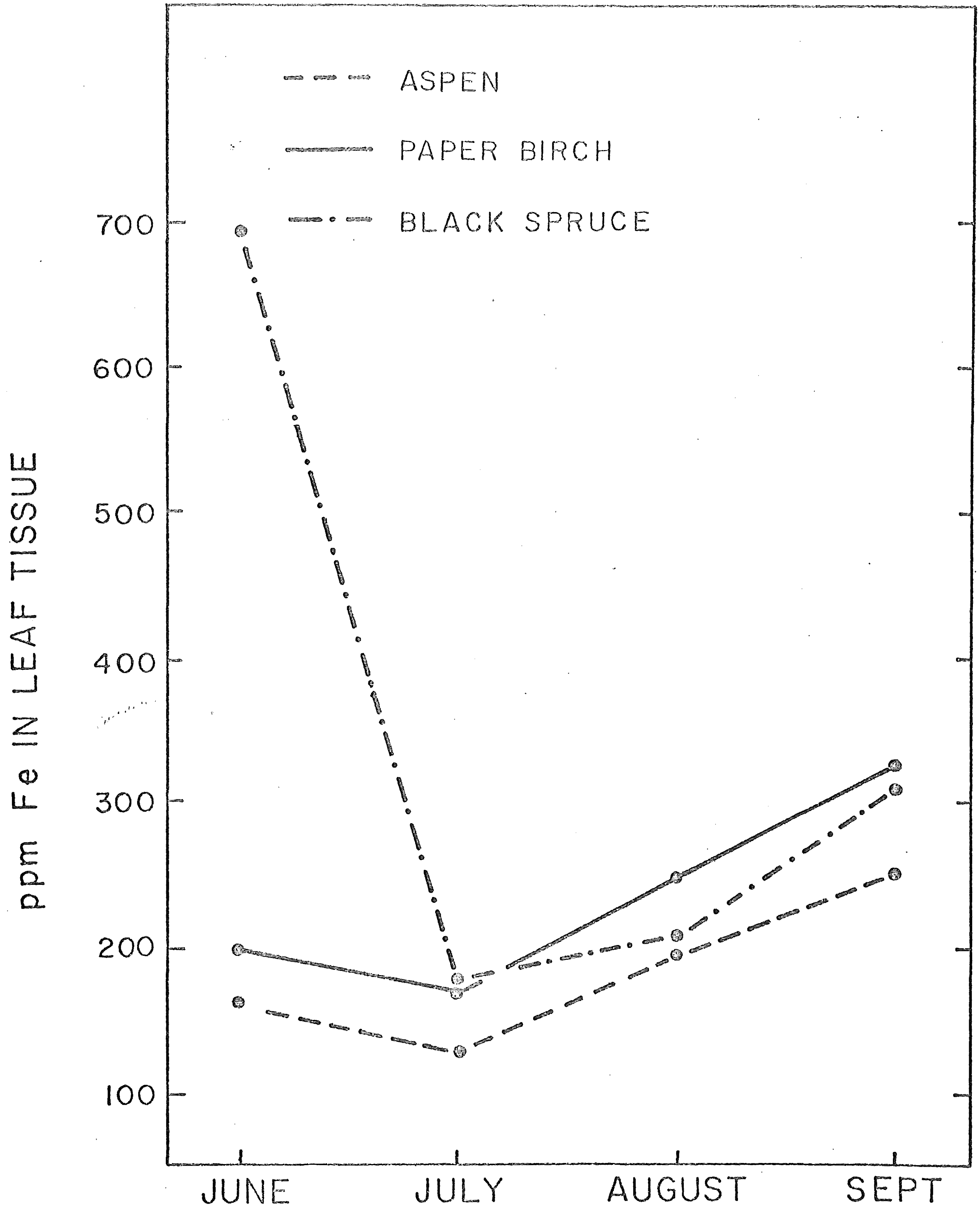
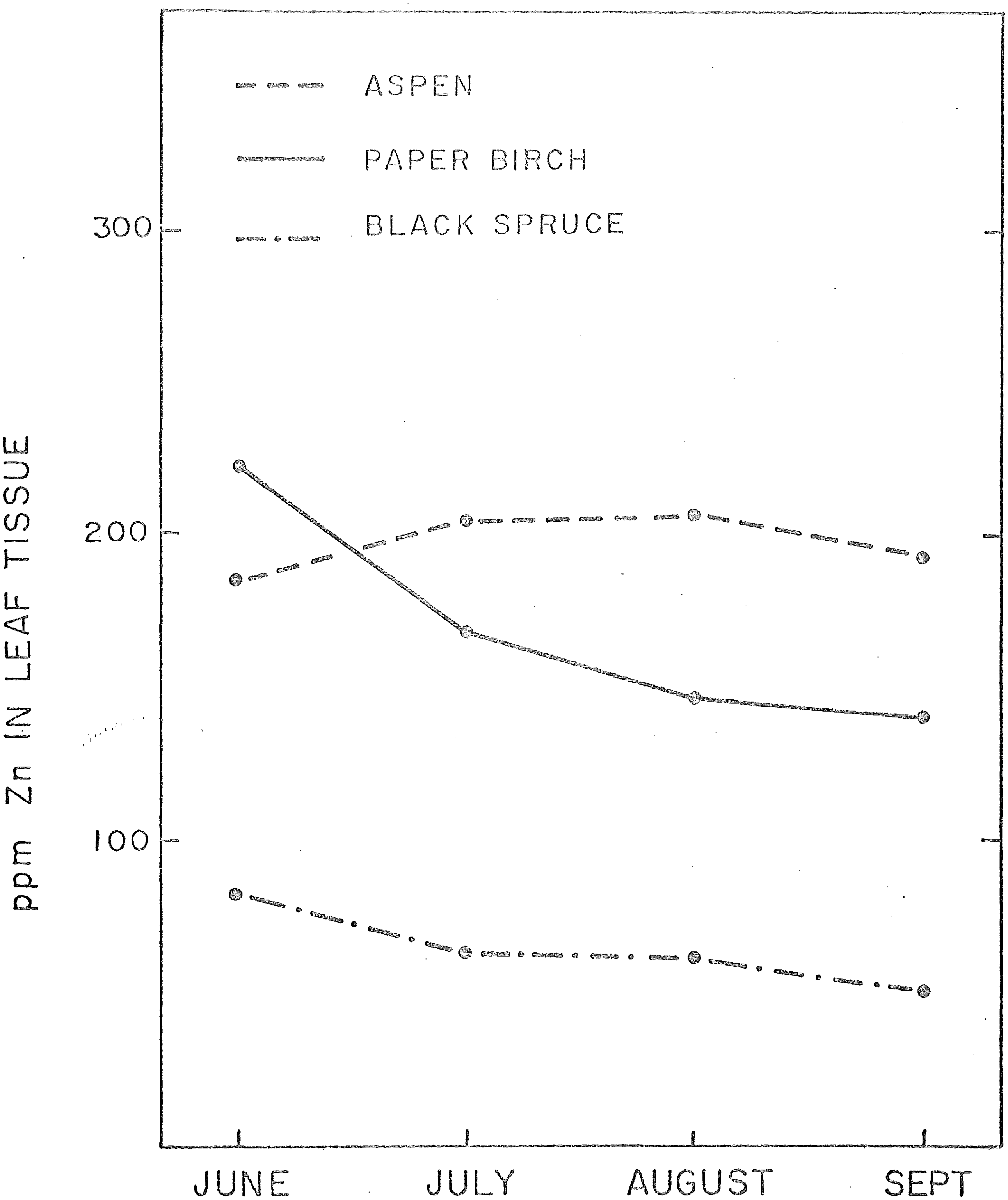

ASPEN
PAPER BIRCH
BLACK SPRUCE
700
600
500
400
300
200
100
ppm Fe IN LEAF TISSUE
JUNE
JULY
AUGUST
SEPT

Figure 10.

Average foliar concentrations of zinc in some plant species and its relationship to temporal changes.



ASPEN
PAPER BIRCH
BLACK SPRUCE
300
200
100
ppm Zn IN LEAF TISSUE
JUNE
JULY
AUGUST
SEPT

Table 2. Foliar elemental composition of selected tree species showing either a temporal or spatial variation significant at the 0.05 confidence level (arranged by tree species).

		Significant Variation	
Species	Element	Temporal	Spatial
Jack Pine	Mg	-	+
	Mn	+	-
Red Pine	K	+	-
	Mn	-	+
	B	-	+
	Ni	+	+
Black Spruce	P	+	+
	Ca	+	+
	Al	+	-
	Fe	+	+
	Mg	-	+
	Zn	+	-
	Mn	+	+
	B	+	+
Paper Birch	P	+	+
	K	+	+
	Ca	-	+

Table 2. (continued)

		Significant Variation	
Species	Element	Temporal	Spatial
Paper Birch (cont.)	Al	+	+
	Fe	+	+
	Mg		+
	Zn	+	+
	Cu	+	
	B	+	+
	S	+	
	Ni	+	+
Balsam Fir	P	+	+
	K		+
	Zn		+
	Mn	+	+
	S	+	+
	Ni	+	
Aspen	P	+	
	K	+	
	Ca	+	
	Al	+	+
	Fe	+	+
	Zn		+

Table 2. (continued)

		Significant Variation	
Species	Element	Temporal	Spatial
Aspen	Cu	+	
(cont.)	B	+	+
	S	+	+
	Ni		+
Tamarack	P		+
	K	+	
	Ca	+	
	Al	+	+
	Fe	+	+
	Cu	+	
	Mn		+
	B		+
	Pb	+	

Table 3. Elements in vegetation of selected tree species showing either temporal or spatial variation significant at the 0.05 confidence level (arranged by element).

Element	Temporal	Spatial
Phosphorus	B. Spruce	B. Spruce
	P. Birch	P. Birch
	B. Fir	B. Fir
	Aspen	-
	-	Tamarack
Potassium	R. Pine	-
	P. Birch	P. Birch
	-	B. Fir
	Aspen	-
	Tamarack	-
Calcium	B. Spruce	B. Spruce
	-	P. Birch
	Aspen	-
	Tamarack	-
Aluminium	B. Spruce	-
	P. Birch	P. Birch
	Aspen	Aspen
	Tamarack	Tamarack

Table 3. (continued)

Element	Temporal	Spatial
Iron	B. Spruce	B. Spruce
	P. Birch	P. Birch
	Aspen	Aspen
	Tamarack	Tamarack
Magnesium	-	J. Pine
	-	B. Spruce
	-	P. Birch
Zinc	B. Spruce	-
	P. Birch	P. Birch
	-	B. Fir
	-	Aspen
Copper	P. Birch	-
	Aspen	-
	Tamarack	-
Manganese	J. Pine	-
	B. Spruce	B. Spruce
	B. Fir	B. Fir
	-	Tamarack

Table 3. (continued)

Element	Temporal	Spatial
Boron	-	R. Pine
	B. Spruce	B. Spruce
	P. Birch	P. Birch
	Aspen	Aspen
	-	Tamarack
Sulfur	P. Birch	-
	B. Fir	B. Fir
	Aspen	Aspen
Lead	Tamarack	-
Nickel	R. Pine	R. Pine
	P. Birch	P. Birch
	B. Fir	-
	-	Aspen

Conclusion

A summary of the significant variation ($P < 0.05$) from the analysis of variance of elements in the vegetation of selected tree species is presented in Tables 2 and 3. The variation is classed as spatial (variation between stands of a given tree species) or temporal (variation occurring from month to month over the growing season).

Approximately 33% of the tree species-element combinations showed a significant ($P < .05$) temporal variation and 32% showed a significant ($P < .05$) spatial variation. In 18% of the tree species-element combinations significant variation occurred both temporally and spatially.

Table 2 lists variation of elements by tree species. The deciduous broad-leafed trees, aspen and paper birch, had the greatest number of elements showing significant variation, 10 and 11 respectively, whereas the dry land conifers, jack pine and red pine, had the least number of elements showing significant variation, 2 and 4 respectively.

Table 3 lists variations of elements in vegetation by element. Lead, a metabolically inactive heavy metal, showed the least variation in leaf tissue, a significant temporal variation occurring only in tamarack. Concentration of copper in birch, aspen and tamarack showed a significant temporal variation, but no spatial variation whereas magnesium in jack pine, black spruce and birch showed a significant spatial variation, but no temporal variation.

The metabolically active elements, phosphorus, potassium, calcium and iron all showed a high variation both temporally and spatially for many of the tree species sampled.

The information presented in the report indicates that heavy metal concentrations in leaf tissue of the major tree species in the proposed Copper-Nickel mining regions in northern Minnesota vary widely between species and within species, both temporally and spatially. Although the limits of this variation in metal concentrations in leaf tissue have been defined in this report, consideration of the weather conditions in northern Minnesota during the summer of 1976 must be realized. Therefore the results of the elemental analysis of vegetation and soil cannot represent the typical and natural (background) characteristics of the vegetation and soil.

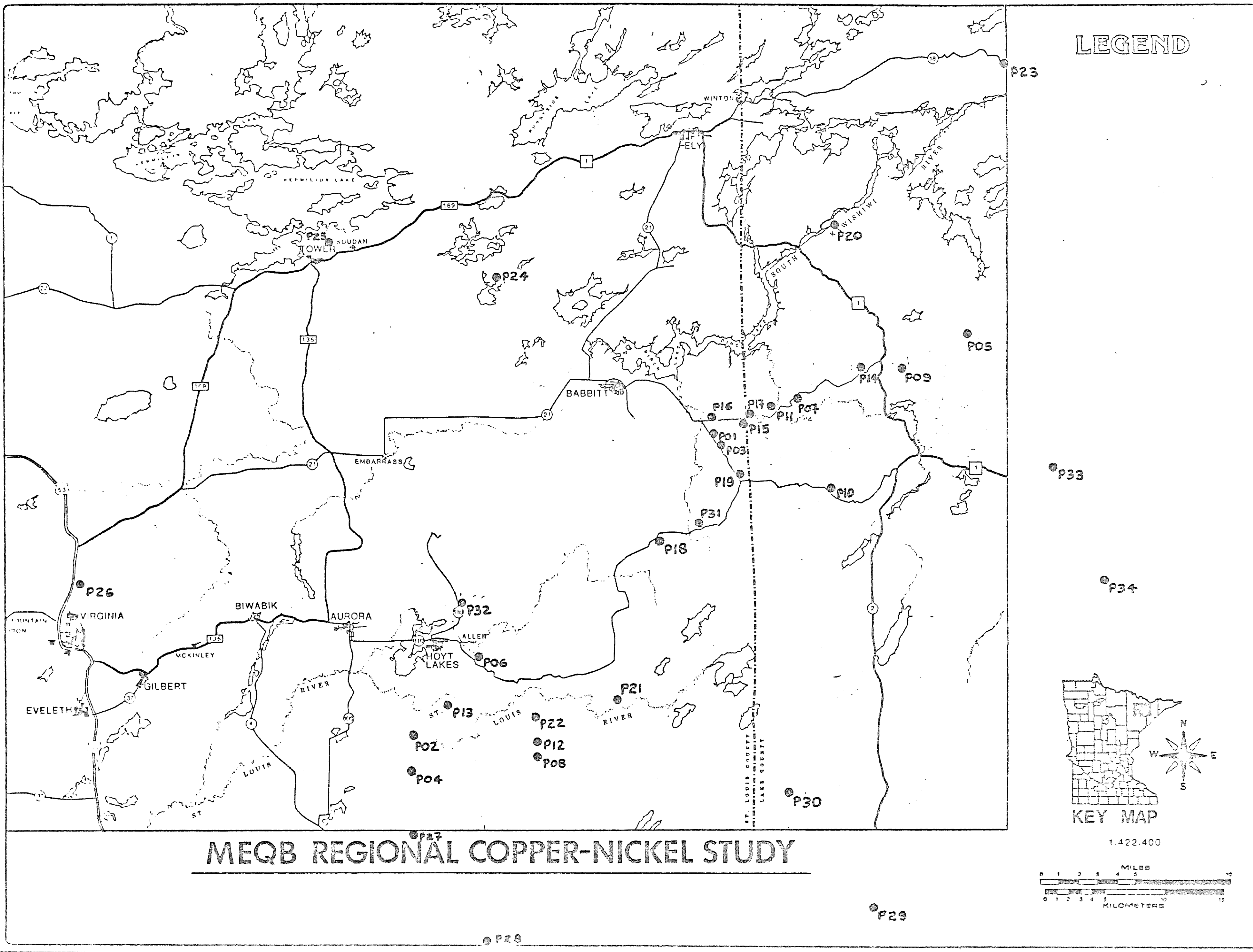
TABLE OF CODES

Plot #'s	1 through 32
JP	jack pine
WP	white pine
RP	red pine
BSP or BS	black spruce
PBR or BR	paper birch
AS or A	aspen
GR	grass
BF	balsam fir
T	tamarack

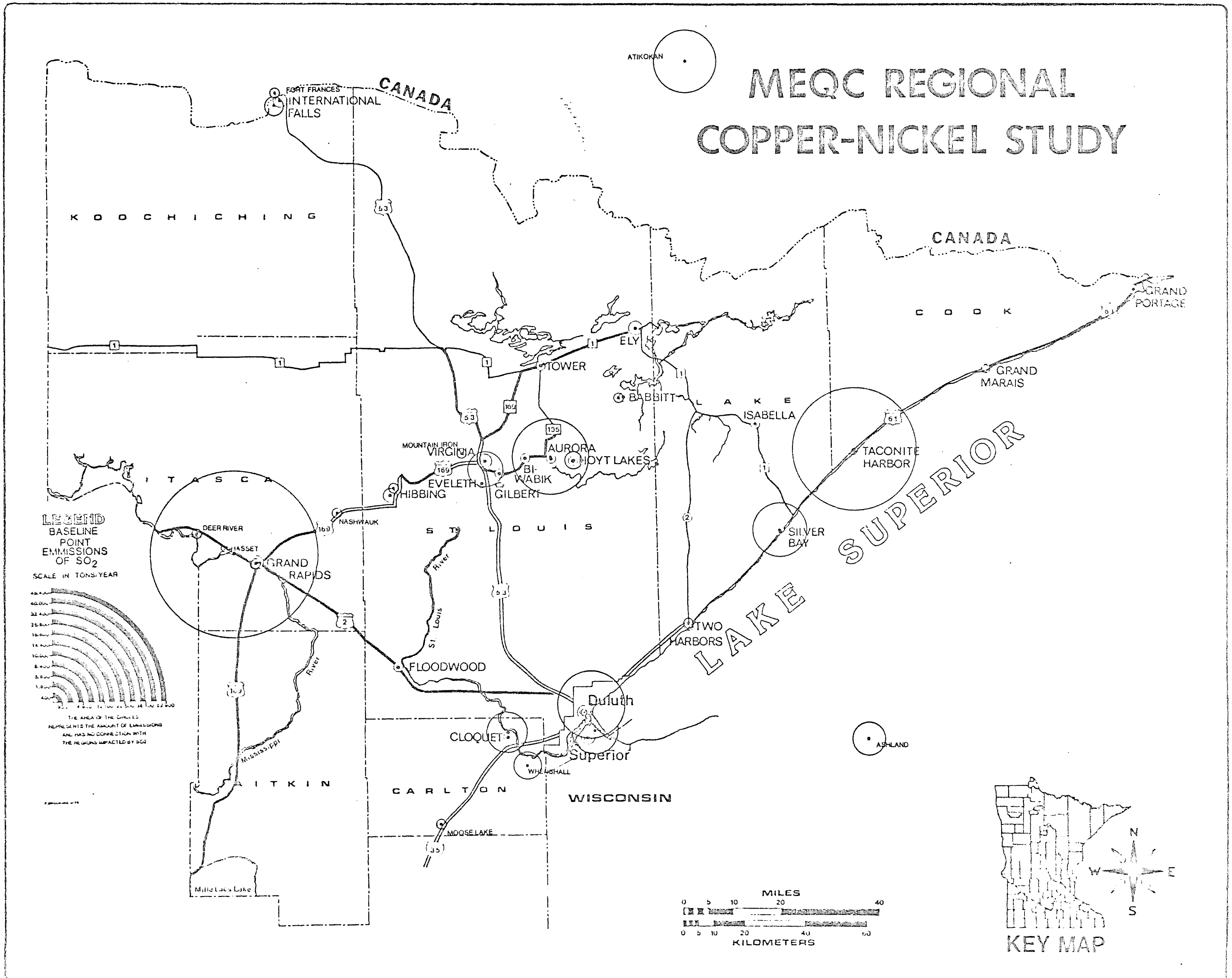
1976 Plant Pathology Sample Sites

Plot	Location*
P01	SW/SW, Sec. 14, T.60N-R.12W.
P02	NE/NE, Sec. 7, T.57N-R.14W.
P03	NW/SW, Sec. 23, T.60N-R.12W.
P04	NE/SE, Sec. 18, T.57N-R.14W.
P05	NE/NE, Sec. 26, T.61N-R.10W.
P06	SE/SE, Sec. 15, T.58N-R.14W.
P07	NE/NW, Sec. 9, T.60N-R.11W.
P08	SE/SW, Sec. 8, T.57N-R.13W.
P09	E/SE, Sec. 32, T.61N-R.10W.
P10	NW/NE, Sec. 3, T.59N-R.11W.
P11	SE/SE, Sec. 7, T.60N-R.11W.
P12	SE/SE, Sec. 31, T.58N-R.13W.
P13	SW/NW, Sec. 33, T.58N-R.14W.
P14	NE/SW, Sec. 31, T.61N-R.11W.
P15	NW/SW, Sec. 18, T.60N-R.11W.
P16	NE/NW, Sec. 12, T.60N-R.12W.
P17	SE/NE, Sec. 18, T.60N-R.11W.
P18	SE/NE, Sec. 18, T.59N-R.12W.
P19	NW/NE, Sec. 36, T.60N-R.12W.
P20	SE/NW, Sec. 26, T.62N-R.11W.
P21	SE/NW, Sec. 36, T.58N-R.13W.
P22	SE/SE, Sec. 6, T.57N-R.13W.
P23	NE/SW, Sec. 8, T.63N-R.9W.
P24	NW/SW, Sec. 1, T.61N-R.14W.
P25	NE/SE, Sec. 27, T.62N-R.15W.
P26	SW/SE, Sec. 25, T.59N-R.17W.
P27	NW/NE, Sec. 6, T.56N-R.14W.
P28	SE/NE, Sec. 3, T.55N-R.14W.
P29	NW/SE, Sec. 24, T.56N-R.11W.
P30	SE/SW, Sec. 21, T.57N-R.11W.
P31	SW/SW, Sec. 10, T.59N-R.12W.
P32	SW/SW, Sec. 34, T.58N-R.14W.
P33	NE/SE, Sec. 26, T.60N-R.9W.
P34	NW/NW, Sec. 32, T.59N-R.8W.

* 40 acre locations are approximate



MEQB REGIONAL COPPER-NICKEL STUDY



MEQC REGIONAL
COPPER-NICKEL STUDY
CANADA
CANADA
ATIKOKAN
FORT FRANCES
INTERNATIONAL FALLS
KOOCHICHING
ITASCA
ST LOUIS
LAKE
COOK
AITKIN
CARLTON
WISCONSIN
LAKE SUPERIOR
ELY
TOWER
BABBITT
ISABELLA
GRAND PORTAGE
GRAND MARAIS
TACONITE HARBOR
SILVER BAY
TWO HARBORS
MOUNTAIN IRON
VIRGINIA
AURORA
HOYT LAKES
BIWABIK
EVELETH
GILBERT
HIBBING
NASHWAUK
DEER RIVER
COHASSET
GRAND RAPIDS
FLOODWOOD
Duluth
Superior
CLOQUET
WRENSHALL
MOOSE LAKE
ASHLAND
Mille Lacs Lake
Mississippi
River
St. Louis River
LEGEND
BASELINE POINT EMMISSIONS OF SO_2
SCALE IN TONS/YEAR
MILES
0 5 10 20 40
0 5 10 20 40 60
KILOMETERS
KEY MAP
N
S
E
W

Element: Zn
Date: June

Plot	Abi balsam. 74 (3) 15.5%	Betula papyrif. 224 (6) 6.5%	Gramin. 51 (1)	Larix laricin. 55 (3) 12.8%	Picea glauca 128 (1)	Picea mariana 83 (4) 2.3%	Pinus banksiana 85 (2) 9.5%	Pinus resinosa 56 (3) 11.6%	Pinus strobus 85 (1)	Populus tremulo. 185 (8) 7.3%	Thuja occident. 30 (1)	
P01							75					P01
P02									85			P02
P03								44				P03
P04								65				P04
P05						84						P05
P06						78						P06
P07		216										P07
P08		246										P08
P09		222										P09
P10	72											P10
P11										171		P11
P12						87						P12
P13										262		P13
P14						81						P14
P15				44								P15
P16				67								P16
P17											30	P17
P18	55											P18
P19							94					P19
P20										151		P20
P21			51									P21
P22										150		P22
P23												P23
P24		281										P24
P25	94											P25
P26					128							P26
P27										199		P27
P28								58				P28
P29										172		P29
P30				53								P30
P31		186										P31
P32										213		P32
P33										164		P33
P34		191										P34

All except aspen w. white cedar show decline between spring and fall, the last two show an increase. [illegible]

Paper birch at P31 is consistently below the average.

Element: Zn

Date: July

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	[illegible]	168 (6) 17.5%	[illegible] (1)	42 (3) [illegible]%	105 (1)	62 (4) 5.9%	73 (2) 4.1%	52 (3) 8.9%	[illegible] (1)	194 (9) 8.5%	[illegible] (1)	
P01							76					P01
P02									71			P02
P03								49				P03
P04								61				P04
P05						65						P05
P06						71						P06
P07		158										P07
P08		184										P08
P09		169										P09
P10	58											P10
P11										197		P11
P12						54						P12
P13										283		P13
P14						59						P14
P15				35								P15
P16				51								P16
P17											33	P17
P18	50											P18
P19							70					P19
P20										197		P20
P21			54									P21
P22										155		P22
P23										132		P23
P24		252										P24
P25	86											P25
P26					105							P26
P27										233		P27
P28								47				P28
P29										187		P29
P30				44								P30
P31		94										P31
P32										143		P32
P33										248		P33
P34		152										P34

Element: Zn
Date: August

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	64 (3)	164 (6)	30 (1)	51 (3)	107 (1)	61 (4)	70 (2)	45 (3)	58 (1)	198 (9)	40 (1)	
	7.0%	9.0%		9.2%		9.3%	2.9%	2.7%		11.9%		
P01							68					P01
P02									58			P02
P03								44				P03
P04								47				P04
P05						53						P05
P06						56						P06
P07		168										P07
P08		187										P08
P09		164										P09
P10	59											P10
P11										230		P11
P12						58						P12
P13										351		P13
P14						78						P14
P15				47								P15
P16				60								P16
P17											40	P17
P18	60											P18
P19							72					P19
P20										195		P20
P21			30									P21
P22										139		P22
P23										122		P23
P24		208										P24
P25	73											P25
P26					107							P26
P27										200		P27
P28								43				P28
P29										159		P29
P30				45								P30
P31		101										P31
P32										144		P32
P33										241		P33
P34		154										P34

Element: Zn

Date: September

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricina	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	64 (3)	134 (6)	30 (1)	51 (1)	107 (1)	62 (4)	70 (2)	45 (3)	58 (1)	198 (9)	40 (1)	
	4.6%	18.1%		1.2%		9.1%	2.9%	2.7%		11.9%		
P01							68					P01
P02									58			P02
P03								44				P03
P04								47				P04
P05						53						P05
P06						56						P06
P07		168										P07
P08		187										P08
P09		164										P09
P10	59											P10
P11										231		P11
P12						59						P12
P13										351		P13
P14						78						P14
P15				47								P15
P16				60								P16
P17											40	P17
P18	60											P18
P19							72					P19
P20										195		P20
P21			30									P21
P22										139		P22
P23										122		P23
P24		208										P24
P25	73											P25
P26					107							P26
P27										200		P27
P28								43				P28
P29										159		P29
P30				45								P30
P31		101										P31
P32										144		P32
P33										241		P33
P34		154										P34

Element: Cu

Date: June

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	4.4(3) [illegible]	8.[illegible](5) [illegible]	7.[illegible](1)	6.6([illegible]) 7.3%?	3.9(1)	4.6(4) 10.[illegible]%	[illegible] 100%?	3.0([illegible]) 9.[illegible]%	4.3(1)	10.1(8) [illegible]%	2.5(1)	
P01							3.9					P01
P02									4.3			P02
P03								2.8				P03
P04								3.4				P04
P05						2.8						P05
P06						6.8						P06
P07		7.8										P07
P08		8.4										P08
P09		8.0										P09
P10	4.9											P10
P11										11.4		P11
P12						4.3						P12
P13										12.0		P13
P14						4.3						P14
P15				6.9								P15
P16				7.3								P16
P17											2.5	P17
P18	4.3											P18
P19							? > 0					P19
P20										8.7		P20
P21			7.3									P21
P22										9.1		P22
P23												P23
P24		8.9										P24
P25	4.4											P25
P26					3.9							P26
P27										9.8		P27
P28								2.7				P28
P29										8.7		P29
P30				5.7								P30
P31		7.3										P31
P32										6.9		P32
P33										14.1		P33
P34		9.4										P34

Temporal variations are observed in birch, grass, tamarack, aspen and possibly white pine

Element: Cu

Date: July

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	[illegible]	5.4([illegible])	3.2(1)	[illegible]	3.2(1)	3.2(4)	4.0(2)	[illegible](3)	3.[illegible](1)	8.[illegible]([illegible])	2.3(1)	
	[illegible]%	[illegible]%		[illegible]		12.0%	2.5%	[illegible]%		7.6%		
P01							4.1					P01
P02									3.9			P02
P03								? > 0				P03
P04								2.5				P04
P05						2.2						P05
P06						3.0						P06
P07		4.1										P07
P08		4.6										P08
P09		5.3										P09
P10	4.3											P10
P11										8.3		P11
P12						3.9						P12
P13										8.7		P13
P14						3.7						P14
P15				4.1								P15
P16				4.1								P16
P17											2.3	P17
P18	4.3											P18
P19							3.9					P19
P20										8.3		P20
P21			3.2									P21
P22										7.4		P22
P23										12.6		P23
P24		5.7										P24
P25	3.7											P25
P26					3.2							P26
P27										8.0		P27
P28								3.7				P28
P29										6.6		P29
P30				4.8								P30
P31		7.3										P31
P32										8.9		P32
P33										5.9		P33
P34		5.5										P34

Element: Cu

Date: August

Plot	Abies balsam.	Betula papyrif.	Gravenia	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	[illegible]9(3) 10.1%	4.4(6) 6.7%	0 (1)	3.8(3) 16.2%	2.9(1)	2.8(4) [illegible]%	3.8(2) [illegible]%	3.1(3) [illegible]%	3.8(1)	5.6(9) [illegible]%	2.5(1)	
P01							4.7					P01
P02									3.8			P02
P03								3.1				P03
P04								3.1				P04
P05						2.3						P05
P06						3.2						P06
P07		4.0										P07
P08		5.6										P08
P09		4.4										P09
P10	4.1											P10
P11										5.2		P11
P12						3.2						P12
P13										5.6		P13
P14						2.5						P14
P15				3.1								P15
P16				3.2								P16
P17											2.5	P17
P18	4.4											P18
P19							2.8					P19
P20										4.7		P20
P21			? > 0									P21
P22										5.6		P22
P23										6.7		P23
P24		4.1										P24
P25	3.1											P25
P26					2.9							P26
P27										6.4		P27
P28								3.1				P28
P29										5.2		P29
P30				5.0								P30
P31		3.5										P31
P32										6.7		P32
P33										4.3		P33
P34		4.7										P34

Element: Cu [illegible]

Date: September

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	14.1%	5.5%		11.1%		11.6%	?%	3.0%		6.6%		
P01							4.0					P01
P02									2.9			P02
P03								2.7				P03
P04								3.0				P04
P05						2.6						P05
P06						3.7						P06
P07		3.4										P07
P08		4.1										P08
P09		3.4										P09
P10	5.0											P10
P11										4.0		P11
P12						4.1						P12
P13										4.7		P13
P14						2.6						P14
P15				2.6								P15
P16				3.2								P16
P17											2.20	P17
P18	3.0											P18
P19							4.1					P19
P20										4.7		P20
P21			2.3									P21
P22										6.1		P22
P23										5.9		P23
P24		3.7										P24
P25	4.0											P25
P26					3.5							P26
P27										5.5		P27
P28								2.9				P28
P29										3.8		P29
P30				4.6								P30
P31		3.7										P31
P32										7.0		P32
P33										5.0		P33
P34		4.7										P34

Element: Mn
Date: June

Plot	Abies ba.	Betula papyrif.	Gramin.	Larix laricina	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	[illegible] 7.3%	[illegible] 15.2%	111 (1)	[illegible] .4%	[illegible]	[illegible] 17.[illegible]	[illegible] 52.1%	[illegible]	[illegible]	78 (9) 11.0%	113 (1)	
P01							474					P01
P02									260			P02
P03								343				P03
P04								507				P04
P05						791						P05
P06						916						P06
P07		512										P07
P08		400										P08
P09		890										P09
P10	604											P10
P11										114		P11
P12						688						P12
P13										106		P13
P14						480						P14
P15				451								P15
P16				1098								P16
P17											113	P17
P18	739											P18
P19							148					P19
P20										62		P20
P21			111									P21
P22										87		P22
P23												P23
P24		773										P24
P25	772											P25
P26					359							P26
P27										67		P27
P28								177				P28
P29										59		P29
P30				682								P30
P31		481										P31
P32										~~851~~		P32
P33										63		P33
P34		~~703~~										P34

Sept. values are lower than June for all species except red pine, aspen & white cedar.

P16 shows consistently very high values
P28 is consistently low.
P01 foliage is consistently higher than P19. Soil have the reverse.

Element: Mn

Date: September

Plot	Abies balsam.	Betula papyrif.	Fraxin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	[illegible]	[illegible]	101 (1)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	111 (9)	145 (1)	
P01							330					P01
P02									210			P02
P03								241				P03
P04								274				P04
P05						617						P05
P06						706						P06
P07		595										P07
P08		501										P08
P09		897										P09
P10	393											P10
P11										120		P11
P12						591						P12
P13										147		P13
P14						500						P14
P15				467								P15
P16				1146								P16
P17											145	P17
P18	627											P18
P19							160					P19
P20										106		P20
P21			101									P21
P22										120		P22
P23										94		P23
P24		898										P24
P25	668											P25
P26					366							P26
P27										108		P27
P28								128				P28
P29										103		P29
P30				874								P30
P31		472										P31
P32										92		P32
P33										111		P33
P34		1184										P34

Element: Mn

Date: August

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin	Picea glauca	Picea mariana	Pinus banksian	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja accident.	
P01							313					P01
P02									195			P02
P03								339				P03
P04								309				P04
P05						578						P05
P06						615						P06
P07		699										P07
P08		396										P08
P09		771										P09
P10	409											P10
P11										129		P11
P12						629						P12
P13										140		P13
P14						449						P14
P15				463								P15
P16				1271								P16
P17											120	P17
P18	563											P18
P19							116					P19
P20										84		P20
P21			94									P21
P22										116		P22
P23										82		P23
P24		743										P24
P25	681											P25
P26					394							P26
P27										85		P27
P28								153				P28
P29										82		P29
P30				814								P30
P31		552										P31
P32										90		P32
P33										115		P33
P34		1121										P34

Element: Mn
Date: July

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	[illegible] (3) 1.1%	583 (5)? 11.1%	71 (1)	614 (3)? [illegible]%	312 (1)	564 (3)? 9.9%?	[illegible] (2) 20.9%?	348? [illegible]%	[illegible] (1)	101 (9)? 5.5%?	125 (1)	
P01							407					P01
P02									176			P02
P03								451				P03
P04								448				P04
P05						634						P05
P06						680						P06
P07		508										P07
P08		368										P08
P09		752										P09
P10	473											P10
P11										109		P11
P12						501						P12
P13										135		P13
P14						454						P14
P15				407								P15
P16				816								P16
P17											125	P17
P18	603											P18
P19							132					P19
P20										103		P20
P21			71									P21
P22										107		P22
P23										83		P23
P24		694										P24
P25	602											P25
P26					312							P26
P27										92		P27
P28								145				P28
P29										84		P29
P30				619								P30
P31		471										P31
P32										86		P32
P33										110		P33
P34		732										P34

Element: S

Date: June

105[illegible] 1373(6) 2500(1) 1172(2) [illegible] 853(4) [illegible]

5.5% 5.4% 4.4% [illegible] 6.[illegible]%

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
P01							999					P01
P02									1300			P02
P03								855				P03
P04								803				P04
P05						790						P05
P06						928						P06
P07		1430										P07
P08		1530										P08
P09		1650										P09
P10	1050											P10
P11										2085		P11
P12						897						P12
P13										2210		P13
P14						813						P14
P15				1224								P15
P16				1120								P16
P17											749	P17
P18	973											P18
P19							1135					P19
P20										2275		P20
P21			2500									P21
P22										2260		P22
P23												P23
P24		1140										P24
P25	1175											P25
P26					792							P26
P27										2405		P27
P28								824				P28
P29										2010		P29
P30				~~553~~								P30
P31		1261										P31
P32										2375		P32
P33										1870		P33
P34		1355										P34

Broadleaf species show a clear decline in concentrations during the growing season. Conifers show no such trend.

Element: S

Date: July

Plot	Abies bals	Betula papyrif.	Gravomin.	Larix laricin	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	1197(3)	1380(6)	1850(1)	1267(3)	850(1)	858(4)	1085(2)	910(3)	1400(1)	1791(9)	700(1)	
	4.5%	2.6%		4.6%		5.6%	5.1%	6.5%		4.4%		
P01							1140					P01
P02									1400			P02
P03								810				P03
P04								950				P04
P05						840						P05
P06						860						P06
P07		1160										P07
P08		1420										P08
P09		1360										P09
P10	1170											P10
P11										1970		P11
P12						790						P12
P13										1870		P13
P14						940						P14
P15				1220								P15
P16				1200								P16
P17											700	P17
P18	1120											P18
P19							1030					P19
P20										1680		P20
P21			1850									P21
P22										1900		P22
P23										1280		P23
P24		1510										P24
P25	1300											P25
P26					850							P26
P27										1800		P27
P28								970				P28
P29										1770		P29
P30				1380								P30
P31		1340										P31
P32										2130		P32
P33										1720		P33
P34		1490										P34

Element: S
Date: August

5.0% [illegible]

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
P01							1220					P01
P02									1100			P02
P03								808				P03
P04								846				P04
P05						838						P05
P06						851						P06
P07		1130										P07
P08		1330										P08
P09		1210										P09
P10	1030											P10
P11										1780		P11
P12						739						P12
P13										1710		P13
P14						783						P14
P15				1180								P15
P16				1380								P16
P17											757	P17
P18	961											P18
P19							795					P19
P20										1480		P20
P21			1420									P21
P22										1840		P22
P23										1580		P23
P24		1320										P24
P25	1140											P25
P26					757							P26
P27										1790		P27
P28								872				P28
P29										1510		P29
P30				1290								P30
P31		1290										P31
P32										1850		P32
P33										1620		P33
P34		1290										P34

Element: S

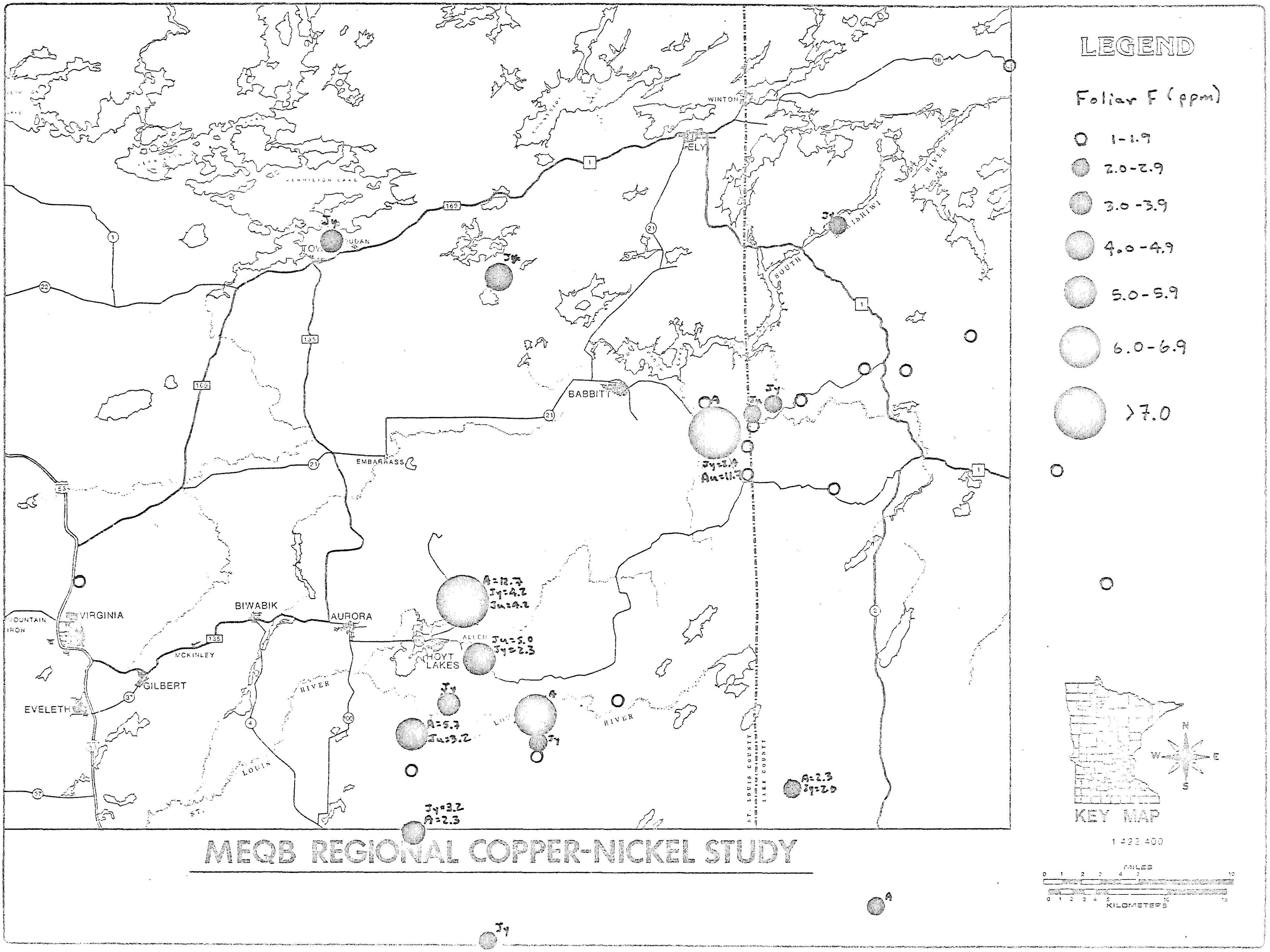
Date: September

3.7% 4.5% 0.1% 0.5% 1.3% 1.0% 6.0%

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricina	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja accident.
P01							1210				
P02									1340		
P03								817			
P04								817			
P05						824					
P06						837					
P07		1050									
P08		1040									
P09		973									
P10	1010										
P11										1590	
P12						830					
P13										1470	
P14						843					
P15				1280							
P16				1290							
P17											1300
P18	960										
P19							843				
P20										1440	
P21			1440								
P22										1740	
P23										1170	
P24		986									
P25	1090										
P26					752						
P27										1400	
P28								843			
P29										1220	
P30				1250							
P31		1270									
P32										2030	
P33										1330	
P34		960									

P01

P34



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Element: F

Date: June

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja accident.	
	1.2(3)	1.2(6)	1.2([illegible])	1.2(3)	1.2(1)	2.2(4)	1.2(2)	1.2(3)	3.1(1)	1.6(8)	1.2(1)	
	0%	0%		0%		43.2%	0%	0%		23.4%		
P01							1.2					P01
P02									3.1			P02
P03								1.2				P03
P04								1.2				P04
P05						1.2						P05
P06						5.0						P06
P07		1.2										P07
P08		1.2										P08
P09		1.2										P09
P10	1.2											P10
P11										1.2		P11
P12						1.2						P12
P13										1.2		P13
P14						1.2						P14
P15				1.2								P15
P16				1.2								P16
P17											1.2	P17
P18	1.2											P18
P19							1.2					P19
P20										1.2		P20
P21			1.2									P21
P22										1.2		P22
P23												P23
P24		1.2										P24
P25	1.2											P25
P26					1.2							P26
P27										1.2		P27
P28								1.2				P28
P29										1.2		P29
P30				1.2								P30
P31		1.2										P31
P32										4.2		P32
P33										1.2		P33
P34		1.2										P34

There are no clear temporal trends.

Element: F
Date: July

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	1.6(3)	1.7(6)	1.8(1)	1.7(3)	1.8(1)	2.0(4)	1.8(2)	1.6(3)	1.9(1)	2.4(9)	2.3(1)	
	48.7%	30.7%		11.9%		17.4%	33.3%	12.5%		15.2%		
P01							2.4					P01
P02									1.9			P02
P03								1.4				P03
P04								1.4				P04
P05						1.4						P05
P06						2.3						P06
P07		1.2										P07
P08		1.2										P08
P09		1.2										P09
P10	1.6											P10
P11										2.8		P11
P12						2.8						P12
P13										3.2		P13
P14						1.4						P14
P15				1.3								P15
P16				1.7								P16
P17											2.3	P17
P18	1.3											P18
P19							1.2					P19
P20										2.9		P20
P21			1.8									P21
P22										1.2		P22
P23										1.2		P23
P24		4.3										P24
P25	3.0											P25
P26					1.8							P26
P27										3.2		P27
P28								2.0				P28
P29										1.8		P29
P30				2.0								P30
P31		1.2										P31
P32										4.2		P32
P33										1.2		P33
P34		1.3										P34

Element: F

Date: August

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricina	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	1.3(3)	1.3(6)	1.6(1)	1.6(3)	1.2(1)	1.2(4)	6.7(2)	1.2(3)	5.7(1)	3.5(9)	1.2(1)	
	5.1%	7.7%		36.7%		0%	78.4%	2.8%		36.3%		
P01							11.9					P01
P02									5.7			P02
P03								1.3				P03
P04								1.2				P04
P05						1.2						P05
P06						1.2						P06
P07		1.2										P07
P08		1.2										P08
P09		1.2										P09
P10	1.2											P10
P11										1.2		P11
P12						1.2						P12
P13										1.5		P13
P14						1.2						P14
P15				1.2								P15
P16				1.2								P16
P17											1.2	P17
P18	1.2											P18
P19							1.4					P19
P20										1.4		P20
P21			1.6									P21
P22										6.3		P22
P23										1.2		P23
P24		1.8										P24
P25	1.4											P25
P26					1.2							P26
P27										3.5		P27
P28								1.2				P28
P29										2.5		P29
P30				2.3								P30
P31		1.2										P31
P32										12.7		P32
P33										1.5		P33
P34		1.2										P34

Element: F

Date: September

No data →

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricina	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.
P01											
P02											
P03											
P04											
P05											
P06											
P07											
P08											
P09											
P10											
P11											
P12											
P13											
P14											
P15											
P16											
P17											
P18											
P19											
P20											
P21											
P22											
P23											
P24											
P25											
P26											
P27											
P28											
P29											
P30											
P31											
P32											
P33											
P34											

Element: Pb

Date: June

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremulo.	Thuja occident.	
P01							2.5					P01
P02									1.5			P02
P03								2.0				P03
P04								2.5				P04
P05						8.5						P05
P06						4.5						P06
P07		1.5										P07
P08		2.0										P08
P09		1.0										P09
P10	4.3											P10
P11										0.5		P11
P12						3.0						P12
P13										1.0		P13
P14						5.0						P14
P15				3.5								P15
P16				6.5								P16
P17											2.0	P17
P18	1.0											P18
P19							0.5					P19
P20										0.5		P20
P21			1.0									P21
P22										0.5		P22
P23												P23
P24		1.5										P24
P25	3.0											P25
P26					3.5							P26
P27										1.0		P27
P28								2.5				P28
P29										1.0		P29
P30				9.0								P30
P31		1.5										P31
P32										1.0		P32
P33										0.5		P33
P34		1.5										P34

There is an apparent increase in concentration during the growing season in tamarack, white spruce, aspen and white cedar.

Element: Pb

Date: July

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	[illegible]	[illegible] %	[illegible]	[illegible] %	[illegible]	[illegible] 35.6%	[illegible] %	4.0(5) [illegible] %	[illegible]	1.4(9) 19.[illegible]%	[illegible]	
P01							5.0					P01
P02									0.5			P02
P03								9.0				P03
P04								2.5				P04
P05						4.5						P05
P06						3.5						P06
P07		4.5										P07
P08		2.0										P08
P09		1.5										P09
P10	3.0											P10
P11										2.5		P11
P12						1.0						P12
P13										0.5		P13
P14						1.0						P14
P15				4.5								P15
P16				6.0								P16
P17											1.0	P17
P18	1.5											P18
P19							0.5					P19
P20										1.0		P20
P21			0.5									P21
P22										2.0		P22
P23										2.7		P23
P24		1.5										P24
P25	2.0											P25
P26					1.0							P26
P27										1.0		P27
P28								0.5				P28
P29										1.5		P29
P30				8.5								P30
P31		1.0										P31
P32										1.0		P32
P33										0.5		P33
P34		2.5										P34

Element: Pb
Date: August

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricina	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
P01							2.0					P01
P02									1.5			P02
P03								2.5				P03
P04								0.5				P04
P05						1.0						P05
P06						1.5						P06
P07		2.0										P07
P08		3.0										P08
P09		2.0										P09
P10	19.5											P10
P11										2.0		P11
P12						8.5						P12
P13										2.5		P13
P14						5.0						P14
P15				23.0								P15
P16				5.5								P16
P17											4.0	P17
P18	1.5											P18
P19							6.5					P19
P20										19.0		P20
P21			1.0									P21
P22										1.0		P22
P23										21.0		P23
P24		1.5										P24
P25	10.0											P25
P26					18.5							P26
P27										2.0		P27
P28								1.0				P28
P29										1.0		P29
P30				21.0								P30
P31		2.5										P31
P32										4.0		P32
P33										4.5		P33
P34		2.0										P34

Element: TD

Date: September

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricina	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	15.1%	11.4%		11.4%		11.4%	35.0%					
P01							1.5					P01
P02									1.0			P02
P03								2.0				P03
P04								1.0				P04
P05						1.0						P05
P06						2.5						P06
P07		2.0										P07
P08		3.0										P08
P09		2.5										P09
P10	2.0											P10
P11										1.0		P11
P12						10.5						P12
P13										4.5		P13
P14						3.0						P14
P15				23.5								P15
P16				31.0								P16
P17											14.0	P17
P18	3.0											P18
P19							?>0					P19
P20										14.0		P20
P21			1.0									P21
P22										1.0		P22
P23										10.0		P23
P24		2.0										P24
P25	3.5											P25
P26					24.0							P26
P27										2.0		P27
P28								1.0				P28
P29										1.5		P29
P30				21.5								P30
P31		2.5										P31
P32										2.5		P32
P33										2.5		P33
P34		4.0										P34

Element: Ni
Date: June

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
P01							1.5					P01
P02									3.5			P02
P03								1.5				P03
P04								3.0				P04
P05						1.5						P05
P06						1.5						P06
P07		1.5										P07
P08		2.0										P08
P09		4.3										P09
P10	2.7											P10
P11										1.0		P11
P12						1.5						P12
P13										2.5		P13
P14						2.5						P14
P15				1.5								P15
P16				1.5								P16
P17											2.5	P17
P18	2.5											P18
P19							2.0					P19
P20										4.0		P20
P21			1.5									P21
P22										1.5		P22
P23												P23
P24		3.0										P24
P25	3.0											P25
P26					2.0							P26
P27										2.5		P27
P28								1.5				P28
P29										1.0		P29
P30				2.0								P30
P31		2.0										P31
P32										2.5		P32
P33										1.5		P33
P34		2.0										P34

There are no apparent temporal variations

Element: Ni

Date: July

Plot	Abies balsam.	Betula papyrif.	Fraxinus	Larix laricin.	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	[illegible]	1.7 (6) 17.6%	[illegible]	1.2 (3) 15.9%	[illegible]	1.1 (4)	[illegible]	2.0 (3) [illegible] 6%	[illegible]	1.7 (9) 15.6%	[illegible]	
P01							2.0					P01
P02									4.5			P02
P03								1.5				P03
P04								3.0				P04
P05						1.5						P05
P06						1.0						P06
P07		2.0										P07
P08		2.5										P08
P09		2.5										P09
P10	2.5											P10
P11										1.5		P11
P12						1.0						P12
P13										2.5		P13
P14						1.0						P14
P15				1.0								P15
P16				1.5								P16
P17											1.5	P17
P18	2.7											P18
P19							2.0					P19
P20										3.0		P20
P21			1.0									P21
P22										2.0		P22
P23										1.0		P23
P24		2.0										P24
P25	2.5											P25
P26					2.5							P26
P27										1.5		P27
P28								1.5				P28
P29										0.5		P29
P30				1.0								P30
P31		1.5										P31
P32										2.0		P32
P33										1.0		P33
P34		1.0										P34

Element: M

Date: August

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricina	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
P01							3.0					P01
P02									4.5			P02
P03								2.5				P03
P04								4.5				P04
P05						2.5						P05
P06						1.5						P06
P07		2.0										P07
P08		2.0										P08
P09		3.5										P09
P10	3.0											P10
P11										1.0		P11
P12						1.0						P12
P13										2.0		P13
P14						2.0						P14
P15				1.0								P15
P16				1.5								P16
P17											3.0	P17
P18	3.5											P18
P19							1.5					P19
P20										3.0		P20
P21			0.5									P21
P22										1.0		P22
P23										1.5		P23
P24		2.0										P24
P25	3.5											P25
P26					3.0							P26
P27										2.0		P27
P28								2.0				P28
P29										0.5		P29
P30				2.5								P30
P31		2.0										P31
P32										2.0		P32
P33										1.5		P33
P34		1.5										P34

Date: September

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricina	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja occident.	
	0%	[illegible]%		11.1%		4.5%	100%	55.6%		14.7%		
P01							3.0					P01
P02									4.0			P02
P03								2.5				P03
P04								4.5				P04
P05						1.5						P05
P06						1.5						P06
P07		1.5										P07
P08		1.0										P08
P09		3.0										P09
P10	3.0											P10
P11										1.0		P11
P12						1.0						P12
P13										3.5		P13
P14						1.5						P14
P15				1.0								P15
P16				1.0								P16
P17											2.5	P17
P18	3.0											P18
P19							1.0					P19
P20										3.0		P20
P21			0.5									P21
P22										1.0		P22
P23										1.5		P23
P24		1.5										P24
P25	3.0											P25
P26					2.5							P26
P27										2.0		P27
P28								2.0				P28
P29										0.5		P29
P30				1.5								P30
P31		1.5										P31
P32										2.0		P32
P33										1.0		P33
P34		1.0										P34

KRUPA CU-NI 1ST SAMPLING GP-93 DATE 9/2/76

ELEMENTS	P	K	CA	AL	NA	FE	MG	ZN	CU	MO	MN	B	
IDENTIFICATION	%	%	%	PPM	%	PPM	%	PPM	PPM	PPM	PPM	PPM	
-PLOT 00 RT112 #10 BFir	0.211	0.77	1.353	567.	*********	582.	0.137	72.2	4.4	*********	603.5	24.2	*
-PLOT 1 JPine	0.166	0.41	0.434	790.	*********	550.	0.145	75.0	3.9	*********	474.3	23.2	*
-PLOT 2 WPine	0.253	0.67	0.501	386.	*********	273.	0.160	84.6	4.3	*********	259.9	25.1	*
-PLOT 3 RPine	0.180	0.56	0.237	234.	*********	166.	0.110	43.8	2.8	*********	343.2	16.1	*
-PLOT 4 RPine	0.181	0.48	0.389	474.	*********	571.	0.140	65.0	3.4	*********	507.1	15.9	*
-PLOT 5 BSPruce	0.125	0.37	0.654	286.	*********	423.	0.139	84.3	2.8	*********	791.1	24.8	*
-PLOT 6 BSPruce	0.233	0.71	0.861	356.	*********	1067.	0.164	78.4	6.8	*********	915.5	40.2	*
-PLOT 7 PBRch	0.265	1.71	1.198	109.	*********	212.	0.420	215.7	7.5	*********	512.0	32.9	*
-PLOT 8 PBRch	0.301	1.55	1.185	74.	*********	216.	0.362	244.5	8.4	*********	399.7	31.8	*
-PLOT 9 PBirch	0.323	2.00	1.270	89.	*********	224.	0.513	222.4	8.0	*********	889.6	36.1	*
-PLOT 11 ASpen	0.339	1.90	1.322	67.	*********	126.	0.313	170.6	11.4	*********	113.7	31.0	*
-PLOY 12 BSPruce	0.205	0.65	0.921	137.	*********	478.	0.110	87.2	4.3	*********	687.7	21.4	*
-PLOT 13 ASpen	0.350	1.57	1.239	54.	*********	139.	0.320	261.6	12.0	*********	106.2	26.7	*
-PLOT 14 BSPruce	0.155	0.55	0.649	492.	*********	796.	0.144	80.7	4.3	*********	479.7	24.9	*
-PLOT 15 TAMarack	0.168	1.03	0.374	202.	*********	493.	0.158	43.5	6.9	*********	450.5	33.6	*
-PLOT 16 TAMarack	0.236	0.78	0.414	313.	*********	661.	0.145	66.6	7.3	*********	1097.6 ?	24.8	*
PLOT 17 White cedar	0.123	0.41	0.861	252.	*********	417.	0.252	29.7	2.5	*********	112.5	11.3	*
-PLOT 18 BFir	0.236	0.83	1.214	463.	*********	356.	0.132	55.1	4.3	*********	739.2	18.7	*
-PLOT 19 JPine	0.353	0.96	0.166	433.	*********	88.	0.139	94.1	*********	*********	148.7	23.5	*
-PLOT 20 ASpen	0.311	1.46	0.885	43.	*********	102.	0.305	151.0	8.7	*********	62.4	24.4	*
-PLOT 21 GRass	0.296	2.17	0.408	82.	*********	166.	0.157	50.6	7.3	*********	110.6	4.7	*
-PLOT 22 ASpen	0.315	1.71	1.129	38.	*********	124.	0.295	150.1	9.1	*********	87.4	28.8	*
-PLOT 24 PBRch	0.312	1.88	1.292	82.	*********	275.	0.343	280.6	8.9	*********	772.7	35.6	*
-PLOT 25 BFir	0.293	1.06	1.001	442.	*********	392.	0.132	94.1	4.4	*********	771.5	21.7	*
PLOT 26 White spruce	0.244	0.92	0.569	95.	*********	422.	0.088	127.7	3.9	*********	359.2	10.0	*
-PLOT 27 ASpen	0.330	1.81	0.892	41.	*********	133.	0.296	199.1	9.8	*********	66.8	24.4	*
-PLOT 28 RPine	0.163	0.50	0.412	241.	*********	191.	0.145	57.5	2.7	*********	177.4	17.8	*
-PLOT 29 ASpen	0.411	2.01	1.168	58.	*********	124.	0.278	172.2	8.7	*********	58.6	23.5	*
-PLOT 30 TAMarack	0.170	0.68	0.385	428.	*********	764.	0.099	53.1	5.7	*********	682.3	18.7	*
-PLOT 31 P.BRch	0.251	1.13	0.950	55.	*********	154.	0.367	185.6	7.3	*********	481.0	29.9	*
-PLOT 32 ASpen	0.300	1.44	0.630	98.	*********	210.	0.175	213.4	6.9	*********	850.5 ?	39.3	*
-PLOT 33 ASpen	0.349	2.13	1.211	53.	*********	335.	0.326	163.6	14.1	*********	63.0	33.6	*
-PLOT 34 P.BRch	0.349	1.64	0.863	45.	*********	110.	0.254	191.4	9.4	*********	102.5	33.8	*

KRUPA CU-NI 1ST SAMPLING GP-93 DATE 9/2/76

	P	K	CA	AL	NA	FE	MG	ZN	CU	MO	MN	B
NUMBER OF CALCULATIONS RELATIVE TO DETECTION LIMITS												
TOO LOW	0	0	0	0	33	0	0	0	1	33	0	0
TOO HIGH	0	0	0	0	0	0	0	0	0	0	0	0
GOOD	33	33	33	33	0	33	33	33	32	0	33	33
LOWER LIMIT	0.020	0.100	0.020	15.000	0.050	20.000	0.010	1.500	2.000	10.000	10.000	2.000
UPPER LIMIT	5.000	30.000	9.900	8000.000	5.000	8000.000	3.000	500.000	300.000	200.000	4000.000	500.000

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

Cu-Ni
GP-93
1st Veg. SAMPLE
1976

PLOT		SULFUR ppm in tissue	FLUORIDE ppm in tissue	LEAD ppm in tissue	NICKEL ppm in tissue
U.D. RT 112 10	B Fir	1050	12	43	27
1	J Pine	999	12	25	15
2	W Pine	1300	31	15	35
3	R Pine	855	12	20	15
4	R Pine	803	12	25	30
5	B. Spruce	790	12	85	15
6	B. Spruce	928	50	45	15
7	BiRch	1430	12	15	15
8	BiRch	1530	12	20	20
9	BiRch	1650	12	10	43
11	ASpen	2085	12	05	10
12	B. Spruce	897	12	30	15
13	ASPen	2210	12	10	25
14	B. Spruce	837	12	50	25
15	TAmar.	1224	12	35	15
16	TAmar.	1120	12	65	15
17	White cedar	749	12	20	25
18	BFir	973	12	10	25
19	JPine	1135	12	05	20
20	ASpen	2275	12	05	40
21	GRass	2500	12	10	15
22	ASpen	2260	12	05	15
24	Paper birch	1140	12	15	30
25	B.Fir	1175	12	30	30
26	White spruce	792	12	35	20
27	ASpen	2405	12	10	25
28	RPine	824	12	25	15
29	ASpen	2010	12	10	10
30	TAmar.	553	12	90	20
31	BiRch	1260	12	15	20
32	ASpen	2375	42	10	25
33	ASpen	1870	12	05	15
34	BiRch	1355	12	15	20

2nd. Sampling KRUPA-CU NI PROJ. GP-145 DATE 9/29/76

ELEMENTS IDENTIFICATION	P %	K %	CA %	AL PPM	NA %	FE PPM	MG %	ZN PPM	CU PPM	MO PPM	MN PPM	S PPM	
01 Jack pine...xx	0.152	0.58	0.339	535.	*********	337.	0.149	76.3	4.1	10.5	406.9	21.2	*
02 White pine...	0.236	0.87	0.320	245.	*********	91.	0.152	70.5	3.9	*********	176.4	20.3	*
03. Red pine.....	0.119	0.53	0.375	262.	*********	172.	0.120	49.0	*********	*********	451.1	14.5	*
04. Red pine.....	0.159	0.64	0.304	283.	*********	211.	0.141	61.4	2.5	*********	448.5	16.1	*
05. Black spruce..	0.089	0.53	0.518	149.	*********	230.	0.134	65.2	2.2	*********	634.3	19.5	*
06. Black spruce	0.109	0.59	0.611	125.	*********	286.	0.119	71.2	3.0	*********	679.6	31.4	*
07. Paper birch	0.181	1.09	1.032	103.	*********	234.	0.352	158.2	4.1	*********	508.2	37.3	*
08. Paper birch..	0.194	1.24	1.037	69.	*********	174.	0.358	184.8	4.6	*********	367.7	35.7	*
09. Paper birch.	0.206	1.31	1.144	82.	*********	140.	0.450	168.7	5.3	*********	751.8	45.0	*
GRASS NO.21	0.209	1.73	0.374	26.	*********	120.	0.127	54.3	3.2	*********	71.4	6.9	*
11. Aspen.......	0.221	1.20	1.437	71.	*********	105.	0.287	197.0	8.3	*********	108.8	45.5	*
12. Black spruce.	0.173	0.77	0.647	81.	*********	95.	0.101	54.7	3.9	*********	500.7	19.8	*
13. Aspen.......	0.227	1.19	1.459	65.	*********	121.	0.312	283.1	8.7	*********	135.2	32.5	*
14. Black spruce.	0.104	0.82	0.422	85.	*********	112.	0.125	58.6	3.7	*********	445.4	21.6	*
15. Tamarack...	0.093	0.67	0.316	149.	*********	303.	0.132	35.4	4.1	*********	406.9	36.7	*
16. Tamarack...	0.155	0.59	0.328	216.	*********	413.	0.112	50.8	4.1	11.1	815.7	24.9	*
17. White cedar	0.092	0.45	0.972	135.	*********	203.	0.275	32.8	2.3	*********	124.9	14.5	*
18. Balsam fir...	0.210	0.92	1.027	380.	*********	151.	0.134	49.8	4.3	*********	603.2	24.0	*
20.. Aspen......	0.209	1.07	1.191	150.	*********	139.	0.319	197.4	8.3	*********	103.7	34.6	*
19. Jack pine....	0.193	0.70	0.211	577.	*********	79.	0.121	69.6	3.9	*********	132.0	16.8	*
22.. Aspen.......	0.240	1.26	1.429	79.	*********	114.	0.293	155.2	7.4	*********	106.9	37.8	*
23.. Aspen.....	0.165	1.09	1.007	66.	*********	78.	0.222	132.3	12.6	*********	83.0	33.2	*
24. Paper birch..	0.244	1.39	1.393	84.	*********	168.	0.314	252.4	5.7	*********	694.4	43.2	*
25. Balsam fir...	0.242	1.10	0.981	362.	*********	153.	0.138	86.4	3.7	*********	602.0	22.1	*
26. White spruce	0.202	0.82	0.574	52.	*********	101.	0.104	105.4	3.2	*********	312.5	12.1	*
27. Aspen......	0.190	1.27	1.163	87.	*********	168.	0.305	232.9	8.0	*********	92.0	35.3	*
28. Red pine.....	0.188	0.60	0.304	201.	*********	83.	0.127	46.5	3.7	*********	144.9	17.7	*
29.. Aspen......	0.210	1.43	1.521	59.	*********	91.	0.308	186.8	6.6	*********	83.6	35.3	*
30. Tamarack...	0.161	0.54	0.325	422.	*********	684.	0.103	44.3	4.8	*********	619.4	24.6	*
31. Paper birch..	0.178	0.65	0.806	63.	*********	116.	0.343	94.1	7.3	*********	470.6	35.9	*
32.. Aspen.....	0.218	1.17	1.436	79.	*********	229.	0.333	143.0	8.9	*********	86.2	45.2	*
33.. Aspen.....	0.211	1.03	1.341	59.	*********	63.	0.234	247.6	5.9	*********	109.5	43.1	*
34.. Paper birch	0.232	1.04	0.555	105.	*********	186.	0.150	152.4	5.5	*********	732.1	61.9	*
U.C.. F.V. Bals. Fir.	0.152	0.97	0.944	396.	*********	203.	0.134	58.8	4.3	*********	473.1	21.2	*

[illegible]	0.218	1.17	1.436	79.*********	229.	0.333	143.0	8.9*********	86.2	45.2	*
....	0.211	1.03	1.341	59.*********	63.	0.234	247.6	5.9*********	109.5	43.1	*
34.............	0.232	1.04	0.555	105.*********	186.	0.150	152.4	5.5*********	732.1	61.9	*
[illegible].......	0.152	0.97	0.944	396.*********	203.	0.134	58.8	4.3*********	473.1	21.2	*

KRUPA-CU NI PROJ. GP-145 DATE 9/29/76

ELEMENTS	P	K	CA	AL	NA	FE	MG	ZN	CU	MO	MN	B
IDENTIFICATION	%	%	%	PPM	%	PPM	%	PPM	PPM	PPM	PPM	PPM

KRUPA-CU NI PROJ. GP-145 DATE 9/29/76

	P	K	CA	AL	NA	FE	MG	ZN	CU	MO	MN	B
NUMBER OF CALCULATIONS RELATIVE TO DETECTION LIMITS												
TOO LOW	0	0	0	0	34	0	0	0	1	32	0	0
TOO HIGH	0	0	0	0	0	0	0	0	0	0	0	0
GOOD	34	34	34	34	0	34	34	34	33	2	34	34
LOWER LIMIT	0.020	0.100	0.020	15.000	0.050	20.000	0.010	1.500	2.000	10.000	10.000	2.000
UPPER LIMIT	5.000	30.000	9.900	8000.000	5.000	8000.000	3.000	500.000	300.000	200.000	4000.000	500.000

Cu-Ni
?.P. 145
?d Veg. Sample

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

Plot			Sulfur ppm in tissue	Flouride ppm in tissue	Lead ppm in tissue	Nickel ppm in tissue
?.D RT 112 10	1	Balsam fir	1170	16	30	25
1	2	Jack pine	1140	24	50	20
2	3	White pine	1400	19	05	45
3	4	Red pine	810	14	90	15
4	5	Red pine	950	14	25	30
5	6	Black spruce	840	14	45	15
6	7	Black spruce	860	23	35	10
7	8	Paper birch	1160	12	45	20
8	9	Paper birch	1420	12	20	25
9	10	Paper birch	1360	12	15	25
11	11	Aspen	1970	28	25	15
12	12	Black spruce	790	28	10	10
13	13	Aspen	1870	32	05	25
14	14	Black Spruce	940	14	10	10
5	15	Tamarack	1220	13	45	10
16	16	Tamarack	1200	17	60	15
7	17	White cedar	700	23	10	15
8	18	Balsam fir	1120	13	15	27
19	19	Jack pine	1030	12	05	20
20	20	Aspen	1680	29	10	30
21	21	Grass	1850	18	05	10
22	22	Aspen	1900	12	20	20
23	23	Aspen	1280	12	27	10
24	24	Paper birch	1510	43	15	20
5	25	Balsam fir	1300	30	20	25
26	26	White spruce	850	18	10	25
27	27	Aspen	1800	32	10	15
15	28	Red pine	970	20	05	15
29	29	Aspen	1770	18	15	05
30	30	Tamarack	1380	20	85	10
31	31	Paper birch	1340	12	10	15
32	32	Aspen	2130	42	10	20
33	33	Aspen	1720	12	05	10
34	34	Paper Birch	1490	13	25	10
	35					
	36					
	37					
	38					
	39					
	40					

KRUPA- CU NI 320 SAMP. ST LOUIS CO. DATE 2/11/77

ELEMENTS	P	K	CA	AL	NA	FE	MG	ZN	CU	MO	MN	B	
IDENTIFICATION	%	%	%	PPM	%	PPM	%	PPM	PPM	PPM	PPM	PPM	
01. Jack pine GP-199...	0.171	0.52	0.312	558.	*********	291.	0.156	67.6	4.7	11.4	312.9	21.3	*
02. White pine..	0.237	0.82	0.339	272.	*********	112.	0.153	57.9	3.8	*********	194.6	17.7	*
03. Red pine.....	0.174	0.70	0.244	202.	*********	120.	0.115	43.9	3.1	*********	338.5	15.1	*
04. Red pine.....	0.189	0.80	0.226	211.	*********	91.	0.114	46.8	3.1	*********	308.6	13.5	*
05. Black spruce..	0.120	0.64	0.346	96.	*********	142.	0.124	52.9	2.3	*********	577.8	21.6	*
06. Black spruce	0.132	0.74	0.396	85.	*********	215.	0.108	55.8	3.2	*********	614.5	24.5	*
07. Paper birch.	0.164	0.84	1.253	306.	*********	418.	0.392	168.0	4.0	*********	649.2	39.8	*
08. Paper birch	0.259	1.17	1.079	83.	*********	218.	0.356	186.5	5.6	13.2	395.6	38.1	*
09. Paper birch.	0.225	1.33	1.206	88.	*********	186.	0.472	163.9	4.4	12.0	770.9	38.9	*
10. ~~Aspen~~ Balsam fir	0.191	1.05	0.772	330.	*********	185.	0.138	59.1	4.1	10.3	408.6	21.3	*
11. Aspen......	0.211	1.16	1.799	112.	*********	159.	0.328	230.7	5.2	*********	129.1	44.1	*
12. Black spruce	0.180	0.74	0.618	58.	*********	108.	0.110	58.3	3.2	12.0	629.1	18.5	*
13. Aspen......	0.240	1.09	1.737	79.	*********	153.	0.335	350.7	5.6	*********	140.4	29.3	*
14. Black spruce	0.107	0.62	0.552	207.	*********	359.	0.134	78.0	2.5	10.3	449.4	21.1	*
15. Tamarack...	0.127	0.56	0.408	278.	*********	637.	0.144	46.7	3.1	12.6	463.6	30.2	*
16. Tamarack..	0.183	0.60	0.395	257.	*********	492.	0.120	59.9	3.2	10.3	1271.1	26.4	*
17. White cedar.	0.120	0.53	1.027	194.	*********	325.	0.298	40.2	2.5	12.0	119.6	11.8	*
18. Balsam fir.	0.207	0.85	1.004	312.	*********	238.	0.140	60.2	4.4	10.3	563.7	20.1	*
19. Jack pine.	0.173	0.65	0.183	633.	*********	237.	0.112	72.4	2.8	14.4	116.4	15.1	*
20. Aspen......	0.205	1.01	1.083	81.	*********	178.	0.308	194.6	4.7	12.6	83.5	30.5	*
21. Grass......	0.134	1.27	0.503	46.	*********	125.	0.124	29.8	*********	*********	93.7	5.6	*
22. Aspen......	0.220	1.14	1.610	79.	*********	137.	0.309	138.8	5.6	*********	116.4	36.9	*
23. Aspen......	0.192	1.16	0.975	64.	*********	101.	0.271	122.8	6.7	10.8	82.3	34.0	*
24. Paper birch	0.257	1.31	1.430	119.	*********	290.	0.335	208.0	4.1	11.4	743.2	45.3	*
25. Balsam fir.	0.223	1.01	0.949	380.	*********	235.	0.124	72.9	3.1	*********	680.8	19.9	*
26. White spruce	0.211	0.77	0.683	76.	*********	189.	0.111	106.8	2.9	11.4	394.3	11.5	*
27. Aspen......	0.189	1.03	1.327	165.	*********	278.	0.275	200.3	6.4	*********	84.8	32.4	*
28. Red pine....	0.181	0.63	0.338	215.	*********	93.	0.125	43.3	3.1	*********	153.1	17.3	*
29. Aspen......	0.194	1.21	1.824	84.	*********	101.	0.286	159.2	5.2	*********	82.3	30.0	*
30. Tamarack..	0.184	0.51	0.416	723.	*********	1001.	0.114	45.1	5.0	*********	814.2	25.0	*
31. Paper birch.	0.211	0.54	1.052	75.	*********	141.	0.383	101.2	3.5	*********	551.5	37.9	*
32. Aspen......	0.195	0.93	1.790	145.	*********	433.	0.342	144.2	6.7	*********	89.9	38.2	*
33. Aspen......	0.217	1.14	1.624	78.	*********	96.	0.256	240.8	4.3	*********	115.2	42.0	*
34. Paper birch	0.263	1.08	0.654	135.	*********	242.	0.166	154.4	4.7	*********	1120.6	66.8	*

KRUPA- CU NI 2ND SAMP. ST LOUIS CO. DATE 2/11/77

ELEMENTS	P	K	CA	AL	NA	FE	MG	ZN	CU	MO	MN	B	
IDENTIFICATION	%	%	%	PPM	%	PPM	%	PPM	PPM	PPM	PPM	PPM	
LOW S CK 2/11	0.301	2.34	0.969	76.*********		206.	0.434	35.0	10.0*********		69.6	15.6	*
NBS CK 2/11/77	0.208	1.51	2.018	199.*********		285.	0.570	25.7	12.2	10.3	80.4	29.2	*

KRUPA- CU NI 2ND SAMP. ST LOUIS CO. DATE 2/11/77

	P	K	CA	AL	NA	FE	MG	ZN	CU	MO	MN	B
NUMBER OF CALCULATIONS RELATIVE TO DETECTION LIMITS												
TOO LOW	0	0	0	0	36	0	0	0	1	20	0	0
TOO HIGH	0	0	0	0	0	0	0	0	0	0	0	0
GOOD	36	36	36	36	0	36	36	36	35	16	36	36
LOWER LIMIT	0.020	0.100	0.020	15.000	0.050	20.000	0.010	1.500	2.000	10.000	10.000	2.000
UPPER LIMIT	5.000	30.000	9.900	8000.000	5.000	8000.000	3.000	500.000	300.000	200.000	4000.000	500.000

Gp 199
3RD Sampling
Veg.

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

		Sulfur ppm in tissue	Fluoride ppm in tissue	Lead ppm in tissue	Nickel ppm in tissue
1	Jack pine	1220	119	20	30
2	White pine	1100	57	15	45
3	Red pine	808	13	25	25
4	Red pine	846	12	05	45
5	Black spruce	838	12	10	25
6	Black spruce	851	12	15	15
7	Paper birch	1130	12	20	20
8	Paper birch	1330	12	30	20
9	Paper birch	1210	12	20	35
10	Balsam fir	1030	12	195	30
11	Aspen	1780	12	20	10
12	Black spruce	739	12	85	10
13	Aspen	1710	15	25	20
14	Black spruce	783	12	50	20
15	Tamarack	1180	12	230	10
16	Tamarack	1380	12	55	15
17	White cedar	757	12	40	30
18	Balsam fir	961	12	15	35
19	Jack pine	795	14	65	15
20	Aspen	1480	14	140	30
21	Grass	1420	16	10	05
22	Aspen	1840	63	10	10
23	Aspen	1580	12	210	15
24	Paper birch	1320	18	15	20
25	Balsam fir	1140	14	100	35
26	White spruce	757	12	185	30
27	Aspen	1790	35	20	20
28	Red pine	872	12	10	20
29	Aspen	1510	25	10	05
30	Tamarack	1290	23	210	25
31	Paper birch	1290	12	25	20
32	Aspen	1850	127	40	20
33	Aspen	1620	15	45	15
34	Paper birch	1290	12	20	15

KRUPA-CU NI [illegible] SAMP. ELY GP-226 DATE 2/16/77

ELEMENTS	P	K	CA	AL	NA	FE	MG	ZN	CU	MO	MN	B	
IDENTIFICATION	%	%	%	PPM	%	PPM	%	PPM	PPM	PPM	PPM	PPM	
01....GP-226... (Jack pine)	0.194	0.51	0.288	812.	*********	477.	0.150	65.7	4.0	13.8	330.3	21.2	*
02. White pine	0.234	0.76	0.365	376.	*********	193.	0.160	56.4	2.9	*********	210.2	17.8	*
03. Red pine	0.187	0.63	0.236	303.	*********	198.	0.109	36.6	2.7	*********	240.8	14.3	*
04. Red pine	0.255	0.71	0.194	299.	*********	217.	0.106	36.8	3.0	12.6	274.0	14.0	*
05. Black spruce	0.119	0.60	0.389	117.	*********	174.	0.132	45.7	2.6	10.3	617.3	20.5	*
06. Black spruce	0.134	0.58	0.463	217.	*********	483.	0.116	54.6	3.7	*********	706.3	26.9	*
07. Paper birch	0.178	0.82	1.131	291.	*********	357.	0.354	124.4	3.4	*********	595.2	47.0	*
08. Paper birch	0.257	0.93	1.199	112.	*********	298.	0.332	174.2	4.1	11.5	501.0	45.8	*
09. Paper birch	0.165	0.98	1.228	163.	*********	303.	0.482	124.1	3.4	13.8	897.0	46.5	*
10. Balsam fir	0.176	0.94	0.773	376.	*********	199.	0.135	52.3	5.0	*********	392.9	19.4	*
11. Aspen	0.176	0.86	1.876	135.	*********	169.	0.295	177.2	4.0	*********	120.0	41.6	*
12. Black spruce	0.163	0.67	0.731	121.	*********	241.	0.104	49.8	4.1	*********	591.4	18.0	*
13. Aspen	0.231	0.95	1.879	115.	*********	219.	0.344	311.4	4.7	*********	147.4	29.2	*
14. Black spruce	0.128	0.71	0.478	247.	*********	340.	0.134	52.7	2.6	*********	500.3	20.5	*
15. Tamarack	0.133	0.52	0.396	463.	*********	739.	0.161	32.4	2.6	10.3	467.0	34.3	*
16. Tamarack	0.171	0.49	0.391	566.	*********	804.	0.119	50.4	3.2	*********	1116.2	22.9	*
17. White cedar	0.115	0.49	0.981	264.	*********	340.	0.285	27.3	*********	*********	145.4	11.2	*
18. Balsam fir	0.210	0.81	1.090	580.	*********	461.	0.160	44.3	3.0	*********	627.0	20.5	*
19. Jack pine	0.158	0.49	0.247	920.	*********	325.	0.112	61.1	4.1	*********	160.1	14.2	*
20. Aspen	0.191	0.75	1.304	207.	*********	332.	0.336	162.6	4.7	*********	105.9	39.3	*
21. Grass	0.130	0.94	0.457	118.	*********	235.	0.117	19.7	2.3	*********	100.5	7.0	*
22. Aspen	0.202	0.88	1.598	103.	*********	187.	0.292	122.5	6.1	*********	120.0	43.2	*
23. Aspen	0.129	0.79	1.038	106.	*********	179.	0.282	126.3	5.9	*********	93.8	33.4	*
24. Paper birch	0.250	1.10	1.548	158.	*********	416.	0.333	237.8	3.7	*********	898.3	48.9	*
25. Balsam fir	0.236	0.99	0.849	378.	*********	260.	0.130	74.7	4.0	*********	667.6	18.9	*
26. White spruce	0.210	0.66	0.621	119.	*********	433.	0.118	102.4	3.5	10.3	365.9	11.2	*
27. Aspen	0.185	0.87	1.497	184.	*********	316.	0.307	258.6	5.5	*********	107.9	39.5	*
28. Red pine	0.190	0.55	0.272	163.	*********	91.	0.125	44.8	2.9	*********	128.0	15.2	*
29. Aspen	0.180	0.95	1.783	106.	*********	165.	0.295	178.6	3.8	*********	103.2	35.3	*
30. Tamarack	0.228	0.50	0.441	973.	*********	1361.	0.124	50.0	4.6	12.0	874.2	26.2	*
31. Paper birch	0.203	0.71	0.651	84.	*********	196.	0.317	60.5	3.7	*********	472.2	36.4	*
32. Aspen	0.193	0.73	1.687	163.	*********	494.	0.373	122.8	7.0	*********	92.4	41.4	*
33. Aspen	0.211	1.01	1.318	101.	*********	144.	0.249	210.8	5.0	10.3	111.2	41.4	*
34. Paper birch	0.241	0.83	0.559	197.	*********	373.	0.148	113.5	4.7	10.9	1183.9	68.1	*

KRUPA-CU NI 3RD SAMP. ELY GP-226 DATE 2/16/77

ELEMENTS	P	K	CA	AL	NA	FE	MG	ZN	CU	MO	MN	B	
IDENTIFICATION	%	%	%	PPM	%	PPM	%	PPM	PPM	PPM	PPM	PPM	
NBS CK 2/16	0.233	1.53	2.188	218.*********		335.	0.600	29.2	13.5	10.3	94.5	31.8	*
LOW S CK 2/16	0.290	2.35	0.896	71.*********		205.	0.428	31.1	9.9*********		66.9	14.5	*
LOW S CK 2/16	0.284	2.25	0.899	71.*********		197.	0.426	32.0	9.3*********		65.6	14.3	*

KRUPA-CU NI 3RD SAMP. ELY GP-226 DATE 2/16/77

	P	K	CA	AL	NA	FE	MG	ZN	CU	MO	MN	B
NUMBER OF CALCULATIONS RELATIVE TO DETECTION LIMITS												
TOO LOW	0	0	0	0	37	0	0	0	1	26	0	0
TOO HIGH	0	0	0	0	0	0	0	0	0	0	0	0
GOOD	37	37	37	37	0	37	37	37	36	11	37	37
LOWER LIMIT	0.020	0.100	0.020	15.000	0.050	20.000	0.010	1.500	2.000	10.000	10.000	2.000
UPPER LIMIT	5.000	30.000	9.900	8000.000	5.000	8000.000	3.000	500.000	300.000	200.000	4000.000	500.000

Sp 226
4th Sampling
Veg.

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

No.	Species	Sulfur ppm in Tissue	Fluoride ppm in Tissue	Lead ppm in Tissue	Nickel ppm in Tissue
1	Jack Pine	1210	NS	15	30
2	White Pine	1340		10	40
3	Red Pine	817		20	25
4	Red Pine	817		10	45
5	Black spruce	824		10	15
6	Black spruce	837		25	15
7	Paper Birch	1050		20	15
8	Paper Birch	1040		30	10
9	Paper Birch	973		25	30
10	Balsam fir	1010		20	30
11	Aspen	1590		10	10
12	Black spruce	830		105	10
13	Aspen	1470		45	35
14	Black spruce	843		30	15
15	Tamarack	1280		235	10
16	Tamarack	1290		310	10
17	White cedar	1300		140	25
18	Balsam fir	960		30	30
19	Jack pine	843		NS	10
20	Aspen	1440		140	30
21	Grass	1440		10	05
22	Aspen	1740		10	10
23	Aspen	1170		100	15
24	Paper birch	986		20	15
25	Balsam fir	1090		35	30
26	White spruce	752		240	25
27	Aspen	1400		20	20
28	Red pine	843		10	20
29	Aspen	1220		15	05
30	Tamarack	1250		215	15
31	Paper birch	1270		25	15
32	Aspen	2030		25	20
33	Aspen	1330		25	10
34	Paper birch	960		40	10

449768

CUNI 1976

3 IN 1 P in JACK PINE

SITE	JUNE	JULY	AUG	SEPT
1	1660.0	1520.0	1710.0	1940.0
19	3530.0	1930.0	1730.0	1580.0

SOURCE	DF	SS	MS	F
MONTHS	3	1111300.0	370433.3	.78
SITES	1	470450.0	470450.0	.99
ERROR	3	1427050.0	475683.3	
TOTAL	7	3008800.0		

CUNI 1976

4 IN 1 K in JACK PINE

SITE	JUNE	JULY	AUG	SEPT
1	4100.0	5800.0	5200.0	5100.0
19	9600.0	7000.0	6500.0	4900.0

SOURCE	DF	SS	MS	F
MONTHS	3	3805000.0	1268333.3	.42
SITES	1	7605000.0	7605000.0	2.51
ERROR	3	9105000.0	3035000.0	
TOTAL	7	20515000.0		

CUNI 1976

5 IN 1 CA in JACKPINE

SITE	JUNE	JULY	AUG	SEPT
1	4340.0	3390.0	3120.0	2880.0
19	1660.0	2110.0	1830.0	2470.0

449769

CUNI 1976

5 IN 1 CA IN JACKPINE

SITE	JUNE	JULY	AUG	SEPT
1	4340.0	3390.0	3120.0	2880.0
19	1660.0	2110.0	1830.0	2470.0

SOURCE	DF	SS	MS	F
MONTHS	3	282500.0	94166.7	.21
SITES	1	4004450.0	4004450.0	9.09
ERROR	3	1322050.0	440683.3	
TOTAL	7	5609000.0		

CUNI 1976

6 IN 1 AL IN JACKPINE

SITE	JUNE	JULY	AUG	SEPT
1	790.0	535.0	558.0	812.0
19	433.0	577.0	633.0	920.0

SOURCE	DF	SS	MS	F
MONTHS	3	119468.5	39822.8	1.68
SITES	1	2178.0	2178.0	.09
ERROR	3	71073.0	23691.0	
TOTAL	7	192719.5		

CUNI 1976

7 IN 1 FE IN JACKPINE

SITE	JUNE	JULY	AUG	SEPT
1	550.0	337.0	291.0	477.0
19	88.0	79.0	237.0	325.0

SOURCE	DF	SS	MS	F
MONTHS	3	40612.0	13537.3	.89
SITES	1	107184.5	107184.5	7.02
ERROR	3	45829.5	15276.5	
TOTAL	7	193626.0		

SOURCE	DF	SS	MS	F
SITES	1	107184.5	107184.5	7.02
ERROR	3	45829.5	15276.5	
TOTAL	7	193626.0		

CUNI 1976

8 IN 1 MG IN JACK PINE

SITE	JUNE	JULY	AUG	SEPT
1	1450.0	1490.0	1560.0	1500.0
19	1390.0	1210.0	1120.0	1120.0

SOURCE	DF	SS	MS	F
MONTHS	3	13000.0	4333.3	.31
SITES	1	168200.0	168200.0	12.07 *
ERROR	3	41800.0	13933.3	
TOTAL	7	223000.0		

CUNI 1976

9 IN 1 ZN IN JACK PINE

SITE	JUNE	JULY	AUG	SEPT
1	75.0	76.3	67.6	65.7
19	94.1	69.6	72.4	61.1

SOURCE	DF	SS	MS	F
MONTHS	3	468.5	156.2	2.26
SITES	1	19.8	19.8	.29
ERROR	3	207.1	69.0	
TOTAL	7	695.5		

CUNI 1976

10 IN 1 CU IN JACKPINE

SITE	JUNE	JULY	AUG	SEPT
1	3.9	4.1	4.7	4.0
19	3.9	3.9	2.8	4.1

SOURCE	DF	SS	MS	F
MONTHS	3	.1	.0	.08
SITES	1	.5	.5	1.13

CUNI 1976

5 IN 1 Ca in Jackpine

SITE	JUNE	JULY	AUG	SEPT
1	4340.0	3390.0	3120.0	2880.0
19	1660.0	2110.0	1830.0	2470.0

ERROR	3	1.3	.4
TOTAL	7	1.9	

449771

CUNI 1976

12 IN 1 Mn in Jack Pine

SITE	JUNE	JULY	AUG	SEPT
1	474.3	406.9	312.9	330.3
19	148.7	132.0	116.4	160.1

SOURCE	DF	SS	MS	F
MONTHS	3	10034.1	3344.7	1.31
SITES	1	116934.5	116934.5	45.87 **
ERROR	3	7648.4	2549.5	
TOTAL	7	134616.9		

CUNI 1976

13 IN 1 B in Jack Pine

SITE	JUNE	JULY	AUG	SEPT
1	23.2	21.2	21.3	21.2
19	23.5	16.8	15.1	14.2

SOURCE	DF	SS	MS	F
MONTHS	3	40.0	13.3	2.49
SITES	1	37.4	37.4	7.00
ERROR	3	16.0	5.3	
TOTAL	7	93.4		

CUNI 1976

14 IN 1 S in Jack Pine

CUNI 1976

14 IN 1 S IN JACK PINE

SITE	JUNE	JULY	AUG	SEPT
1	999.0	1140.0	1220.0	1210.0
19	1135.0	1030.0	795.0	843.0

SOURCE	DF	SS	MS	F
MONTHS	3	7647.0	2549.0	.08
SITES	1	73344.5	73344.5	2.21
ERROR	3	99610.5	33203.5	
TOTAL	7	180602.0		

449772

CUNI 1976

16 IN 1 PB IN JACK PINE

SITE	JUNE	JULY	AUG	SEPT
1	2.5	5.0	2.0	1.5
19	.5	.5	6.5	1.5

SOURCE	DF	SS	MS	F
MONTHS	3	10.3	3.4	.47
SITES	1	.5	.5	.07
ERROR	3	21.8	7.3	
TOTAL	7	32.5		

CUNI 1976

17 IN 1 NI IN JACK PINE

SITE	JUNE	JULY	AUG	SEPT
1	1.5	2.0	3.0	3.0
19	2.0	2.0	1.5	1.0

SOURCE	DF	SS	MS	F
MONTHS	3	.3	.1	.12
SITES	1	1.1	1.1	1.59
ERROR	3	2.1	.7	
TOTAL	7	3.5		

MONTHS	3	.3	.1	.12
SITES	1	1.1	1.1	1.59
ERROR	3	2.1	.7	
TOTAL	7	3.5		

CUNI 1976

3 IN 3 P IN RED PINE

SITE	JUNE	JULY	AUG	SEPT
3	1800.0	1190.0	1740.0	1870.0
4	1810.0	1590.0	1890.0	2550.0
28	1630.0	1880.0	1810.0	1900.0

SOURCE	DF	SS	MS	F
MONTHS	3	473433.3	157811.1	2.53
SITES	2	192200.0	96100.0	1.54
ERROR	6	374866.7	62477.8	
TOTAL	11	1040500.0		

CUNI 1976

4 IN 3 K IN RED PINE

SITE	JUNE	JULY	AUG	SEPT
3	5600.0	5300.0	7000.0	6300.0
4	4800.0	6400.0	8000.0	7100.0
28	5000.0	6000.0	6300.0	5500.0

SOURCE	DF	SS	MS	F
MONTHS	3	6042500.0	2014166.7	5.61 *
SITES	2	1551666.7	775833.3	2.16
ERROR	6	2155000.0	359166.7	
TOTAL	11	9749166.7		

CUNI 1976

5 IN 3 CA IN RED PINE

SITE	JUNE	JULY	AUG	SEPT
3	2370.0	3750.0	2440.0	2360.0
4	3890.0	3040.0	2260.0	1940.0
28	4120.0	3040.0	3380.0	2720.0

CUNI 1976

5 IN 3 Ca in Red Pine

SITE	JUNE	JULY	AUG	SEPT
3	2370.0	3750.0	2440.0	2360.0
4	3890.0	3040.0	2260.0	1940.0
28	4120.0	3040.0	3380.0	2720.0

SOURCE	DF	SS	MS	F
MONTHS	3	2413691.7	804563.9	2.07
SITES	2	838050.0	419025.0	1.08
ERROR	6	2334883.3	389147.2	
TOTAL	11	5586625.0		

4497714

CUNI 1976

6 IN 3 Al in Red Pine

SITE	JUNE	JULY	AUG	SEPT
3	234.0	262.0	202.0	303.0
4	474.0	283.0	211.0	299.0
28	241.0	201.0	215.0	163.0

SOURCE	DF	SS	MS	F
MONTHS	3	17596.7	5865.6	1.24
SITES	2	25277.2	12638.6	2.66
ERROR	6	28456.8	4742.8	
TOTAL	11	71330.7		

CUNI 1976

7 IN 3 Fe in Red Pine

SITE	JUNE	JULY	AUG	SEPT
3	166.0	172.0	120.0	198.0
4	571.0	211.0	91.0	217.0
28	191.0	83.0	93.0	91.0

SOURCE	DF	SS	MS	F
MONTHS	3	70796.0	23598.7	2.05
SITES	2	52248.7	26124.3	2.27
ERROR	6	69130.0	11521.7	
TOTAL	11	192174.7		

MONTHS	3	[illegible]	[illegible]	[illegible]
SITES	2	52248.7	26124.3	2.27
ERROR	6	69130.0	11521.7	
TOTAL	11	192174.7		

CUNI 1976

8 IN 3 MG IN RED PINE

449775

SITE	JUNE	JULY	AUG	SEPT
3	1100.0	1200.0	1150.0	1090.0
4	1400.0	1410.0	1140.0	1060.0
28	1450.0	1270.0	1250.0	1250.0

SOURCE	DF	SS	MS	F
MONTHS	3	70091.7	23363.9	2.25
SITES	2	60616.7	30308.3	2.92
ERROR	6	62183.3	10363.9	
TOTAL	11	192891.7		

CUNI 1976

9 IN 3 ZN IN RED PINE

SITE	JUNE	JULY	AUG	SEPT
3	43.8	49.0	43.9	36.6
4	65.0	61.4	46.8	36.8
28	57.5	46.5	43.3	44.8

SOURCE	DF	SS	MS	F
MONTHS	3	476.4	158.8	3.96
SITES	2	168.4	84.2	2.10
ERROR	6	240.8	40.1	
TOTAL	11	885.6		

CUNI 1976

10 IN 3 CU IN RED PINE

SITE	JUNE	JULY	AUG	SEPT
3	2.8	0	3.1	2.7
4	3.4	2.5	3.1	3.0
28	2.7	3.7	3.1	2.9

12 IN 3 Cu IN ...

SITE	JUNE	JULY	AUG	SEPT
3	2.8	0	3.1	2.7
4	3.4	2.5	3.1	3.0
28	2.7	3.7	3.1	2.9

SOURCE	DF	SS	MS	F
MONTHS	3	2.0	.7	.74
SITES	2	2.2	1.1	1.24
ERROR	6	5.3	.9	
TOTAL	11	9.4		

449776

CUNI 1976

12 IN 3 Mn IN RED PINE

SITE	JUNE	JULY	AUG	SEPT
3	343.2	451.1	338.5	240.8
4	507.1	448.5	309.6	274.0
28	177.4	144.9	153.1	128.0

SOURCE	DF	SS	MS	F
MONTHS	3	37167.2	12389.1	3.18
SITES	2	124512.7	62256.3	16.00 **
ERROR	6	23348.2	3891.4	
TOTAL	11	185028.1		

CUNI 1976

13 IN 3 B IN RED PINE

SITE	JUNE	JULY	AUG	SEPT
3	16.1	14.5	15.1	14.3
4	15.9	16.1	13.5	14.0
28	17.8	17.7	17.3	15.2

SOURCE	DF	SS	MS	F
MONTHS	3	7.6	2.5	3.84
SITES	2	11.4	5.7	8.56 *
ERROR	6	4.0	.7	
TOTAL	11	23.0		

CUNI 1976

SOURCE	DF	SS	MS	F
MONTHS	3	[illegible]	[illegible]	[illegible]
SITES	2	11.4	5.7	8.56 *
ERROR	6	4.0	.7	
TOTAL	11	23.0		

CUNI 1976

14 IN 3

S in Red Pine

SITE	JUNE	JULY	AUG	SEPT
3	855.0	810.0	808.0	817.0
4	803.0	950.0	846.0	817.0
28	824.0	970.0	872.0	843.0

SOURCE	DF	SS	MS	F
MONTHS	3	14290.9	4763.6	2.19
SITES	2	6040.5	3020.3	1.39
ERROR	6	13050.8	2175.1	
TOTAL	11	33382.3		

CUNI 1976

16 IN 3 Pb in Red Pine

SITE	JUNE	JULY	AUG	SEPT
3	2.0	9.0	2.5	2.0
4	2.5	2.5	.5	1.0
28	2.5	.5	1.0	1.0

SOURCE	DF	SS	MS	F
MONTHS	3	14.3	4.8	1.08
SITES	2	16.1	8.1	1.83
ERROR	6	26.4	4.4	
TOTAL	11	56.8		

CUNI 1976

17 IN 3 Ni in Red Pine

SITE	JUNE	JULY	AUG	SEPT
3	1.5	1.5	2.5	2.5
4	3.0	3.0	4.5	4.5
28	1.5	1.5	2.0	2.0

SITE	JUNE	JULY	AUG	SEPT
3	1.5	1.5	2.5	2.5
4	3.0	3.0	4.5	4.5
28	1.5	1.5	2.0	2.0

SOURCE	DF	SS	MS	F
MONTHS	3	3.0	1.0	12.00 **
SITES	2	9.5	4.8	57.00 **
ERROR	6	.5	.1	
TOTAL	11	13.0		

CUNI 1976

3 IN 4 P in BLACK SPRUCE

SITE	JUNE	JULY	AUG	SEPT
5	1250.0	890.0	1200.0	1190.0
6	2330.0	1090.0	1320.0	1340.0
12	2050.0	1730.0	1800.0	1630.0
14	1550.0	1040.0	1070.0	1280.0

SOURCE	DF	SS	MS	F
MONTHS	3	814050.0	271350.0	5.52 *
SITES	3	1092650.0	364216.7	7.41 **
ERROR	9	442600.0	49177.8	
TOTAL	15	2349300.0		

CUNI 1976

4 IN 4 K in BLACK SPRUCE

SITE	JUNE	JULY	AUG	SEPT
5	3700.0	5300.0	6400.0	6000.0
6	7100.0	5900.0	7400.0	5800.0
12	6500.0	7700.0	7400.0	6700.0
14	5500.0	8200.0	6200.0	7100.0

SOURCE	DF	SS	MS	F
MONTHS	3	3316875.0	1105625.0	1.24
SITES	3	6796875.0	2265625.0	2.55
ERROR	9	8000625.0	888958.3	
TOTAL	15	18114375.0		

SOURCE	DF	SS	MS	F
SITES	3	6796875.0	2265625.0	2.55
ERROR	9	8000625.0	888958.3	
TOTAL	15	18114375.0		

CUNI 1976

5 IN 4

Ca in Black Spruce

SITE	JUNE	JULY	AUG	SEPT
5	6540.0	5180.0	3460.0	3890.0
6	8610.0	6110.0	3960.0	4630.0
12	9210.0	6470.0	6180.0	7310.0
14	6490.0	4220.0	5520.0	4780.0

SOURCE	DF	SS	MS	F
MONTHS	3	20837750.0	6945916.7	10.11 **
SITES	3	14372900.0	4790966.7	6.98 *
ERROR	9	6180950.0	686772.2	
TOTAL	15	41391600.0		

CUNI 1976

6 IN 4

Al in Black Spruce

SITE	JUNE	JULY	AUG	SEPT
5	286.0	149.0	96.0	117.0
6	356.0	125.0	85.0	217.0
12	137.0	81.0	58.0	121.0
14	492.0	85.0	207.0	247.0

SOURCE	DF	SS	MS	F
MONTHS	3	114322.7	38107.6	8.10 **
SITES	3	52523.2	17507.7	3.72
ERROR	9	42345.6	4705.1	
TOTAL	15	209191.4		

CUNI 1976

7 IN 4

Fe in Black Spruce

SITE	JUNE	JULY	AUG	SEPT
5	423.0	230.0	142.0	174.0
6	1067.0	286.0	215.0	483.0
12	478.0	95.0	108.0	241.0
14	796.0	112.0	359.0	340.0

7 IN 4 FE IN BLACK SPRUCE

SITE	JUNE	JULY	AUG	SEPT
5	423.0	230.0	142.0	174.0
6	1067.0	286.0	215.0	483.0
12	478.0	95.0	108.0	241.0
14	796.0	112.0	359.0	340.0

SOURCE	DF	SS	MS	F	
MONTHS	3	669048.7	223016.2	12.06	**
SITES	3	220061.2	73353.7	3.97	*
ERROR	9	166390.6	18487.8		
TOTAL	15	1055500.4			

CUNI 1976

8 IN 4 MG IN BLACK SPRUCE

SITE	JUNE	JULY	AUG	SEPT
5	1390.0	1340.0	1240.0	1320.0
6	1640.0	1190.0	1090.0	1160.0
12	1100.0	1010.0	1100.0	1040.0
14	1440.0	1250.0	1340.0	1340.0

SOURCE	DF	SS	MS	F	
MONTHS	3	111525.0	37175.0	2.89	
SITES	3	197075.0	65691.7	5.11	*
ERROR	9	115775.0	12863.9		
TOTAL	15	424375.0			

CUNI 1976

9 IN 4 ZN IN BLACK SPRUCE

SITE	JUNE	JULY	AUG	SEPT
5	84.3	65.2	52.9	45.7
6	78.4	71.2	55.8	54.6
12	87.2	54.7	58.3	49.8
14	80.7	58.6	78.0	52.7

SOURCE	DF	SS	MS	F	
MONTHS	3	2138.0	712.7	11.42	**
SITES	3	76.6	25.5	.41	
ERROR	9	561.5	62.4		
TOTAL	15	2776.0			

SOURCE	DF	SS	MS	F
MONTHS	3	2138.0	712.7	11.42 **
SITES	3	76.6	25.5	.41
ERROR	9	561.5	62.4	
TOTAL	15	2776.0		

CUNI 1976

10 IN 4 Cu IN BLACK SPRUCE

449/81

SITE	JUNE	JULY	AUG	SEPT
5	2.8	2.2	2.3	2.6
6	6.8	3.0	3.2	3.7
12	4.3	3.9	3.2	4.1
14	4.3	3.7	2.5	2.6

SOURCE	DF	SS	MS	F
MONTHS	3	6.9	2.3	3.65
SITES	3	6.7	2.2	3.55
ERROR	9	5.7	.6	
TOTAL	15	19.4		

CUNI 1976

12 IN 4 MN IN BLACK SPRUCE

SITE	JUNE	JULY	AUG	SEPT
5	791.1	634.3	577.8	617.3
6	915.5	679.6	614.5	706.3
12	687.7	500.7	629.1	591.4
14	479.7	445.4	449.4	500.3

SOURCE	DF	SS	MS	F
MONTHS	3	62272.9	20757.6	5.28 *
SITES	3	144644.1	48214.7	12.26 **
ERROR	9	35395.7	3932.9	
TOTAL	15	242312.7		

CUNI 1976

13 IN 4 B IN BLACK SPRUCE

SITE	JUNE	JULY	AUG	SEPT

CUNI 1976

3 IN 4 B in Black Spruce

SITE	JUNE	JULY	AUG	SEPT
5	24.8	19.5	21.6	20.5
6	40.2	31.4	24.5	26.9
12	21.4	19.8	18.5	18.0
14	24.9	21.6	21.1	20.5

SOURCE	DF	SS	MS	F
MONTHS	3	109.1	36.4	4.75 *
SITES	3	299.8	99.9	13.05 **
ERROR	9	68.9	7.7	
TOTAL	15	477.8		

CUNI 1976

14 IN 4 S in Black Spruce

SITE	JUNE	JULY	AUG	SEPT
5	790.0	840.0	838.0	824.0
6	928.0	860.0	851.0	837.0
12	897.0	790.0	739.0	830.0
14	837.0	940.0	783.0	843.0

SOURCE	DF	SS	MS	F
MONTHS	3	9049.7	3016.6	1.15
SITES	3	7675.7	2558.6	.98
ERROR	9	23615.1	2623.9	
TOTAL	15	40340.4		

CUNI 1976

16 IN 4 Pb in Black Spruce

SITE	JUNE	JULY	AUG	SEPT
5	8.5	4.5	1.0	1.0
6	4.5	3.5	1.5	2.5
12	3.0	1.0	8.5	10.5
14	5.0	1.0	5.0	3.0

SOURCE	DF	SS	MS	F
MONTHS	3	15.5	5.2	.47
SITES	3	17.5	5.8	.53
ERROR	9	99.0	11.0	
TOTAL	15	132.0		

SOURCE	DF	SS	MS	F
MONTHS	3	15.5	5.2	.47
SITES	3	17.5	5.8	.53
ERROR	9	99.0	11.0	
TOTAL	15	132.0		

449783

CUNI 1976

17 IN 4 Ni IN BLACK SPRUCE

SITE	JUNE	JULY	AUG	SEPT
5	1.5	1.5	2.5	1.5
6	1.5	1.0	1.5	1.5
12	1.5	1.0	1.0	1.0
14	2.5	1.0	2.0	1.5

SOURCE	DF	SS	MS	F
MONTHS	3	1.1	.4	2.70
SITES	3	1.1	.4	2.70
ERROR	9	1.3	.1	
TOTAL	15	3.5		

CUNI 1976

3 IN 5 P IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	2650.0	1810.0	1640.0	1780.0
8	3010.0	1940.0	2590.0	2570.0
9	3230.0	2060.0	2250.0	1850.0
24	3120.0	2440.0	2570.0	2500.0
31	2510.0	1780.0	2110.0	2030.0
34	3490.0	2320.0	2630.0	2410.0

SOURCE	DF	SS	MS	F	
MONTHS	3	3195045.8	1065015.3	28.23	**
SITES	5	1809720.8	361944.2	9.59	**
ERROR	15	565929.2	37728.6		
TOTAL	23	5570695.8			

CUNI 1976

4 IN 5 K IN PAPER BIRCH

CUNI 1976

4 IN 5 K IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	*	*	8400.0	8200.0
8	*	*	*	9300.0
9	*	*	*	9800.0
24	*	*	*	*
31	*	6500.0	5400.0	7100.0
34	*	*	*	830.0

SEE GREEN SHEET

SOURCE	DF	SS	MS	F
MONTHS	3	* .244E+09	81514704.2	20.51 **
SITES	5	* .133E+09	26737304.2	6.73 **
ERROR	15	59623562.5	3974904.2	
TOTAL	23	* .437E+09		

CUNI 1976

5 IN 5 CA IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	*	*	2530.0	*
8	*	*	*	*
9	*	*	*	*
24	*	*	*	*
31	9500.0	8060.0	*	6510.0
34	8630.0	5550.0	6540.0	5590.0

SEE GREEN SHEET

SOURCE	DF	SS	MS	F
MONTHS	3	10899645.8	3633215.3	.80
SITES	5	* .149E+09	29826534.2	6.54 **
ERROR	15	68381479.2	4558765.3	
TOTAL	23	* .228E+09		

CUNI 1976

6 IN 5 AL IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	109.0	103.0	306.0	291.0
8	74.0	69.0	83.0	112.0
9	89.0	82.0	88.0	163.0
24	82.0	84.0	119.0	158.0
31	55.0	63.0	75.0	84.0
34	[illegible]	105.0	[illegible]	197.0

SITE	JUNE	JULY	AUG	SEPT
7	109.0	103.0	306.0	291.0
8	74.0	69.0	83.0	112.0
9	89.0	82.0	88.0	163.0
24	82.0	84.0	119.0	158.0
31	55.0	63.0	75.0	84.0
34	45.0	105.0	135.0	197.0

SOURCE	DF	SS	MS	F
MONTHS	3	33700.5	11233.5	6.64 **
SITES	5	43092.7	8618.5	5.10 **
ERROR	15	25370.8	1691.4	
TOTAL	23	102164.0		

CUNI 1976

7 IN 5 Fe in Paper Birch

SITE	JUNE	JULY	AUG	SEPT
7	212.0	234.0	418.0	357.0
8	216.0	174.0	218.0	298.0
9	224.0	140.0	186.0	303.0
24	275.0	168.0	290.0	416.0
31	154.0	116.0	141.0	196.0
34	117.0	186.0	242.0	373.0

SOURCE	DF	SS	MS	F
MONTHS	3	82154.5	27384.8	10.13 **
SITES	5	60772.2	12154.4	4.50 *
ERROR	15	40558.3	2703.9	
TOTAL	23	183485.0		

CUNI 1976

8 IN 5 Mg in Paper Birch

SITE	JUNE	JULY	AUG	SEPT
7	4200.0	3520.0	920.0	3540.0
8	3620.0	3580.0	3560.0	3320.0
9	5230.0	4500.0	4720.0	4820.0
24	3430.0	3140.0	3350.0	3330.0
31	3670.0	3430.0	3830.0	3170.0
34	2543.0	1500.0	1660.0	1480.0

SOURCE	DF	SS	MS	F
MONTHS	3	1886226.1	628742.0	1.62
SITES	5	18888090.2	3777618.0	9.72 **
ERROR	15	[illegible]	[illegible]	

31	3670.0	3430.0	3830.0	3170.0
34	2543.0	1500.0	1660.0	1480.0

SOURCE	DF	SS	MS	F	
MONTHS	3	1886226.1	628742.0	1.62	
SITES	5	18888090.2	3777618.0	9.72	**
ERROR	15	5828100.6	388540.0		
TOTAL	23	26602417.0			

CUNI 1976

9 IN 5 Zn IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	215.7	159.2	68.0	124.4
8	244.5	184.8	186.5	174.2
9	222.4	168.7	163.9	124.1
24	280.6	252.4	208.0	237.8
31	185.6	94.1	101.2	60.5
34	191.4	152.4	154.4	113.5

SOURCE	DF	SS	MS	F	
MONTHS	3	26005.1	8668.4	16.94	**
SITES	5	43969.5	8793.9	17.19	**
ERROR	15	7674.6	511.6		
TOTAL	23	77649.2			

CUNI 1976

10 IN 5 Cu IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	7.8	4.1	4.0	3.4
8	8.4	4.6	5.6	4.1
9	8.0	5.3	4.4	3.4
24	8.9	5.7	4.1	3.7
31	7.3	7.3	3.5	3.7
34	9.4	5.5	4.7	4.7

SOURCE	DF	SS	MS	F	
MONTHS	3	71.2	23.7	38.39	**
SITES	5	3.5	.7	1.14	
ERROR	15	9.3	.6		
TOTAL	23	84.0			

SOURCE	DF	SS	MS	F
SITES	5	3.5	.7	1.14
ERROR	15	9.3	.6	
TOTAL	23	84.0		

CUNI 1976

12 IN 5 Mn IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	512.0	508.2	649.2	595.2
8	399.7	367.7	395.6	501.0
9	889.6	751.8	770.9	897.0
24	772.7	694.4	743.2	898.3
31	481.0	479.6	551.5	472.2
34	192.5	732.1	1120.6	1183.9

SOURCE	DF	SS	MS	F
MONTHS	3	202698.5	67566.2	1.67
SITES	5	607005.9	121401.2	3.00
ERROR	15	606741.7	40449.4	
TOTAL	23	1416446.1		

CUNI 1976

13 IN 5 B IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	32.9	37.3	39.8	47.0
8	31.8	35.7	38.1	45.8
9	36.1	45.0	38.9	46.5
24	35.6	43.2	45.3	48.9
31	29.9	35.9	37.9	36.4
34	33.8	61.9	66.8	68.1

SOURCE	DF	SS	MS	F
MONTHS	3	765.0	255.0	8.92 **
SITES	5	1275.6	255.1	8.93 **
ERROR	15	428.7	28.6	
TOTAL	23	2469.3		

CUNI 1976

14 IN 5 S IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	1430.0	1160.0	1150.0	1050.0

CUNI 1976

14 IN 5 S IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	1430.0	1160.0	1130.0	1050.0
8	1530.0	1420.0	1330.0	1040.0
9	1650.0	1360.0	1210.0	973.0
24	1140.0	1510.0	1320.0	986.0
31	1260.0	1340.0	1290.0	1270.0
34	1355.0	1490.0	1200.0	960.0

SOURCE	DF	SS	MS	F
MONTHS	3	465226.2	155075.4	7.77 **
SITES	5	47109.3	9421.9	.47
ERROR	15	299446.3	19963.1	
TOTAL	23	811781.8		

CUNI 1976

16 IN 5 PB IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	1.5	4.5	2.0	2.0
8	2.0	2.0	3.0	3.0
9	1.0	1.5	2.0	2.5
24	1.5	1.5	1.5	2.0
31	1.5	1.0	2.5	2.5
34	1.5	2.5	2.0	4.0

SOURCE	DF	SS	MS	F
MONTHS	3	4.1	1.4	2.29
SITES	5	3.5	.7	1.17
ERROR	15	9.0	.6	
TOTAL	23	16.6		

CUNI 1976

17 IN 5 NI IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	1.5	2.0	2.0	0
8	2.0	2.5	2.0	1.0
9	4.3	2.5	3.5	3.0
24	3.0	2.0	2.0	1.5
31	2.0	1.5	2.0	1.5
34	2.0	1.0	1.5	1.0

SOURCE	DF	SS	MS	F

SITES	5	10.5	2.1	8.74	**
ERROR	15	3.6	.2		
TOTAL	23	18.3			

CUNI 1976

3 IN 6 P IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	2110.0	1520.0	1910.0	1760.0
18	2360.0	2100.0	2070.0	2100.0
25	2930.0	2420.0	2230.0	2360.0

SOURCE	DF	SS	MS	F	
MONTHS	3	393291.7	131097.2	6.02	*
SITES	2	871216.7	435608.3	20.02	**
ERROR	6	130583.3	21763.9		
TOTAL	11	1395091.7			

CUNI 1976

4 IN 6 K IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	7700.0	9700.0	*	9400.0
18	8300.0	9200.0	8500.0	8100.0
25	*	*	*	9900.0

SEE GREEN SHEET

SOURCE	DF	SS	MS	F	
MONTHS	3	2296666.7	765555.6	1.39	
SITES	2	7081666.7	3540833.3	6.44	*
ERROR	6	3298333.3	549722.2		
TOTAL	11	12676666.7			

CUNI 1976

ERROR	6	3298333.3	549722.2	
TOTAL	11	12676666.7		

CUNI 1976

5 IN 6 Ca in Balsam Fir

449790

SITE	JUNE	JULY	AUG	SEPT
10	*	9440.0	7720.0	7730.0
18	*	*	*	*
25	*	9810.0	9490.0	8490.0

See Green Sheet

SOURCE	DF	SS	MS	F
MONTHS	3	16101158.3	5367052.8	3.09
SITES	2	4624316.7	2312158.3	1.33
ERROR	6	10425416.7	1737569.4	
TOTAL	11	31150891.7		

CUNI 1976

6 IN 6 Al in Balsam Fir

SITE	JUNE	JULY	AUG	SEPT
10	567.0	396.0	330.0	376.0
18	463.0	380.0	312.0	580.0
25	442.0	362.0	380.0	378.0

SOURCE	DF	SS	MS	F
MONTHS	3	40193.0	13397.7	2.25
SITES	2	3811.2	1905.6	.32
ERROR	6	35685.5	5947.6	
TOTAL	11	79689.7		

CUNI 1976

7 IN 6 Fe in Balsam Fir

SITE	JUNE	JULY	AUG	SEPT
10	582.0	203.0	185.0	199.0
18	356.0	151.0	238.0	461.0
25	392.0	153.0	235.0	260.0

SOURCE	DF	SS	MS	F
MONTHS	3	129918.9	43306.3	3.89

SITE	JUNE	JULY	AUG	SEPT
10	582.0	203.0	185.0	199.0
18	356.0	151.0	238.0	461.0
25	392.0	153.0	235.0	260.0

SOURCE	DF	SS	MS	F
MONTHS	3	129918.9	43306.3	3.89
SITES	2	3797.2	1898.6	.17
ERROR	6	66790.8	11131.8	
TOTAL	11	200506.9		

449791

CUNI 1976

8 IN 6 Mg IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	1370.0	1340.0	1380.0	1350.0
18	1320.0	1340.0	1400.0	1600.0
25	1320.0	1380.0	1240.0	1300.0

SOURCE	DF	SS	MS	F
MONTHS	3	12566.7	4188.9	.53
SITES	2	22066.7	11033.3	1.39
ERROR	6	47533.3	7922.2	
TOTAL	11	82166.7		

CUNI 1976

9 IN 6 Zn IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	72.2	58.8	59.1	52.3
18	55.1	49.8	60.2	44.3
25	94.1	86.4	72.9	74.7

SOURCE	DF	SS	MS	F
MONTHS	3	422.2	140.7	3.68
SITES	2	1876.9	938.5	24.57 **
ERROR	6	229.1	38.2	
TOTAL	11	2528.2		

CUNI 1976

10 IN 6 Cu IN BALSAM FIR

TOTAL	11	2528.2		

CUNI 1976

10 IN 6 Cu IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	4.4	4.3	4.1	5.0
18	4.3	4.3	4.4	3.0
25	4.4	3.7	3.1	4.0

SOURCE	DF	SS	MS	F
MONTHS	3	.4	.1	.35
SITES	2	.9	.4	1.16
ERROR	6	2.3	.4	
TOTAL	11	3.6		

CUNI 1976

12 IN 6 Mn IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	603.5	473.1	408.6	392.9
18	739.2	603.2	563.7	627.0
25	771.5	602.0	680.8	667.6

SOURCE	DF	SS	MS	F
MONTHS	3	48883.2	16294.4	9.51 *
SITES	2	98055.7	49027.9	28.63 **
ERROR	6	10276.6	1712.8	
TOTAL	11	157215.5		

CUNI 1976

13 IN 6 B IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	24.2	21.2	21.3	19.4
18	18.7	24.0	20.1	20.5
25	21.7	22.1	19.9	18.9

SOURCE	DF	SS	MS	F
MONTHS	3	13.9	4.6	1.38
SITES	2	1.7	.9	.26

25	21.7	22.1	19.9	18.9

SOURCE	DF	SS	MS	F
MONTHS	3	13.9	4.6	1.38
SITES	2	1.7	.9	.26
ERROR	6	20.0	3.3	
TOTAL	11	35.6		

CUNI 1976

14 IN 6 S IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	1050.0	1170.0	1030.0	1010.0
18	973.0	1120.0	961.0	960.0
25	1175.0	1300.0	1140.0	1090.0

SOURCE	DF	SS	MS	F
MONTHS	3	56151.6	18717.2	69.40 **
SITES	2	61335.2	30667.6	113.71 **
ERROR	6	1618.2	269.7	
TOTAL	11	119104.9		

CUNI 1976

16 IN 6 PB IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	4.3	3.0	19.5	2.0
18	1.0	1.5	1.5	3.0
25	3.0	2.0	10.0	3.5

SOURCE	DF	SS	MS	F
MONTHS	3	135.8	45.3	2.46
SITES	2	59.5	29.7	1.61
ERROR	6	110.6	18.4	
TOTAL	11	305.8		

CUNI 1976

17 IN 6 NI IN BALSAM FIR

SITE JUNE JULY AUG SEPT

CUNI 1976

17 IN 6 Ni IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	2.8	2.5	3.0	3.0
18	2.5	2.8	3.5	3.0
25	3.0	2.5	3.5	3.0

SOURCE	DF	SS	MS	F	
MONTHS	3	.9	.3	6.31	*
SITES	2	.1	.0	.68	
ERROR	6	.3	.0		
TOTAL	11	1.3			

CUNI 1976

3 IN 7 P IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	3390.0	2210.0	2110.0	1760.0
13	3500.0	2270.0	2400.0	2310.0
20	3110.0	2090.0	2050.0	1910.0
22	3150.0	2400.0	2200.0	2020.0
27	3300.0	1900.0	1890.0	1850.0
29	4110.0	2100.0	1940.0	1800.0
32	3600.0	2180.0	1950.0	1930.0
33	3490.0	2110.0	2170.0	2110.0

SOURCE	DF	SS	MS	F	
MONTHS	3	10488034.4	3496011.5	78.91	**
SITES	7	485221.9	69317.4	1.56	
ERROR	21	930390.6	44304.3		
TOTAL	31	11903646.9			

CUNI 1976

4 IN 7 K IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	*	*	*	8600.0
13	*	*	*	9500.0
20	*	*	*	7500.0
22	*	*	*	8800.0
27	*	*	*	8700.0
29	*	*	1210.0	9500.0
32	*	*	9300.0	7300.0

SEE GREEN SHEET

SITE	JUNE	JULY	AUG	SEPT
11	*	*	*	8600.0
13	*	*	*	9500.0
20	*	*	*	7500.0
22	*	*	*	8800.0
27	*	*	*	8700.0
29	*	*	1210.0	9500.0
32	*	*	9300.0	7300.0
33	*	*	*	*

SEE GREEN SHEET

SOURCE	DF	SS	MS	F
MONTHS	3	* .378E+09	* .126E+09	22.15
SITES	7	26336021.9	3762288.8	.66
ERROR	21	* .119E+09	5699348.4	
TOTAL	31	* .524E+09		

449795

CUNI 1976

5 IN 7 CA IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	*	*	*	*
13	*	*	*	*
20	8850.0	*	*	*
22	*	*	*	*
27	8920.0	*	*	*
29	*	*	1824.0	*
32	6300.0	*	*	*
33	*	*	*	*

SEE GREEN SHEET

SOURCE	DF	SS	MS	F
MONTHS	3	* .126E+09	42143679.5	4.34
SITES	7	93950912.9	13421559.0	1.38
ERROR	21	* .204E+09	9716332.3	
TOTAL	31	* .424E+09		

CUNI 1976

6 IN 7 AL IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	67.0	71.0	112.0	135.0
13	54.0	65.0	79.0	115.0
20	43.0	150.0	81.0	207.0
22	38.0	79.0	79.0	103.0
27	41.0	87.0	165.0	184.0
29	58.0	59.0	84.0	106.0
32	98.0	79.0	145.0	163.0
33	53.0	59.0	78.0	101.0

SOURCE DF SS MS F

SITE	JUNE	JULY	AUG	SEPT
13	54.0	65.0	79.0	[illegible]
20	43.0	150.0	81.0	207.0
22	38.0	79.0	79.0	103.0
27	41.0	87.0	165.0	184.0
29	58.0	59.0	84.0	106.0
32	98.0	79.0	145.0	163.0
33	53.0	59.0	78.0	101.0

SOURCE	DF	SS	MS	F
MONTHS	3	29558.6	9852.9	13.83 **
SITES	7	13739.9	1962.8	2.75 ✝
ERROR	21	14963.4	712.5	
TOTAL	31	58261.9		

CUNI 1976

7 IN 7 FE IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	126.0	105.0	159.0	169.0
13	139.0	121.0	153.0	219.0
20	102.0	139.0	178.0	332.0
22	124.0	114.0	137.0	187.0
27	133.0	168.0	278.0	316.0
29	124.0	91.0	101.0	165.0
32	210.0	229.0	433.0	494.0
33	335.0	63.0	96.0	144.0

SOURCE	DF	SS	MS	F
MONTHS	3	67285.8	22428.6	4.42 *
SITES	7	142363.5	20337.6	4.01 * ✝
ERROR	21	106596.3	5076.0	
TOTAL	31	316245.5		

CUNI 1976

8 IN 7 MG IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	3130.0	2870.0	3280.0	2950.0
13	3200.0	3120.0	3350.0	3440.0
20	3050.0	3190.0	3080.0	3360.0
22	2950.0	2930.0	309.0	2920.0
27	2960.0	3050.0	2750.0	3070.0
29	2780.0	3080.0	2860.0	2950.0
32	1750.0	3330.0	3420.0	3730.0
33	3260.0	2340.0	2560.0	2490.0

SOURCE	DF	SS	MS	F
MONTHS	3	731026.3	243675.4	.67
SITES	7	2835711.5	405101.6	1.11

32	1750.0	3330.0	3420.0	3730.0
33	3260.0	2340.0	2560.0	2490.0

SOURCE	DF	SS	MS	F
MONTHS	3	731026.3	243675.4	.67
SITES	7	2835711.5	405101.6	1.11
ERROR	21	7640434.4	363830.2	
TOTAL	31	11207172.2		

CUNI 1976

9 IN 7 ZN IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	170.6	197.0	230.7	177.2
13	261.6	283.1	350.7	311.4
20	151.0	197.4	194.6	162.6
22	150.1	155.2	138.9	122.5
27	199.1	232.9	200.3	258.6
29	172.2	186.8	159.2	178.6
32	213.4	143.0	144.2	122.8
33	163.6	247.6	240.8	210.8

SOURCE	DF	SS	MS	F
MONTHS	3	2647.8	882.6	1.02
SITES	7	70719.3	10102.8	11.67 **
ERROR	21	18174.4	865.4	
TOTAL	31	91541.5		

CUNI 1976

10 IN 7 CU IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	11.4	8.3	5.2	4.0
13	12.0	8.7	5.6	4.7
20	8.7	8.3	4.7	4.7
22	9.1	7.4	5.6	6.1
27	9.8	8.0	6.4	5.5
29	8.7	6.6	5.2	3.8
32	6.9	8.9	6.7	7.0
33	14.1	5.9	4.2	5.0

SOURCE	DF	SS	MS	F
MONTHS	3	128.7	42.9	18.30 **
SITES	7	7.8	1.1	.48
ERROR	21	49.2	2.3	
TOTAL	31	185.8		

SOURCE	DF	SS	MS	F
MONTHS	3	128.7	42.9	18.30 **
SITES	7	7.8	1.1	.48
ERROR	21	49.2	2.3	
TOTAL	31	185.8		

4497798

CUNI 1976

12 IN 7 Mn in Aspen

SITE	JUNE	JULY	AUG	SEPT
11	113.7	108.8	129.1	120.0
13	146.2	135.2	140.4	147.4
20	62.4	103.7	83.5	105.9
22	87.4	106.9	116.4	120.0
27	66.8	92.0	84.8	107.9
29	58.6	83.6	82.3	103.2
32	850.5	109.5	89.9	92.4
33	63.0	109.5	115.2	111.2

SOURCE	DF	SS	MS	F
MONTHS	3	27904.4	9301.5	.48
SITES	7	125461.3	17923.0	.93
ERROR	21	404622.9	19267.8	
TOTAL	31	557988.6		

CUNI 1976

13 IN 7 B in Aspen

SITE	JUNE	JULY	AUG	SEPT
11	31.0	45.5	44.1	41.6
13	26.7	32.5	29.3	29.2
20	24.4	34.6	30.5	39.3
22	28.8	37.8	36.9	43.2
27	24.4	35.3	32.4	39.5
29	23.5	35.3	30.0	35.3
32	39.3	43.1	38.2	41.4
33	33.6	43.1	42.0	41.4

SOURCE	DF	SS	MS	F
MONTHS	3	499.4	166.5	21.91 **
SITES	7	587.5	83.9	11.04 **
ERROR	21	159.6	7.6	
TOTAL	31	1246.6		

SOURCE	DF	SS	MS	F
SITES	7	[illegible]	[illegible]	[illegible]
ERROR	21	159.6	7.6	
TOTAL	31	1246.6		

CUNI 1976

14 IN 7 S IN ASPEN

449/99

SITE	JUNE	JULY	AUG	SEPT
11	2085.0	1970.0	1780.0	1590.0
13	2210.0	1870.0	1710.0	1470.0
20	2275.0	1680.0	1480.0	1400.0
22	2260.0	1900.0	1840.0	1740.0
27	2405.0	1800.0	1790.0	1400.0
29	2010.0	1770.0	1510.0	1220.0
32	2375.0	2130.0	1850.0	2030.0
33	1870.0	1720.0	1620.0	1330.0

SOURCE	DF	SS	MS	F	
MONTHS	3	1910309.4	636769.8	43.64	**
SITES	7	700746.9	100106.7	6.86	**
ERROR	21	306440.6	14592.4		
TOTAL	31	2917496.9			

CUNI 1976

16 IN 7 PB IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	.5	2.5	2.0	1.0
13	1.0	.5	2.5	4.5
20	.5	1.0	14.0	14.0
22	.5	2.0	1.0	1.0
27	1.0	1.0	2.0	2.0
29	1.0	1.5	1.0	1.5
32	1.0	1.0	4.0	2.5
33	.5	.5	4.5	2.5

SOURCE	DF	SS	MS	F
MONTHS	3	61.8	20.6	2.97
SITES	7	118.5	16.9	2.44
ERROR	21	145.8	6.9	
TOTAL	31	326.0		

CUNI 1976

17 IN 7 NI IN ASPEN

TOTAL	31	326.0		

CUNI 1976

17 IN 7 Ni in Aspen

449800

SITE	JUNE	JULY	AUG	SEPT
11	1.0	1.5	1.0	1.0
13	2.5	2.5	2.0	3.5
20	4.0	3.0	3.0	3.0
22	1.5	2.0	1.0	1.0
27	2.5	1.5	2.0	2.0
29	1.0	.5	.5	.5
32	2.5	2.0	2.0	2.0
33	1.5	1.0	1.5	1.0

SOURCE	DF	SS	MS	F
MONTHS	3	.8	.3	1.89
SITES	7	21.0	3.0	20.30 **
ERROR	21	3.1	.1	
TOTAL	31	24.9		

CUNI 1976

3 IN 8

P in Tamarack

SITE	JUNE	JULY	AUG	SEPT
15	1680.0	930.0	1270.0	1330.0
16	2360.0	1550.0	1830.0	1710.0
30	1700.0	1610.0	1840.0	2280.0

SOURCE	DF	SS	MS	F
MONTHS	3	493225.0	164408.3	2.33
SITES	2	828866.7	414433.3	5.86 *
ERROR	6	424200.0	70700.0	
TOTAL	11	1746291.7		

CUNI 1976

4 IN 8

K in Tamarack

SITE	JUNE	JULY	AUG	SEPT
15	*	6700.0	5600.0	5200.0
16	7800.0	5900.0	6000.0	4900.0
30	6800.0	5400.0	5100.0	5000.0

4 IN 8

K IN TAMARACK

SITE	JUNE	JULY	AUG	SEPT
15	*	6700.0	5600.0	5200.0
16	7800.0	5900.0	6000.0	4900.0
30	6800.0	5400.0	5100.0	5000.0

SOURCE	DF	SS	MS	F
MONTHS	3	18629166.7	6209722.2	9.32 *
SITES	2	3815000.0	1907500.0	2.86
ERROR	6	3998333.3	666388.9	
TOTAL	11	26442500.0		

4498U1

CUNI 1976

5 IN 8

CA IN TAMARACK

SITE	JUNE	JULY	AUG	SEPT
15	3740.0	3160.0	4080.0	3960.0
16	4140.0	3280.0	3950.0	3910.0
30	3850.0	3250.0	4160.0	4410.0

SOURCE	DF	SS	MS	F
MONTHS	3	1470158.3	490052.8	14.66 **
SITES	2	66716.7	33358.3	1.00
ERROR	6	200616.7	33436.1	
TOTAL	11	1737491.7		

CUNI 1976

6 IN 8

AL IN TAMARACK

SITE	JUNE	JULY	AUG	SEPT
15	202.0	149.0	278.0	463.0
16	313.0	216.0	257.0	566.0
30	428.0	422.0	723.0	973.0

SOURCE	DF	SS	MS	F
MONTHS	3	291387.0	97129.0	11.80 **
SITES	2	300612.7	150306.3	18.25 **
ERROR	6	49406.0	8234.3	
TOTAL	11	641405.7		

ERROR	6	49406.0	8234.3
TOTAL	11	641405.7	

CUNI 1976

7 IN 8

Fe IN TAMARACK

SITE	JUNE	JULY	AUG	SEPT
15	493.0	303.0	637.0	739.0
16	661.0	413.0	492.0	804.0
30	764.0	684.0	1001.0	1361.0

SOURCE	DF	SS	MS	F
MONTHS	3	389954.7	129984.9	9.07 *
SITES	2	399654.0	199827.0	13.94 **
ERROR	6	85991.3	14331.9	
TOTAL	11	875600.0		

CUNI 1976

8 IN 8

MG IN TAMARACK

SITE	JUNE	JULY	AUG	SEPT
15	1580.0	1320.0	1440.0	1610.0
16	1450.0	1120.0	1200.0	1190.0
30	990.0	*	1140.0	1240.0

SOURCE	DF	SS	MS	F
MONTHS	3	19344633.3	6448211.1	.88
SITES	2	11370216.7	5685108.3	.78
ERROR	6	43961916.7	7326986.1	
TOTAL	11	74676766.7		

CUNI 1976

9 IN 8

Zn IN TAMARACK

SITE	JUNE	JULY	AUG	SEPT
15	43.5	35.4	46.7	32.4
16	66.6	50.8	59.9	50.4
30	53.1	44.3	45.1	50.0

SOURCE	DF	SS	MS	F
MONTHS	3	244.8	81.6	3.92

SITE	JUNE	JULY	AUG	SEPT
15	43.5	35.4	46.7	32.4
16	66.6	50.8	59.9	50.4
30	53.1	44.3	45.1	50.0

SOURCE	DF	SS	MS	F
MONTHS	3	244.8	81.6	3.92
SITES	2	607.3	303.6	14.59 **
ERROR	6	124.9	20.8	
TOTAL	11	976.9		

CUNI 1976

10 IN 8 Cu in TAMARACK

SITE	JUNE	JULY	AUG	SEPT
15	6.9	4.1	3.1	2.6
16	7.3	4.1	3.2	3.2
30	5.7	4.8	5.0	4.6

SOURCE	DF	SS	MS	F
MONTHS	3	18.5	6.2	8.05 *
SITES	2	1.5	.8	.98
ERROR	6	4.6	.8	
TOTAL	11	24.6		

CUNI 1976

12 IN 8 Mn in TAMARACK

SITE	JUNE	JULY	AUG	SEPT
15	450.5	406.9	463.6	467.0
16	1097.6	815.7	1271.1	1116.2
30	682.3	619.4	814.2	874.2

SOURCE	DF	SS	MS	F
MONTHS	3	99218.6	33072.9	3.81
SITES	2	789634.5	394817.2	45.43 **
ERROR	6	52139.5	8689.9	
TOTAL	11	940992.5		

CUNI 1976

ERROR	6	52139.5	8689.9	
TOTAL	11	940992.5		

CUNI 1976

13 IN 8 B in TAMARACK

SITE	JUNE	JULY	AUG	SEPT
15	33.6	36.7	30.2	34.3
16	24.8	24.9	26.4	22.9
30	18.7	24.6	25.0	26.2

4498U4

SOURCE	DF	SS	MS	F
MONTHS	3	14.6	4.9	.62
SITES	2	243.8	121.9	15.59 **
ERROR	6	46.9	7.8	
TOTAL	11	305.3		

CUNI 1976

14 IN 8 S in TAMARACK

SITE	JUNE	JULY	AUG	SEPT
15	1224.0	1220.0	1180.0	1280.0
16	1120.0	1200.0	1380.0	1260.0
30	553.0	1380.0	1290.0	1250.0

SOURCE	DF	SS	MS	F
MONTHS	3	210605.6	70201.9	1.59
SITES	2	35505.5	17752.8	.40
ERROR	6	265343.2	44223.9	
TOTAL	11	511454.3		

CUNI 1976

16 IN 8 PB in TAMARACK

SITE	JUNE	JULY	AUG	SEPT
15	3.5	4.5	23.0	23.5
16	6.5	6.0	5.5	31.0
30	9.0	8.5	21.0	21.5

SOURCE	DF	SS	MS	F
MONTHS	3	755.1	251.7	6.24 *

SITE	JUNE	JULY	AUG	SEPT
15	3.5	4.5	23.0	23.5
16	6.5	6.0	5.5	31.0
30	9.0	8.5	21.0	21.5

SOURCE	DF	SS	MS	F
MONTHS	3	755.1	251.7	6.24 *
SITES	2	15.1	7.6	.19
ERROR	6	241.9	40.3	
TOTAL	11	1012.1		

4498U5

CUNI 1976

17 IN 8 Ni in Tamarack

SITE	JUNE	JULY	AUG	SEPT
15	1.5	1.0	1.0	1.0
16	1.5	1.5	1.5	1.0
30	2.0	1.0	2.5	1.5

SOURCE	DF	SS	MS	F
MONTHS	3	.8	.3	1.71
SITES	2	.8	.4	2.71
ERROR	6	.9	.1	
TOTAL	11	2.4		

CUNI 1976

4 IN 5 K IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	17100.0	10900.0	8400.0	8200.0
8	15500.0	12400.0	11700.0	9300.0
9	20000.0	13100.0	13300.0	9800.0
24	18000.0	13900.0	13100.0	11000.0
31	11300.0	6500.0	5400.0	7100.0
34	16400.0	10400.0	10800.0	830.0

SOURCE	DF	SS	MS	F
MONTHS	3	* .244E+09	81514704.2	20.51
SITES	5	* .133E+09	26737304.2	6.73
ERROR	15	59623562.5	3974904.2	
TOTAL	23	* .437E+09		

CUNI 1976

5 IN 5 CA IN PAPER BIRCH

SITE	JUNE	JULY	AUG	SEPT
7	11960.0	10320.0	2530.0	11310.0
8	11850.0	10370.0	10790.0	11990.0
9	12700.0	11440.0	12060.0	12280.0
24	12920.0	13930.0	14300.0	15480.0
31	9500.0	8060.0	10520.0	6510.0
34	8030.0	5550.0	6540.0	5590.0

SOURCE	DF	SS	MS	F
MONTHS	3	10899645.8	3633215.3	.80
SITES	5	* .149E+09	29826534.2	6.54
ERROR	15	68381479.2	4558765.3	
TOTAL	23	* .228E+09		

SITES	5	* .149E+09	29826534.2	6.54
ERROR	15	68381479.2	4558765.3	
TOTAL	23	* .228E+09		

CUNI 1976

4 IN 6

K IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	7700.0	9700.0	10500.0	9400.0
18	8300.0	9200.0	8500.0	8100.0
25	10000.0	11000.0	10100.0	9900.0

SOURCE	DF	SS	MS	F
MONTHS	3	2296666.7	765555.6	1.39
SITES	2	7081666.7	3540833.3	6.44
ERROR	6	3298333.3	549722.2	
TOTAL	11	12676666.7		

CUNI 1976

5 IN 6

CA IN BALSAM FIR

SITE	JUNE	JULY	AUG	SEPT
10	13530.0	9440.0	7720.0	7730.0
18	12140.0	10270.0	10040.0	10900.0
25	10010.0	9310.0	9490.0	8490.0

SOURCE	DF	SS	MS	F
MONTHS	3	16101158.3	5367052.8	3.09
SITES	2	4624316.7	2312158.3	1.33
ERROR	6	10425416.7	1737569.4	
TOTAL	11	31150891.7		

CUNI 1976

4 IN 7

K IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	19000.0	12000.0	11600.0	8600.0
13	15700.0	11900.0	10900.0	9500.0
20	14000.0	10700.0	10100.0	7500.0
22	17100.0	12600.0	11400.0	8800.0
27	[illegible]	12700.0	10300.0	8700.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

4 IN 7

K IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	19000.0	12000.0	11600.0	8600.0
13	15700.0	11900.0	10900.0	9500.0
20	14000.0	10700.0	10100.0	7500.0
22	17100.0	12600.0	11400.0	8800.0
27	18100.0	12700.0	10300.0	8700.0
29	20100.0	14300.0	1210.0	9500.0
32	14400.0	11700.0	9300.0	7300.0
33	21500.0	10300.0	11400.0	10100.0

SOURCE	DF	SS	MS	F
MONTHS	3	* .378E+09	* .126E+09	22.15
SITES	7	26336021.9	3762288.8	.66
ERROR	21	* .119E+09	5699348.4	
TOTAL	31	* .524E+09		

CONT 1976

5 IN 7

CA IN ASPEN

SITE	JUNE	JULY	AUG	SEPT
11	13220.0	14370.0	17990.0	18760.0
13	12090.0	14590.0	17370.0	18790.0
20	8650.0	11910.0	10830.0	13040.0
22	11290.0	14290.0	16100.0	15980.0
27	8920.0	11630.0	13270.0	14970.0
29	11080.0	15210.0	1824.0	17830.0
32	6300.0	14380.0	17900.0	16870.0
33	12110.0	13410.0	16240.0	13180.0

SOURCE	DF	SS	MS	F
MONTHS	3	* .126E+09	42143679.5	4.34
SITES	7	93950912.9	13421559.0	1.38
ERROR	21	* .204E+09	9716332.3	
TOTAL	31	* .424E+09		

4. Soil chemical and statistical analyses data.

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

GROUP NO. 38

Cu-Ni 1st SAMPLING 1976

SAMPLE	S.A.	Row	SULFATE ppm in soil	pH	CALCIUM ppm in soil	MAGNESIUM ppm in soil	SODIUM ppm in soil	POTASSIUM ppm in soil	FLUORIDE ppm in soil
40 0-6	7	1	114	59	0573	989	84	513	5.5
40 6-12	-	2	116	55	1180	186	53	113	4.8
1 0-6	7	3	113	53	690	178	152	651	10.2
1 6-12		4	115	57	341	104	160	262	10.2
2 0-6	49	5	18	53	831	134	105	106	8.0
2 6-12		6	31	56	327	734	98	243	9.6
3 0-6	7	7	23	54	1410	154	74	157	6.2
3 6-12		8	20	61	658	680	100	525	5.3
4 0-6	5	9	15	51	1040	201	124	147	10.9
5 0-6	58	10	158	56	5000	3690	546	168	9.6
5 6-12		11	165	57	5760	3300	573	111	9.3
6 0-6	58	12	34	56	3840	1310	249	992	13.4
7 0-6	7	13	14	57	1170	236	126	115	6.2
7 6-12		14	16	59	658	110	105	500	5.9
8 0-6	5	15	15	56	1360	219	126	878	9.3
9 0-6	7	16	16	56	643	133	105	910	5.0
9 6-12		17	12	60	1310	235	77	234	4.1
11 0-6	7	18	33	54	1270	164	152	109	4.7
12 0-6	5	19	20	53					6.8
12 6-12		20	21	57	295	532	105	352	6.8
13 0-6	5	21	21	53	1520	219	129	153	6.8
13 6-12		22	15	56	374	693	95	757	9.0
14 0-6	58	23	96	57	6160	4160	107	100	4.4
15 0-6	58	24	14	55	1640	779	333	718	7.1
17 0-6	58	25	186	54	4640	2140	500	233	6.5
18 0-6	8	26	14	50	993	171	98	104	7.7
19 0-6	7	27	13	55	1010	959	92	120	5.5
19 6-12		28	10	59	374	519	58	516	7.1
20 0-6	8	29	20	54	1010	154	48	112	7.4

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

SAMPLE		SULFATE ppm in soil	PH	CALCIUM ppm in soil	MAGNESIUM ppm in soil	SODIUM ppm in soil	POTASSIUM ppm in soil	FLUORIDE ppm in soil
21 0-6	5	20	58	2010	234	95	214	71
21 6-12		14	58	945	962	88	666	80
22 0-6	5	10	53	993	131	81	101	80
22 6-12		18	57	429	559	69	357	80
23 0-6	10	32	50	1420	207	186	157	71
24 0-6	5	16	52	1560	200	88	218	63
24 6-12		8	53	383	653	44	964	38
25 0-6	5	20	55	2430	225	86	159	106
26 0-6	10	11	53	902	160	136	937	77
26 6-12		9	52	564	178	160	432	96
27 0-6	5	20	51	1910	394	140	187	96
28 0-6	5	13	57	1140	150	81	163	106
28 6-12		14	58	993	123	69	112	102
29 0-6	6	16	54	1960	211	105	145	90
29 6-12		15	55	1080	127	95	760	90
30 0-6	57	56	45	1900	431	343	123	NS
30 6-12		45	40	1200	265	259	525	62
31 0-6	8	20	50	950	149	119	101	71
32 0-6	5	21	50	1520	235	74	121	121
33 0-6	7	15	53	1460	135	67	136	64
34 0-6	4	18	50	1440	171	55	126	77

Cu-Ni
GP-38
1 II Soil Sample
1976

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

Site	Depth		Row	Manganese ppm in soil	Copper ppm in soil	Iron ppm in soil	Zinc ppm in sol	Lead ppm in soil	Nickel ppm in soil	Cadmium ppm in soil	Chromium ppm in soil
UD	0-6	7	1	18	014	212	008	01	<02	<1	03
UD	6-12		2	167	027	114	766	09	05	<1	03
1	0-6	7	3	115	043	208	075	06	04	<1	05
1	6-12		4	11	037	214	007	<01	03	<1	03
2	0-6	49	5	466	052	168	260	07	07	<1	05
2	6-12		6	32	054	164	030	<01	03	<1	07
3	0-6	7	7	602	034	109	199	08	04	<1	02
3	6-12		8	100	026	408	045	<01	<02	<1	<1
4	0-6	5	9	370	055	210	544	09	11	<1	05
5	0-6	58	10	283	240	1500	381	40	76	NS	NS
5	6-12		11	NS	NS	NS	NS	NS	NS	NS	NS
6	0-6	58	12	332	194	410	206	18	18	01	<1
7	0-6	7	13	322	027	108	076	10	08	<1	02
7	6-12		14	40	027	482	014	03	<02	<1	<1
8	0-6	5	15	232	053	136	400	10	04	02	04
9	0-6	7	16	141	034	366	024	02	<02	<1	<1
9	6-12		17	406	031	108	136	05	09	<1	<1
11	0-6	7	18	360	024	140	149	10	05	<1	01
12	0-6	5	19	163	036	136	079	04	02	<1	02
12	6-12		20	18	022	358	007	<01	<02	<1	<1
13	0-6	5	21	628	046	168	532	08	07	01	03
13	6-12		22	34	064	101	021	01	<02	<1	03
14	0-6	58	23	NS	NS	NS	NS	NS	NS	NS	NS
15	0-6	58	24	66	062	416	113	04	12	<1	<1
17	0-6	58	25	110	604	1850	108	15	66	NS	NS
18	0-6	8	26	344	053	194	178	16	08	<1	04
19	0-6	7	27	244	037	127	164	08	03	<1	02
19	6-12		28	25	024	252	204	02	<02	<1	<1
20	0-6	8	29	358	256	153	572	10	07	<1	04

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

				Manganese ppm in soil	Copper ppm in soil	Iron ppm in soil	Zinc ppm in soil	Lead ppm in soil	Nickel ppm in soil	Cadmium ppm in soil	Chromium ppm in soil
21	0-6	5	1	224	063	127	420	08	05	<1	02
21	6-12		2	32	031	528	072	01	<02	<1	01
22	0-6	5	3	546	036	121	298	13	03	<1	03
22	6-12		4	28	019	392	007	01	<02	<1	01
23	0-6	10	5	478	035	214	558	10	08	<1	01
24	0-6	5	6	123	025	187	102	15	07	<1	03
24	6-12		7	266	014	100	042	02	03	NS	NS
25	0-6	5	8	151	064	166	179	31	10	02	02
26	0-6	10	9	121	038	260	358	13	08	<1	01
26	6-12		10	156	053	174	048	02	04	<1	<1
27	0-6	5	11	264	012	466	348	<01	15	<1	<1
28	0-6	5	12	134	097	87	300	34	09	<1	<1
28	6-12		13	71	063	72	076	10	03	<1	<1
29	0-6	6	14	242	056	80	926	08	06	02	<1
29	6-12		15	120	053	110	108	02	03	<1	02
30	0-6	57	16	173	021	400	105	<01	13	NS	NS
30	6-12		17	<01	<010	<01	<01	<01	<02	NS	NS
31	0-6	8	18	95	034	147	134	12	04	<1	01
32	0-6	5	19	354	056	212	538	17	08	<1	02
33	0-6	7	20	348	052	120	978	07	04	<1	01
34	0-6	4	21	332	042	218	268	04	05	<1	<1

Grupa
Cu-Ni study
Gp. 60
2nd Soil Sample
1976

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

Sample		No.	Ca ppm in soil	Mg ppm in soil	Na ppm in soil	K ppm in soil	Mn ppm in soil	Fe ppm in soil	Cu ppm in soil	FLUORIDE ppm soil	No.
1-6	7	1	514	187	91	687	62	262	03	93	1
1-12		2	193	804	96	187	<01	132	02	90	2
2-6	49	3	718	136	60	939	390	151	06	96	3
2-12		4	247	606	65	341	03	115	03	96	4
3-6	7	5	607	886	40	926	111	789	03	61	5
3-12		6	361	540	50	465	102	255	02	64	6
4-6	5	7	777	165	93	173	388	170	05	90	7
5-6	58	8	4560	4040	49	152	268	175	19	72	8
5-12		9	6020	3990	60	320	373	2230	21	124	9
6-6	58	10	4610	1470	36	930	94	117	01	113	10
6-12		11	3690	1120	26	373	57	911	07	NS	11
7-6	7	12	1250	238	40	172	189	958	02	58	12
7-12		13	497	969	47	819	08	320	07	55	13
8-6	5	14	1400	255	65	926	259	116	07	77	14
9-6	7	15	1340	255	50	220	194	860	03	45	15
9-12		16	532	936	86	605	37	309	02	42	16
10-6	7	17	647	153	55	832	108	962	01	48	17
10-12		18	424	112	73	382	11	311	<01	64	18
11-6	7	19	1610	223	111	150	321	128	03	55	19
12-6	5	20	1000	184	91	119	264	187	03	74	20
12-12		21	309	540	53	220	28	682	02	71	21
13-6	5	22	1180	170	61	110	414	130	04	61	22
13-12		23	462	837	64	680	21	108	05	77	23
14-6	58	24	5500	4380	676	102	162	1630	20	39	24
14-12		25	6370	5250	742	300	56	1560	37	28	25
15-6	58	26	3510	2580	688	148	308	1510	37	77	26
15-12		27	2190	1040	382	390	138	890	34	84	27
17-6	58	28	5800	3020	688	236	1090	2040	56	74	28
18-6	8	29	1090	170	83	980	330	178	03	71	29
18-12		30	347	639	108	290	34	115	02	74	30

Krupa
Cu-Ni study
Gp 60

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

Sample		Row	Ca ppm in soil	Mg ppm in soil	Na ppm in soil	K ppm in soil	Mn ppm in soil	Fe ppm in soil	Cu ppm in soil	FLUORIDE ppm in soil	Row
19-6	7	1	836	104	80	120	231	111	03	71	1
19-12		2	284	474	47	561	47	645	03	65	2
20-6	8	3	836	132	53	106	208	259	17	88	3
21-6	5	4	1870	238	76	164	186	151	05	75	4
21-12		5	616	787	101	671	19	570	03	99	5
22-6	5	6	1110	156	76	101	343	162	03	55	6
22-12		7	491	559	70	342	41	731	02	85	7
23-6	10	8	1180	197	93	153	343	204	07	71	8
23-12		9	165	352	88	584	13	682	06	62	9
24-6	5	10	1280	192	37	131	765	173	03	54	10
24-12		11	424	126	42	621	60	138	01	53	11
25-6	5	12	1630	178	40	123	762	197	07	103	12
26-6	10	13	1520	298	180	150	602	184	08	78	13
27-6	5	14	2060	388	73	167	412	201	09	96	14
28-6	5	15	1430	197	37	158	154	131	13	78	15
28-12		16	1150	867	73	995	39	518	67	103	16
29-6	6	17	1600	233	78	167	240	191	04	96	17
29-12		18	436	799	81	449	16	103	02	96	18
30-6	57	19	1610	412	522	137	300	1020	32	119	19
31-6	8	20	818	177	191	102	44	165	05	75	20
32-6	5	21	2420	427	109	131	608	272	07	152	21
33-6	7	22	2200	233	70	153	374	197	04	71	22
33-12		23	606	114	70	897	80	106	04	75	23
34-6	4	24	1400	236	88	114	122	272	04	78	24
34-12		25	444	782	78	374	21	128	03	103	25

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

rupa

p60

Sample		Zinc ppm in so	Cd ppm in soil	Cr ppm in soil	Ni ppm in soil	Pb ppm in soil	SULFATE-S ppm in soil	pH
1-6	7	0.7	<0.1	<0.1	0.3	0.8	8	5.1
1-12		<0.1	<0.1	<0.1	<0.1	<0.1	9	5.6
2-6	49	3.6	<0.1	<0.1	0.6	0.6	12	5.2
2-12		0.2	<0.1	<0.1	0.1	<0.1	22	5.4
3-6	7	1.0	<0.1	<0.1	<0.1	0.4	14	5.5
3-12		<0.1	<0.1	<0.1	<0.1	<0.1	18	5.8
4-6	5	3.7	<0.1	<0.1	0.7	0.8	11	5.0
5-6	58	2.6	0.1	<0.1	7.0	4.3	101	5.5
5-12		1.5	0.1	<0.1	6.4	2.3	83	5.6
6-6	58	0.6	0.1	<0.1	1.3	2.5	76	5.4
6-12		0.1	<0.1	<0.1	2.0	0.3	73	5.9
7-6	7	1.1	<0.1	<0.1	0.5	1.2	25	5.7
7-12		<0.1	<0.1	<0.1	<0.1	0.1	22	6.0
8-6	5	3.3	<0.1	<0.1	0.6	0.3	13	5.5
9-6	7	1.6	<0.1	<0.1	0.6	0.8	24	5.7
9-12		1.6	<0.1	<0.1	<0.1	0.6	27	5.7
10-6	7	0.6	<0.1	<0.1	0.2	0.7	23	5.4
10-12		<0.1	<0.1	<0.1	<0.1	0.4	24	5.8
11-6	7	2.0	<0.1	<0.1	0.4	1.2	30	5.2
12-6	5	1.3	<0.1	<0.1	0.3	0.9	11	5.0
12-12		0.2	0.1	<0.1	<0.1	<0.1	16	5.6
13-6	5	5.2	<0.1	<0.1	0.4	0.8	14	5.2
13-12		0.3	<0.1	<0.1	0.2	0.2	11	5.2
14-6	58	3.1	0.3	<0.1	3.9	4.2	125	5.6
14-12		7.1	0.2	<0.1	6.5	0.2	107	5.7
15-6	58	4.1	0.1	<0.1	4.1	3.5	128	5.3
15-12		2.8	0.3	<0.1	3.6	<0.1	57	5.2
17-6	58	9.4	0.1	<0.1	6.6	0.6	130	5.5
18-6	8	1.3	<0.1	<0.1	0.6	1.0	16	4.9
18-12		0.4	<0.1	<0.1	0.3	<0.1	19	5.3

ST. PAUL CAMPUS COMPUTING CENTER—(01-73)

Krupa

Gp60

Sample		Row	Zn ppm in soil	Cd ppm in soil	Cr ppm in soil	Ni ppm in soil	Pb ppm in soil	SULFATE-S ppm in soil	pH
19-6	7	1	26	<01	<01	03	07	10	54
19-12	-	2	05	<01	<01	01	<01	14	56
20-6	8	3	31	<01	<01	06	03	18	51
21-6	5	4	34	<01	<01	06	05	20	57
21-12		5	02	<01	<01	02	<01	15	60
22-6	5	6	20	<01	<01	04	06	12	55
22-12		7	03	<01	<01	02	04	16	58
23-6	10	8	21	<01	<01	06	11	27	49
23-12		9	02	<01	<01	02	01	38	52
24-6	5	10	101	<01	<01	05	15	14	54
24-12		11	04	<01	<01	02	02	11	54
25-6	5	12	209	01	<01	11	36	17	52
26-6	10	13	52	01	<01	09	16	17	51
27-6	5	14	54	01	<01	07	14	13	52
28-6	5	15	42	<01	<01	03	70	18	57
28-12		16	08	<01	<01	01	13	19	65
29-6	6	17	37	<01	<01	03	07	21	51
29-12		18	08	<01	<01	02	02	20	55
30-6	57	19	136	02	<01	25	62	55	41
31-6	8	20	06	<01	<01	04	07	33	48
32-6	5	21	46	01	<01	15	18	28	50
33-6	7	22	97	<01	<01	04	06	10	51
33-12		23	07	<01	<01	03	02	27	54
34-6	4	24	29	<01	<01	07	02	14	49
34-12		25	04	<01	<01	04	<01	23	53

4385187

3 IN 1 PLOTS CA IN JP

SITE	JUNE	AUG.
1	690.0	514.0
19	1010.0	836.0

SOURCE	DF	SS	MS	F
MONTHS	1	30625.0	30625.0	* .30E+05
SITES	1	103041.0	103041.0	* .10E+06
ERROR	1	1.0	1.0	
TOTAL	3	133667.0		

CUNI 1976 0-6 INCH SOIL DATA

6 IN 1 PLOTS K IN JP

SITE	JUNE	AUG
1	65.1	68.7
19	120.0	120.0

SOURCE	DF	SS	MS	F
MONTHS	1	3.2	3.2	1.0000
SITES	1	2819.6	2819.6	870.2500
ERROR	1	3.2	3.2	
TOTAL	3	2826.1		

CUNI 1976 0-6 INCH SOIL DATA

7 IN 1 PLOTS MN IN JP

SITE	JUNE	AUG
1	11.5	6.2
19	24.4	23.1

SOURCE	DF	SS	MS	F
MONTHS	1	10.9	10.9	2.7225
SITES	1	222.0	222.0	55.5025

438519

TOTAL	3	236.9	

CUNI 1976 0-6 INCH SOIL DATA

8 IN 1 PLOTS FE IN JP

SITE	JUNE	AUG
1	208.0	262.0
19	127.0	111.0

SOURCE	DF	SS	MS	F
MONTHS	1	361.0	361.0	.2947
SITES	1	13456.0	13456.0	10.9845
ERROR	1	1225.0	1225.0	
TOTAL	3	15042.0		

CUNI 1976 0-6 INCH SOIL DATA

9 IN 1 PLOTS CU IN JP

SITE	JUNE	AUG
1	.4	.3
19	.4	.3

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	11.1111
SITES	1	.0	.0	1.0000
ERROR	1	.0	.0	
TOTAL	3	.0		

CUNI 1976 0-6 INCH SOIL DATA

10 IN 1 PLOTS F IN JP

SITE	JUNE	AUG
1	10.2	9.3

I5 IN 1 PLOTS

SITE	JUNE	AUG
1	.5	0
19	.2	0

SOURCE	DF	SS	MS	F
MONTHS	1	.1	.1	5.4444
SITES	1	.0	.0	1.0000
ERROR	1	.0	.0	
TOTAL	3	.2		

CUNI 1976 0-6 INCH SOIL DATA

I4 IN 1 PLOTS NI IN JP

SITE	JUNE	AUG
1	.4	.3
19	.3	.3

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	1.0000
SITES	1	.0	.0	1.0000
ERROR	1	.0	.0	
TOTAL	3	.0		

CUNI 1976 0-6 INCH SOIL DATA

I5 IN 1 PLOTS PB IN JP

SITE	JUNE	AUG
1	.6	.8
19	.8	.7

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.1111
SITES	1	.0	.0	.1111
ERROR	1	.0	.0	
TOTAL	3	.0		

CUNI 1976 0-6 INCH SOIL DATA

SITE	JUNE	AUG
1	.6	.8
19	.8	.7

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.1111
SITES	1	.0	.0	.1111
ERROR	1	.0	.0	
TOTAL	3	.0		

CUNI 1976 0-6 INCH SOIL DATA

16 IN 1 PLOTS S IN JP

SITE	JUNE	AUG
1	18.0	8.0
19	13.0	10.0

SOURCE	DF	SS	MS	F
MONTHS	1	42.3	42.3	3.4490
SITES	1	2.3	2.3	.1837
ERROR	1	12.3	12.3	
TOTAL	3	56.8		

CUNI 1976 0-6 INCH SOIL DATA

17 IN 1 PLOTS PH IN JP

SITE	JUNE	AUG
1	5.3	5.1
19	5.5	5.4

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	9.0000
SITES	1	.1	.1	25.0000
ERROR	1	.0	.0	
TOTAL	3	.1		

CUNI 1976 0-6 INCH SOIL DATA

3 IN 3 PLOTS CA IN RP

3	1410.0	607.0
4	1040.0	777.0
28	1140.0	1430.0

4385?3

SOURCE	DF	SS	MS	F
MONTHS	1	100362.7	100362.7	.6720
SITES	2	152136.3	76068.2	.5094
ERROR	2	298676.3	149338.2	
TOTAL	5	551175.3		

CUNI 1976 0-6 INCH SOIL DATA

6 IN 3 PLOTS K IN RP

SITE	JUNE	AUG
3	157.0	92.6
4	14.7	173.0
28	163.0	158.0

SOURCE	DF	SS	MS	F
MONTHS	1	1317.2	1317.2	.1981
SITES	2	4449.7	2224.9	.3346
ERROR	2	13298.4	6649.2	
TOTAL	5	19065.4		

CUNI 1976 0-6 INCH SOIL DATA

7 IN 3 PLOTS MN IN RP

SITE	JUNE	AUG
3	60.2	11.1
4	37.0	38.3
28	13.4	15.4

SOURCE	DF	SS	MS	F
MONTHS	1	349.6	349.6	.8143
SITES	2	664.1	332.0	.7734
ERROR	2	858.6	429.3	
TOTAL	5	1872.3		

28	13.4	15.4

SOURCE	DF	SS	MS	F
MONTHS	1	349.6	349.6	.8143
SITES	2	664.1	332.0	.7734
ERROR	2	858.6	429.3	
TOTAL	5	1872.3		

CUNI 1976 0-6 INCH SOIL DATA
8 IN 3 PLOTS Fe in RP

SITE	JUNE	AUG
3	109.0	78.9
4	210.0	170.0
28	87.0	131.0

SOURCE	DF	SS	MS	F
MONTHS	1	113.5	113.5	.1077
SITES	2	10675.4	5337.7	5.0655
ERROR	2	2107.5	1053.7	
TOTAL	5	12896.4		

CUNI 1976 0-6 INCH SOIL DATA
9 IN 3 PLOTS Cu in RP

SITE	JUNE	AUG
3	.3	.3
4	.6	.5
28	1.0	1.3

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.4094
SITES	2	.7	.4	15.3284
ERROR	2	.0	.0	
TOTAL	5	.8		

CUNI 1976 0-6 INCH SOIL DATA
10 IN 3 PLOTS F in RP

SITE	JUNE	AUG

438525

28	10.6	7.8

SOURCE	DF	SS	MS	F
MONTHS	1	3.8	3.8	4.0635
SITES	2	16.2	8.1	8.5732
ERROR	2	1.9	.9	
TOTAL	5	21.9		

CUNI 1976 0-6 INCH SOIL DATA

I1 IN 3 PLOTS ZN IN RP

SITE	JUNE	AUG
3	2.0	1.0
4	5.4	3.7
28	3.0	4.2

SOURCE	DF	SS	MS	F
MONTHS	1	.4	.4	.3344
SITES	2	9.9	4.9	4.2358
ERROR	2	2.3	1.2	
TOTAL	5	12.6		

CUNI 1976 0-6 INCH SOIL DATA

~~I2 IN 3 PLOTS~~

SITE	JUNE	AUG
3	0	0
4	0	0
28	0	0

SOURCE	DF	SS	MS	F
MONTHS	1	0	0	I
SITES	2	0	0	I
ERROR	2	0	0	
TOTAL	5	0		

SOURCE	DF	SS	MS	F
MONTHS	1	0	0	I
SITES	2	0	0	I
ERROR	2	0	0	
TOTAL	5	0		

4385526

CUNI 1976 0-6 INCH SOIL DATA

~~13 IN 3 PLOTS~~

SITE	JUNE	AUG
3	.2	0
4	.5	0
28	0	0

SOURCE	DF	SS	MS	F
MONTHS	1	.1	.1	2.5789
SITES	2	.1	.0	1.0000
ERROR	2	.1	.0	
TOTAL	5	.2		

CUNI 1976 0-6 INCH SOIL DATA

I4 IN 3 PLOTS Ni IN RP

SITE	JUNE	AUG
3	.4	0
4	1.1	.7
28	.4	.3

SOURCE	DF	SS	MS	F
MONTHS	1	.1	.1	9.0000
SITES	2	.5	.3	18.1111
ERROR	2	.0	.0	
TOTAL	5	.7		

CUNI 1976 0-6 INCH SOIL DATA

I5 IN 3 PLOTS PB IN RP

SITE	JUNE	AUG
3	.8	.4
4	.9	.8
[illegible]	[illegible]	7.[illegible]

438527

SOURCE	DF	SS	MS	F
MONTHS	1	1.6	1.6	.6454
SITES	2	26.8	13.4	5.3922
ERROR	2	5.0	2.5	
TOTAL	5	33.3		

CUNI 1976 0-6 INCH SOIL DATA

I6 IN 3 PLOTS S IN RP

SITE	JUNE	AUG
3	23.0	14.0
4	15.0	11.0
28	13.0	18.0

SOURCE	DF	SS	MS	F
MONTHS	1	10.7	10.7	.4238
SITES	2	30.3	15.2	.6026
ERROR	2	50.3	25.2	
TOTAL	5	91.3		

CUNI 1976 0-6 INCH SOIL DATA

I7 IN 3 PLOTS PH IN RP

SITE	JUNE	AUG
3	5.4	5.5
4	5.1	5.0
28	5.7	5.7

SOURCE	DF	SS	MS	F
MONTHS	1	0	0	0
SITES	2	.4	.2	43.0000
ERROR	2	.0	.0	
TOTAL	5	.4		

SOURCE	DF	SS	MS	F
MONTHS	1	0	0	0
SITES	2	.4	.2	43.0000
ERROR	2	.0	.0	
TOTAL	5	.4		

CUNI 1976 0-6 INCH SOIL DATA

3 IN 4 PLOTS CA IN BS

SITE	JUNE	AUG
5	5000.0	4580.0
6	3840.0	4610.0
12	799.0	1000.0
14	6160.0	5500.0

SOURCE	DF	SS	MS	F
MONTHS	1	1485.1	1485.1	.0072
SITES	3	27240810.4	9080270.1	43.8544
ERROR	3	621165.4	207055.1	
TOTAL	7	27863460.9		

CUNI 1976 0-6 INCH SOIL DATA

6 IN 4 PLOTS K IN BS

SITE	JUNE	AUG
5	168.0	152.0
6	99.2	93.0
12	121.0	119.0
14	100.0	102.0

SOURCE	DF	SS	MS	F
MONTHS	1	61.6	61.6	2.0623
SITES	3	5060.2	1686.7	56.4662
ERROR	3	89.6	29.9	
TOTAL	7	5211.4		

CUNI 1976 0-6 INCH SOIL DATA

7 IN 4 PLOTS MN IN BS

SITE	JUNE	AUG
5	28.3	26.8
[illegible]	[illegible]	9.4

438529

SOURCE	DF	SS	MS	F
MONTHS	1	.1	.1	.0008
SITES	3	402.8	134.3	.8636
ERROR	3	466.4	155.5	
TOTAL	7	869.4		

CUNI 1976 0-6 INCH SOIL DATA
8 IN 4 PLOTS FE IN BS

SITE	JUNE	AUG
5	1500.0	175.0
6	410.0	117.0
12	136.0	187.0
14	0	1630.0

SOURCE	DF	SS	MS	F
MONTHS	1	496.1	496.1	.0007
SITES	3	764288.4	254762.8	.3397
ERROR	3	2249991.4	749997.1	
TOTAL	7	3014775.9		

CUNI 1976 0-6 INCH SOIL DATA
9 IN 4 PLOTS CU IN BS

SITE	JUNE	AUG
5	2.4	1.9
6	1.9	.1
12	.4	1.3
14	0	2.0

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.0320
SITES	3	2.2	.7	.5228
ERROR	3	4.2	1.4	
TOTAL	7	6.5		

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.0320
SITES	3	2.2	.7	.5228
ERROR	3	4.2	1.4	
TOTAL	7	6.5		

CUNI 1976 0-6 INCH SOIL DATA

10 IN 4 PLOTS F IN BS

SITE	JUNE	AUG
5	9.6	7.7
6	13.4	11.8
12	6.8	7.4
14	4.4	3.9

SOURCE	DF	SS	MS	F
MONTHS	1	1.4	1.4	2.2288
SITES	3	74.3	24.8	38.2031
ERROR	3	1.9	.6	
TOTAL	7	77.7		

CUNI 1976 0-6 INCH SOIL DATA

11 IN 4 PLOTS ZN IN BS

SITE	JUNE	AUG
5	3.2	2.6
6	3.1	.6
12	.8	1.3
14	1.0	3.1

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.0126
SITES	3	3.5	1.2	.6273
ERROR	3	5.5	1.8	
TOTAL	7	9.0		

CUNI 1976 0-6 INCH SOIL DATA

~~12 IN 4 PLOTS~~

SITE JUNE AUG

438531

SITE	JUNE	AUG
6	.1	.1
12	0	0
14	0	.3

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	2.0000
SITES	3	.0	.0	.8333
ERROR	3	.0	.0	
TOTAL	7	.1		

CUNI 1976 0-6 INCH SOIL DATA

~~13 IN 4 PLOTS~~

SITE	JUNE	AUG
5	0	0
6	0	0
12	.2	0
14	0	0

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	1.0000
SITES	3	.0	.0	1.0000
ERROR	3	.0	.0	
TOTAL	7	.0		

CUNI 1976 0-6 INCH SOIL DATA

14 IN 4 PLOTS

Ni in BS

SITE	JUNE	AUG
5	7.6	2.0
6	1.8	1.3
12	.2	.3
14	1.2	3.9

SOURCE	DF	SS	MS	F
MONTHS	1	1.4	1.4	.2257
SITES	3	22.2	7.4	1.2244
ERROR	3	18.1	6.0	

12	.2	.3
14	1.2	3.9

SOURCE	DF	SS	MS	F
MONTHS	1	1.4	1.4	.2257
SITES	3	22.2	7.4	1.2244
ERROR	3	18.1	6.0	
TOTAL	7	41.6		

438532

CUNI 1976 0-6 INCH SOIL DATA

I5 IN 4 PLOTS PB IN BS

SITE	JUNE	AUG
5	4.0	4.3
6	1.8	2.5
12	.4	.9
14	.1	4.2

SOURCE	DF	SS	MS	F
MONTHS	1	3.9	3.9	2.4000
SITES	3	12.4	4.1	2.5255
ERROR	3	4.9	1.6	
TOTAL	7	21.2		

CUNI 1976 0-6 INCH SOIL DATA

I6 IN 4 PLOTS S IN BS

SITE	JUNE	AUG
5	158.0	161.0
6	34.0	76.0
12	20.0	11.0
14	96.0	125.0

SOURCE	DF	SS	MS	F
MONTHS	1	3.1	3.1	.0032
SITES	3	16286.4	5428.8	5.4940
ERROR	3	2964.4	988.1	
TOTAL	7	19253.9		

CUNI 1976 0-6 INCH SOIL DATA

I7 IN 4 PLOTS PH IN BS

438533

SITE	JUNE	AUG
5	5.6	5.5
6	5.6	5.4
12	5.3	5.0
14	5.7	5.6

SOURCE	DF	SS	MS	F
MONTHS	1	.1	.1	13.3636
SITES	3	.3	.1	20.6364
ERROR	3	.0	.0	
TOTAL	7	.4		

CUNI 1976 0-6 INCH SOIL DATA

3 IN 5 PLOTS CA IN PB

SITE	JUNE	AUG
7	1170.0	1250.0
8	1360.0	1400.0
9	643.0	1340.0
24	1560.0	1280.0
31	950.0	818.0
34	1440.0	1400.0

SOURCE	DF	SS	MS	F
MONTHS	1	11102.1	11102.1	.1951
SITES	5	541546.4	108309.3	1.9034
ERROR	5	284514.4	56902.9	
TOTAL	11	837162.9		

CUNI 1976 0-6 INCH SOIL DATA

6 IN 5 PLOTS K IN PB

SITE	JUNE	AUG
7	115.0	172.0
8	87.8	92.6
9	91.0	220.0
24	218.0	131.0
31	101.0	102.0
34	126.0	114.0

4385534

SITE	JUNE	AUG
7	115.0	172.0
8	87.8	92.6
9	91.0	220.0
24	218.0	131.0
31	101.0	102.0
34	126.0	114.0

SOURCE	DF	SS	MS	F
MONTHS	1	717.7	717.7	.2740
SITES	5	10609.1	2121.8	.8101
ERROR	5	13095.9	2619.2	
TOTAL	11	24422.6		

CUNI 1976 0-6 INCH SOIL DATA

7 IN 5 PLOTS MN IN PB

SITE	JUNE	AUG
7	32.2	18.9
8	23.2	25.9
9	14.1	19.4
24	123.0	76.5
31	9.5	4.4
34	33.2	2.1

SOURCE	DF	SS	MS	F
MONTHS	1	645.3	645.3	3.1069
SITES	5	11506.1	2301.2	11.0791
ERROR	5	1038.5	207.7	
TOTAL	11	13190.0		

CUNI 1976 0-6 INCH SOIL DATA

8 IN 5 PLOTS FE IN PB

SITE	JUNE	AUG
7	108.0	95.8
8	136.0	116.0
9	36.6	86.0
24	187.0	173.0
31	147.0	165.0
34	218.0	128.0

SOURCE	DF	SS	MS	F
MONTHS	1	394.5	394.5	.3645
SITES	5	20990.2	4198.0	3.8798
[illegible]	5	[illegible]	[illegible]	

TOTAL	11	26794.8

4385535

CUNI 1976 0-6 INCH SOIL DATA

9 IN 5 PLOTS Cu IN PB

SITE	JUNE	AUG
7	.3	.2
8	.5	.7
9	.3	.3
24	.3	.3
31	.3	.5
34	.4	.3

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.2529
SITES	5	.2	.0	4.9829
ERROR	5	.0	.0	
TOTAL	11	.2		

CUNI 1976 0-6 INCH SOIL DATA

10 IN 5 PLOTS F IN PB

SITE	JUNE	AUG
7	6.2	5.8
8	9.3	7.7
9	5.0	4.5
24	6.8	5.9
31	7.1	7.8
34	7.7	10.3

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.0008
SITES	5	25.9	5.2	4.6923
ERROR	5	5.5	1.1	
TOTAL	11	31.4		

CUNI 1976 0-6 INCH SOIL DATA

SOURCE	DF	SS	MS	F
ERROR	5	5.5	1.1	
TOTAL	11	31.4		

CUNI 1976 0-6 INCH SOIL DATA

11 IN 5 PLOTS

ZN IN PB

SITE	JUNE	AUG
7	.8	1.1
8	4.0	3.3
9	.2	1.6
24	10.2	10.1
31	1.3	.6
34	2.9	2.9

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.0090
SITES	5	127.8	25.6	84.9914
ERROR	5	1.5	.3	
TOTAL	11	129.3		

CUNI 1976 0-6 INCH SOIL DATA

~~12 IN 5 PLOTS~~

SITE	JUNE	AUG
7	0	0
8	.2	0
9	0	0
24	0	0
31	0	0
34	0	0

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	1.0000
SITES	5	.0	.0	1.0000
ERROR	5	.0	.0	
TOTAL	11	.0		

CUNI 1976 0-6 INCH SOIL DATA

~~13 IN 5 PLOTS~~

SITE	JUNE	AUG
7	.2	0

4385537

24	.3	0
31	.1	0
34	0	0

SOURCE	DF	SS	MS	F
MONTHS	1	.1	.1	6.2500
SITES	5	.1	.0	1.0000
ERROR	5	.1	.0	
TOTAL	11	.2		

CUNI 1976 0-6 INCH SOIL DATA
I4 IN 5 PLOTS Ni in PB

SITE	JUNE	AUG
7	.8	.5
8	.4	.6
9	.1	.6
24	.7	.5
31	.4	.4
34	.5	.7

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.3077
SITES	5	.1	.0	.6769
ERROR	5	.2	.0	
TOTAL	11	.4		

CUNI 1976 0-6 INCH SOIL DATA
I5 IN 5 PLOTS PB in PB

SITE	JUNE	AUG
7	1.0	1.2
8	1.0	.3
9	.2	.8
24	1.5	1.5
31	1.2	.7
34	.4	.2

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.2679

SITE	JUNE	AUG
7	1.0	1.2
8	1.0	.3
9	.2	.8
24	1.5	1.5
31	1.2	.7
34	.4	.2

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.2679
SITES	5	1.9	.4	3.4226
ERROR	5	.6	.1	
TOTAL	11	2.5		

4385338

CUNI 1976 0-6 INCH SOIL DATA

I6 IN 5 PLOTS S IN PB

SITE	JUNE	AUG
7	14.0	25.0
8	15.0	13.0
9	16.0	24.0
24	16.0	14.0
31	20.0	33.0
34	18.0	14.0

SOURCE	DF	SS	MS	F
MONTHS	1	48.0	48.0	1.7021
SITES	5	212.0	42.4	1.5035
ERROR	5	141.0	28.2	
TOTAL	11	401.0		

CUNI 1976 0-6 INCH SOIL DATA

I7 IN 5 PLOTS PH IN PB

SITE	JUNE	AUG
7	5.7	5.7
8	5.6	5.5
9	5.6	5.7
24	5.2	5.4
31	5.0	4.8
34	5.0	4.9

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.0769
SITES	5	1.2	.2	22.7846
ERROR	5	.1	.0	
TOTAL	11	1.3		

438539

CUNI 1976 0-6 INCH SOIL DATA
3 IN 6 PLOTS CA IN BF

SITE	JUNE	AUG
10	573.0	647.0
18	993.0	1090.0
25	2430.0	1630.0

SOURCE	DF	SS	MS	F
MONTHS	1	65940.2	65940.2	.5043
SITES	2	2119816.3	1059908.2	8.1063
ERROR	2	261502.3	130751.2	
TOTAL	5	2447258.8		

CUNI 1976 0-6 INCH SOIL DATA
6 IN 6 PLOTS K IN BF

SITE	JUNE	AUG
10	51.3	83.2
18	104.0	98.0
25	159.0	123.0

SOURCE	DF	SS	MS	F
MONTHS	1	17.0	17.0	.0294
SITES	2	5452.1	2726.0	4.7090
ERROR	2	1157.8	578.9	
TOTAL	5	6626.9		

CUNI 1976 0-6 INCH SOIL DATA
7 IN 6 PLOTS MN IN BF

SITE	JUNE	AUG
10	1.9	10.8
18	24.4	33.0
25	[illegible]	76.2

438540

CUNI 1976 0-6 INCH SOIL DATA

IN 6 PLOTS MN IN BF

SITE	JUNE	AUG
10	1.8	10.8
18	34.4	33.0
25	151.0	76.2

SOURCE	DF	SS	MS	F
MONTHS	1	752.6	752.6	.7215
SITES	2	12432.0	6216.0	5.9587
ERROR	2	2086.4	1043.2	
TOTAL	5	15271.0		

CUNI 1976 0-6 INCH SOIL DATA

8 IN 6 PLOTS FE IN BF

SITE	JUNE	AUG
10	21.2	96.2
18	194.0	178.0
25	166.0	197.0

SOURCE	DF	SS	MS	F
MONTHS	1	1350.0	1350.0	1.3037
SITES	2	20870.3	10435.1	10.0774
ERROR	2	2071.0	1035.5	
TOTAL	5	24291.3		

CUNI 1976 0-6 INCH SOIL DATA

9 IN 6 PLOTS CU IN BF

SITE	JUNE	AUG
10	.1	.1
18	.5	.3
25	.6	.7

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.6774
SITES	2	.3	.2	13.9647
ERROR	2	.0	.0	
TOTAL	5	.3		

438541

CUNI 1976 0-6 INCH SOIL DATA

I0 IN 6 PLOTS F in BF

SITE	JUNE	AUG
10	5.5	4.8
18	7.7	7.1
25	10.6	10.3

SOURCE	DF	SS	MS	F
MONTHS	1	.4	.4	19.6923
SITES	2	28.3	14.2	653.1538
ERROR	2	.0	.0	
TOTAL	5	28.8		

CUNI 1976 0-6 INCH SOIL DATA

I1 IN 6 PLOTS Zn in BF

SITE	JUNE	AUG
10	.1	.6
18	1.8	1.3
25	17.9	20.9

SOURCE	DF	SS	MS	F
MONTHS	1	1.5	1.5	.9596
SITES	2	455.8	227.9	141.9885
ERROR	2	3.2	1.6	
TOTAL	5	460.6		

CUNI 1976 0-6 INCH SOIL DATA

~~I2 IN 6 PLOTS~~

SITE	JUNE	AUG
10	0	0
18	0	0
25	.2	.1

~~12 IN 6 PLOTS~~

SITE	JUNE	AUG
10	0	0
18	0	0
25	.2	.1

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	1.0000
SITES	2	.0	.0	9.0000
ERROR	2	.0	.0	
TOTAL	5	.0		

4385422

CUNI 1976 0-6 INCH SOIL DATA

~~13 IN 6 PLOTS~~

SITE	JUNE	AUG
10	.3	0
18	.4	0
25	.2	0

SOURCE	DF	SS	MS	F
MONTHS	1	.1	.1	27.0000
SITES	2	.0	.0	1.0000
ERROR	2	.0	.0	
TOTAL	5	.2		

CUNI 1976 0-6 INCH SOIL DATA

14 IN 6 PLOTS Ni in BF

SITE	JUNE	AUG
10	.1	.2
18	.8	.6
25	1.0	1.1

SOURCE	DF	SS	MS	F
MONTHS	1	0	0	0
SITES	2	.8	.4	27.4444
ERROR	2	.0	.0	
TOTAL	5	.9		

4385743

I5 IN 6 PLOTS PB IN BF

SITE	JUNE	AUG
10	.1	.7
18	1.6	1.0
25	3.1	3.6

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.1880
SITES	2	9.1	4.6	20.6241
ERROR	2	.4	.2	
TOTAL	5	9.6		

CUNI 1976 0-6 INCH SOIL DATA

I6 IN 6 PLOTS S IN BF

SITE	JUNE	AUG
10	14.0	23.0
18	14.0	16.0
25	20.0	17.0

SOURCE	DF	SS	MS	F
MONTHS	1	10.7	10.7	.5872
SITES	2	16.3	8.2	.4495
ERROR	2	36.3	18.2	
TOTAL	5	63.3		

CUNI 1976 0-6 INCH SOIL DATA

I7 IN 6 PLOTS PH IN BF

SITE	JUNE	AUG
10	5.9	5.4
18	5.0	4.9
25	5.5	5.2

SOURCE	DF	SS	MS	F
[illegible]	1	[illegible]	[illegible]	[illegible]

SITE	JUNE	AUG
10	5.9	5.4
18	5.0	4.9
25	5.5	5.2

SOURCE	DF	SS	MS	F
MONTHS	1	.1	.1	6.7500
SITES	2	.5	.2	12.3333
ERROR	2	.0	.0	
TOTAL	5	.7		

CUNI 1976 0-6 INCH SOIL DATA

3 IN 7 PLOTS Ca IN A

SITE	JUNE	AUG
11	1270.0	1610.0
13	1520.0	1180.0
20	1010.0	836.0
22	993.0	1110.0
23	1420.0	1180.0
27	1910.0	2060.0
29	1960.0	1600.0
32	1580.0	2420.0
33	1460.0	2200.0

SOURCE	DF	SS	MS	F
MONTHS	1	63962.7	63962.7	.6356
SITES	8	2539759.1	317469.9	3.1547
ERROR	8	805069.8	100633.7	
TOTAL	17	3408791.6		

CUNI 1976 0-6 INCH SOIL DATA

6 IN 7 PLOTS K IN A

SITE	JUNE	AUG
11	109.0	150.0
13	153.0	110.0
20	112.0	106.0
22	101.0	101.0
23	157.0	153.0
27	187.0	167.0
29	145.0	167.0
32	121.0	131.0
33	136.0	153.0

SOURCE	DF	SS	MS	F
MONTHS	1	16.1	16.1	.0533

ERROR	8	2411.4	301.4	
TOTAL	17	11682.3		

CUNI 1976 0-6 INCH SOIL DATA

7 IN 7 PLOTS MN IN A

SITE	JUNE	AUG
11	36.0	32.1
13	62.8	41.4
20	35.8	20.8
22	54.6	34.3
23	47.8	34.3
27	26.4	41.2
29	24.2	24.0
32	35.4	60.8
33	34.8	37.4

SOURCE	DF	SS	MS	F
MONTHS	1	55.1	55.1	.4296
SITES	8	1351.8	169.0	1.3167
ERROR	8	1026.6	128.3	
TOTAL	17	2433.5		

CUNI 1976 0-6 INCH SOIL DATA

8 IN 7 PLOTS FE IN A

SITE	JUNE	AUG
11	140.0	128.0
13	168.0	130.0
20	153.0	259.0
22	121.0	162.0
23	214.0	204.0
27	466.0	201.0
29	80.0	191.0
32	212.0	272.0
33	120.0	197.0

SOURCE	DF	SS	MS	F
MONTHS	1	272.2	272.2	.0410
SITES	8	70089.8	8761.2	1.3208

29	80.0	191.0
32	212.0	272.0
33	120.0	197.0

SOURCE	DF	SS	MS	F
MONTHS	1	272.2	272.2	.0410
SITES	8	70089.8	8761.2	1.3208
ERROR	8	53067.8	6633.5	
TOTAL	17	123429.8		

438546

CUNI 1976 0-6 INCH SOIL DATA

9 IN 7 PLOTS Cu in A

SITE	JUNE	AUG
11	.2	.3
13	.5	.4
20	2.6	1.7
22	.4	.3
23	.4	.7
27	.1	.9
29	.6	.4
32	.6	.7
33	.5	.4

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.0028
SITES	8	5.2	.6	6.7138
ERROR	8	.8	.1	
TOTAL	17	5.9		

CUNI 1976 0-6 INCH SOIL DATA

10 IN 7 PLOTS F in A

SITE	JUNE	AUG
11	4.7	5.5
13	6.8	6.1
20	7.4	8.8
22	8.0	8.5
23	7.1	7.1
27	9.6	9.6
29	9.0	9.6
32	12.1	15.2
33	6.4	7.1

SOURCE	DF	SS	MS	F
MONTHS	1	2.3	2.3	3.9366
SITES	8	97.7	12.2	21.1235
ERROR	8	4.6	.6	

CUNI 1976 0-6 INCH SOIL DATA

11 IN 7 PLOTS ZN IN A

SITE	JUNE	AUG
11	1.5	2.0
13	5.3	5.2
20	5.7	3.1
22	3.0	2.0
23	5.6	2.1
27	3.5	5.4
29	9.3	3.7
32	5.4	4.6
33	9.8	9.7

SOURCE	DF	SS	MS	F
MONTHS	1	7.0	7.0	2.6813
SITES	8	86.7	10.8	4.1764
ERROR	8	20.8	2.6	
TOTAL	17	114.4		

CUNI 1976 0-6 INCH SOIL DATA

~~12 IN 7 PLOTS~~

SITE	JUNE	AUG
11	0	0
13	.1	0
20	0	0
22	0	0
23	0	0
27	0	.1
29	.2	0
32	0	.1
33	0	0

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.1290
SITES	8	.0	.0	.6129
ERROR	8	.0	.0	
TOTAL	17	.1		

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.1290
SITES	8	.0	.0	.6129
ERROR	8	.0	.0	
TOTAL	17	.1		

CUNI 1976 0-6 INCH SOIL DATA

13 IN 7 PLOTS

SITE	JUNE	AUG
11	.1	0
13	.3	0
20	.4	0
22	.3	0
23	.1	0
27	0	0
29	0	0
32	.2	0
33	.1	0

SOURCE	DF	SS	MS	F
MONTHS	1	.1	.1	12.5000
SITES	8	.1	.0	1.0000
ERROR	8	.1	.0	
TOTAL	17	.3		

CUNI 1976 0-6 INCH SOIL DATA

14 IN 7 PLOTS Ni in A

SITE	JUNE	AUG
11	.5	.4
13	.7	.4
20	.7	.6
22	.3	.4
23	.8	.6
27	1.5	.7
29	.6	.3
32	.8	1.5
33	.4	.4

SOURCE	DF	SS	MS	F
MONTHS	1	.1	.1	.7005
SITES	8	1.4	.2	2.1979
ERROR	8	.6	.1	
TOTAL	17	2.1		

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CUNI 1976 0-6 INCH SOIL DATA

15 IN 7 PLOTS PB IN A

SITE	JUNE	AUG
11	1.0	1.2
13	.8	.8
20	1.0	.3
22	1.3	.6
23	1.0	1.1
27	.1	1.4
29	.8	.7
32	1.7	1.8
33	.7	.6

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	.0032
SITES	8	1.9	.2	1.3880
ERROR	8	1.4	.2	
TOTAL	17	3.3		

CUNI 1976 0-6 INCH SOIL DATA

16 IN 7 PLOTS S IN A

SITE	JUNE	AUG
11	33.0	30.0
13	21.0	14.0
20	20.0	18.0
22	10.0	12.0
23	32.0	27.0
27	20.0	13.0
29	16.0	21.0
32	21.0	28.0
33	15.0	10.0

SOURCE	DF	SS	MS	F
MONTHS	1	12.5	12.5	.9346
SITES	8	803.4	100.4	7.5088
ERROR	8	107.0	13.4	
TOTAL	17	922.9		

CUNI 1976 0-6 INCH SOIL DATA

I6 IN 7 PLOTS S IN A

SITE	JUNE	AUG
11	33.0	30.0
13	21.0	14.0
20	20.0	18.0
22	10.0	12.0
23	32.0	27.0
27	20.0	13.0
29	16.0	21.0
32	21.0	28.0
33	15.0	10.0

SOURCE	DF	SS	MS	F
MONTHS	1	12.5	12.5	.9346
SITES	8	803.4	100.4	7.5088
ERROR	8	107.0	13.4	
TOTAL	17	922.9		

CUNI 1976 0-6 INCH SOIL DATA

I7 IN 7 PLOTS PH IN A

SITE	JUNE	AUG
11	5.4	5.2
13	5.3	5.2
20	5.4	5.1
22	5.3	5.5
23	5.0	4.9
27	5.1	5.2
29	5.4	5.1
32	5.0	5.0
33	5.3	5.1

SOURCE	DF	SS	MS	F
MONTHS	1	.0	.0	3.0000
SITES	8	.3	.0	2.7037
ERROR	8	.1	.0	
TOTAL	17	.5		

CUNI 1976 0-6 INCH SOIL DATA

3 IN 8 PLOTS

CA IN T

SITE	JUNE	AUG
15	1640.0	3510.0
30	1900.0	1610.0

SOURCE	DF	SS	MS	F
MONTHS	1	624100.0	624100.0	.5351
SITES	1	672400.0	672400.0	.5765
ERROR	1	1166400.0	1166400.0	

CUNI 1976 0-6 INCH SOIL DATA

4 IN 8 PLOTS MG IN T

SITE	JUNE	AUG
15	779.0	2580.0
30	431.0	412.0

SOURCE	DF	SS	MS	F
MONTHS	1	793881.0	793881.0	.9587
SITES	1	1582564.0	1582564.0	1.9111
ERROR	1	828100.0	828100.0	
TOTAL	3	3204545.0		

CUNI 1976 0-6 INCH SOIL DATA

5 IN 8 PLOTS NA IN T

SITE	JUNE	AUG
15	33.3	68.8
30	34.3	52.2

SOURCE	DF	SS	MS	F
MONTHS	1	712.9	712.9	9.2057
SITES	1	60.8	60.8	.7856
ERROR	1	77.4	77.4	
TOTAL	3	851.2		

CUNI 1976 0-6 INCH SOIL DATA

6 IN 8 PLOTS K IN T

SITE	JUNE	AUG
15	71.8	148.0
30	123.0	137.0

SOURCE	DF	SS	MS	F

6 IN 8 PLOTS K IN T

SITE	JUNE	AUG
15	71.8	148.0
30	123.0	137.0

SOURCE	DF	SS	MS	F
MONTHS	1	2034.0	2034.0	2.1030
SITES	1	404.0	404.0	.4177
ERROR	1	967.2	967.2	
TOTAL	3	3405.2		

CUNI 1976 0-6 INCH SOIL DATA

7 IN 8 PLOTS MN IN T

SITE	JUNE	AUG
15	6.6	30.8
30	17.3	30.0

SOURCE	DF	SS	MS	F
MONTHS	1	340.4	340.4	10.2957
SITES	1	24.5	24.5	.7411
ERROR	1	33.1	33.1	
TOTAL	3	398.0		

CUNI 1976 0-6 INCH SOIL DATA

8 IN 8 PLOTS FE IN T

SITE	JUNE	AUG
15	416.0	1510.0
30	400.0	1020.0

SOURCE	DF	SS	MS	F
MONTHS	1	734449.0	734449.0	13.0757
SITES	1	64009.0	64009.0	1.1396
ERROR	1	56169.0	56169.0	
TOTAL	3	854627.0		

CUNI 1976 0-6 INCH SOIL DATA

9 IN 8 PLOTS

SITE	JUNE	AUG
15	.6	3.7
30	.2	3.2

SOURCE	DF	SS	MS	F
MONTHS	1	9.2	9.2	4548.7531
SITES	1	.2	.2	102.2346
ERROR	1	.0	.0	
TOTAL	3	9.4		

CONI 1976 0-6 INCH SOIL DATA

10 IN 8 PLOTS F IN T

SITE	JUNE	AUG
15	7.1	7.7
30	5.7	11.9

SOURCE	DF	SS	MS	F
MONTHS	1	11.6	11.6	1.4745
SITES	1	2.0	2.0	.2500
ERROR	1	7.8	7.8	
TOTAL	3	21.4		

CONI 1976 0-6 INCH SOIL DATA

11 IN 8 PLOTS ZN IN T

SITE	JUNE	AUG
15	1.1	4.1
30	1.0	13.6

SOURCE	DF	SS	MS	F
MONTHS	1	60.2	60.2	2.6245
SITES	1	22.2	22.2	.9669
ERROR	1	22.9	22.9	

SOURCE	DF	SS	MS	F
MONTHS	1	60.2	60.2	2.6245
SITES	1	22.2	22.2	.9669
ERROR	1	22.9	22.9	
TOTAL	3	105.3		

CUNI 1976 0-6 INCH SOIL DATA

14 IN 8 PLOTS NI IN T

SITE	JUNE	AUG
15	1.2	4.1
30	1.3	2.5

SOURCE	DF	SS	MS	F
MONTHS	1	4.2	4.2	5.8166
SITES	1	.6	.6	.7785
ERROR	1	.7	.7	
TOTAL	3	5.5		

CUNI 1976 0-6 INCH SOIL DATA

15 IN 8 PLOTS PB IN T

SITE	JUNE	AUG
15	.4	3.5
30	.1	6.2

SOURCE	DF	SS	MS	F
MONTHS	1	21.2	21.2	9.4044
SITES	1	1.4	1.4	.6400
ERROR	1	2.3	2.3	
TOTAL	3	24.8		

CUNI 1976 0-6 INCH SOIL DATA

16 IN 8 PLOTS S IN T

SITE	JUNE	AUG
15	14.0	1.5
30	56.0	55.0

MONTHS	1	47.1	47.1	1.3704
SITES	1	2290.6	2290.6	66.7037
ERROR	1	34.3	34.3	
TOTAL	3	2372.0		

CUNI 1976 0-6 INCH SOIL DATA

17 IN 8 PLOTS

PH IN T

SITE	JUNE	AUG
15	5.5	5.3
30	4.5	4.1

SOURCE	DF	SS	MS	F
MONTHS	1	.1	.1	9.0000
SITES	1	1.2	1.2	121.0000
ERROR	1	.0	.0	
TOTAL	3	1.3		

CUNI 1976 0-6 INCH SOIL DATA

4 IN 1 PLOTS MG IN JP

SITE	JUNE	AUG
1	178.0	187.0
19	95.9	104.0

SOURCE	DF	SS	MS	F
MONTHS	1	73.1	73.1	361.0000
SITES	1	6814.5	6814.5	* .33E+05
ERROR	1	.2	.2	
TOTAL	3	6887.8		

SOURCE	DF	SS	MS	F
MONTHS	1	73.1	73.1	361.0000
SITES	1	6814.5	6814.5	* .33E+05
ERROR	1	.2	.2	
TOTAL	3	6887.8		

CUNI 1976 0-6 INCH SOIL DATA

5 IN 1 PLOTS NA IN JP

SITE	JUNE	AUG
1	152.0	9.1
19	9.2	8.0

SOURCE	DF	SS	MS	F
MONTHS	1	5191.2	5191.2	1.0342
SITES	1	5176.8	5176.8	1.0313
ERROR	1	5019.7	5019.7	
TOTAL	3	15387.7		

CUNI 1976 0-6 INCH SOIL DATA

4 IN 3 PLOTS MG IN RP

SITE	JUNE	AUG
3	154.0	88.0
4	201.0	165.0
28	150.0	197.0

SOURCE	DF	SS	MS	F
MONTHS	1	493.2	493.2	.2903
SITES	2	4414.7	2207.3	1.2992
ERROR	2	3397.8	1698.9	
TOTAL	5	8305.7		

CUNI 1976 0-6 INCH SOIL DATA

5 IN 3 PLOTS NA IN RP

SITE	JUNE	AUG
3	7.4	4.0
4	12.4	9.3
28	8.1	3.7

.5 IN 3 PLOTS

NA IN RP

SITE	JUNE	AUG
3	7.4	4.0
4	12.4	9.3
28	8.1	3.7

SOURCE	DF	SS	MS	F
MONTHS	1	19.8	19.8	85.4748
SITES	2	34.0	17.0	73.4748
ERROR	2	.5	.2	
TOTAL	5	54.3		

CUNI 1976 0-6 INCH SOIL DATA

4 IN 4 PLOTS

MG IN BS

SITE	JUNE	AUG
5	3690.0	4040.0
6	1310.0	1470.0
12	95.4	184.0
14	4160.0	4380.0

SOURCE	DF	SS	MS	F
MONTHS	1	83763.2	83763.2	13.6483
SITES	3	23542269.1	7847423.0	1278.6557
ERROR	3	18411.7	6137.2	
TOTAL	7	23644444.1		

CUNI 1976 0-6 INCH SOIL DATA

5 IN 4 PLOTS

NA IN BS

SITE	JUNE	AUG
5	54.6	4.9
6	24.9	3.6
12	0	9.1
14	107.0	67.0

SOURCE	DF	SS	MS	F
MONTHS	1	1282.7	1282.7	3.8606
SITES	3	8232.6	2744.2	8.2594
ERROR	3	996.9	332.3	
TOTAL	7	10512.1		

CUNI 1976 0-6 INCH SOIL DATA

4 IN 5 PLOTS MG IN PB

SITE	JUNE	AUG
7	236.0	238.0
8	219.0	255.0
9	133.0	255.0
24	200.0	192.0
31	149.0	177.0
34	171.0	236.0

SOURCE	DF	SS	MS	F
MONTHS	1	5002.1	5002.1	4.4452
SITES	5	8032.4	1606.5	1.4276
ERROR	5	5626.4	1125.3	
TOTAL	11	18660.9		

CUNI 1976 0-6 INCH SOIL DATA

5 IN 5 PLOTS NA IN PB

SITE	JUNE	AUG
7	12.6	4.0
8	12.6	6.5
9	10.5	5.0
24	8.8	3.7
31	11.9	19.1
34	5.5	8.8

SOURCE	DF	SS	MS	F
MONTHS	1	18.3	18.3	.9426
SITES	5	111.1	22.2	1.1474
ERROR	5	96.8	19.4	
TOTAL	11	226.2		

CUNI 1976 0-6 INCH SOIL DATA

4 IN 6 PLOTS MG IN BF

SITE	JUNE	AUG
[illegible]	[illegible]	[illegible]

CUNI 1976 0-6 INCH SOIL DATA

4 IN 6 PLOTS MG IN BF

SITE	JUNE	AUG
10	98.9	153.0
18	171.0	170.0
25	225.0	178.0

SOURCE	DF	SS	MS	F
MONTHS	1	6.2	6.2	.0048
SITES	2	5769.0	2884.5	2.2516
ERROR	2	2562.2	1281.1	
TOTAL	5	8337.4		

CUNI 1976 0-6 INCH SOIL DATA

5 IN 6 PLOTS

NA IN BF

SITE	JUNE	AUG
10	8.4	5.5
18	9.8	8.5
25	8.6	4.0

SOURCE	DF	SS	MS	F
MONTHS	1	13.5	13.5	11.2033
SITES	2	8.3	4.1	3.4288
ERROR	2	2.4	1.2	
TOTAL	5	24.2		

CUNI 1976 0-6 INCH SOIL DATA

4 IN 7 PLOTS MG IN A

SITE	JUNE	AUG
11	164.0	223.0
13	219.0	170.0
20	154.0	132.0
22	131.0	156.0
23	207.0	197.0
27	399.0	388.0
29	211.0	233.0
32	235.0	427.0
33	135.0	233.0

SOURCE	DF	SS	MS	F

22	131.0	156.0
23	207.0	197.0
27	399.0	388.0
29	211.0	233.0
32	235.0	427.0
33	135.0	233.0

SOURCE	DF	SS	MS	F
MONTHS	1	5134.2	5134.2	1.8714
SITES	8	114200.0	14275.0	5.2033
ERROR	8	21947.8	2743.5	
TOTAL	17	141282.0		

CUNI 1976 0-6 INCH SOIL DATA

5 IN 7 PLOTS

NA IN A

SITE	JUNE	AUG
11	15.2	11.1
13	12.9	6.1
20	4.8	5.3
22	8.1	7.0
23	16.6	9.3
27	14.0	7.3
29	10.5	7.8
32	7.4	10.9
33	6.7	7.0

SOURCE	DF	SS	MS	F
MONTHS	1	37.0	37.0	4.2083
SITES	8	128.5	16.1	1.8275
ERROR	8	70.3	8.8	
TOTAL	17	235.8		

CUNI 1976 0-6 INCH SOIL DATA

4 IN 8 PLOTS

MG IN T

SITE	JUNE	AUG
15	779.0	2580.0
30	431.0	412.0

SOURCE	DF	SS	MS	F
MONTHS	1	793881.0	793881.0	.9587
SITES	1	1582564.0	1582564.0	1.9111
ERROR	1	828100.0	828100.0	
TOTAL	3	3204545.0		

SOURCE	DF	SS	MS	F
MONTHS	1	793881.0	793881.0	.0587
SITES	1	1582564.0	1582564.0	1.9111
ERROR	1	828100.0	828100.0	
TOTAL	3	3204545.0		

CUNI 1976 0-6 INCH SOIL DATA

5 IN 8 PLOTS

NR IN T

SITE	JUNE	AUG
15	33.3	68.8
30	34.3	52.2

SOURCE	DF	SS	MS	F
MONTHS	1	712.9	712.9	9.2057
SITES	1	60.8	60.8	.7856
ERROR	1	77.4	77.4	
TOTAL	3	851.2		

Element

Date

Plot	Abies balsam.	Betula papyrif.	Gramin.	Larix laricin	Picea glauca	Picea mariana	Pinus banksiana	Pinus resinosa	Pinus strobus	Populus tremuloi.	Thuja accident.	
P01												P01
P02												P02
P03												P03
P04												P04
P05												P05
P06												P06
P07												P07
P08												P08
P09												P09
P10												P10
P11												P11
P12												P12
P13												P13
P14												P14
P15												P15
P16												P16
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P34												P34