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RECLAMATION RESEARCH AT LORNEX MINING CORPORATION LTD. GREENHOUSE AND FIELD SCALE TRIALS

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INTRODUCTION

Lornex is an open pit copper-molybdenum mine located in the Highland Valley in the south-central interior of British Columbia, approximately 80 km southwest of Kamloops. This region is characterized by hot summers and cold winters, with an annual range of temperatures of about 25 C. Climatic conditions at the mine site vary significantly from the cooler, moist sites at elevations above 1500 m which receive 20-25 cm of precipitation from May to September, to the warm drier conditions in the valley bottom which receive only 15-20 cm of precipitation during the growing season. A climatic gradient also occurs from the cooler eastern end of the tailings deposition area to the warmer, drier western end.

The major types of waste rock materials at Lornex are Bethsaida granodiorite and Skeena quartz diorite, with lesser amounts of fault gouge. The surficial materials in the mine area are of glacial origin, primarily morainal materials in the pit area and glaciofluvial deposits on the valley floor. The soils in the area range from well drained Luvisols on the hill slopes to rapidly drained Brunisols in the valley bottom. The vegetation reflects the climatic and soil conditions and also the fire history in the valley. A Lodgepole pine-Spruce community is typical of sites above 1500 m, while mid-slope positions may be forested with either a Douglas fir or a Lodgepole pine community. The lower slopes and the valley floor are generally an open forest-grassland complex.

Lornex made an initial application for a reclamation permit in 1970, and the mine went into production in 1972. Reclamation studies and programs have been conducted by Lornex since 1971. The total area developed to date is approximately 2600 ha, and about 300 ha have been reclaimed. Areas of reclamation were roads, pipelines, borrow pits, reservoir dams, and disturbed sites around the plant site. Test plots were established both on mine waste dumps and on tailings. In 1983, Lornex retained Reid, Collins Nurseries Ltd. to evaluate the reclamation projects which had been initiated at the mine to facilitate the development of a reclamation program for the mine area.

Reid, Collins believed that to develop a realistic reclamation plan it was necessary to integrate the physical and biological aspects of soils and plant growth with the potential land use objectives. To achieve this integrated approach to reclamation planning we retained Mr. Gary Runka of Land Sense Inc. to carry out a detailed assessment of end land use objectives for the mine area.

A reclamation program was prepared which outlines both the short term objectives of operational and research reclamation, and the long term objectives of the final reclamation at the end of the mining period. Reclamation research projects were designed to provide information necessary to determine the most practical end land use from the list of various potential land uses.

RESEARCH OBJECTIVES

There were indications from some of the earlier research that plant growth response varied with the type of waste material and that some waste materials experienced rapid weathering. Experiments were necessary to determine which materials supported the best plant growth and if weathering affected the plant growth on these materials. Tissue sampling of plants grown in all types of waste materials was required.

Some native plants had been planted in waste materials with varying success. There was also some evidence to suggest that tree seedlings planted into areas with a grass cover experienced severe damage from rodents and suffered moisture stress due to competition with grasses. Trials were necessary to assess native species suitability, effect of competition, and the best season for planting.

Grasses and legumes had been grown on the tailings material but assessment of the potential for the tailings to support agricultural crops, particularly when irrigated were required. Additionally, native trees and shrubs had not been planted on the tailings and trials with these plants were necessary to evaluate all of the potential land uses of this waste area.

METHODS

Greenhouse trials were established to determine, under controlled conditions, which waste materials had the potential to support plant growth and what the Copper to Molybdenum ratio was in the tissues of agronomic species. Eight agronomic and four native plants were grown in five types of waste materials. The agronomic species tested were Climax Timothy, Carl ton Smooth Bromegrass, Fairway Crested Wheatgrass, Boreal Creeping Red Fescue, Roamer Alfalfa, Vernal Alfalfa, and Crown Vetch. The seed for these trials was kindly donated by Richardson Seeds Ltd. The native species tested were Lodgepole pine, Buffaloberry, Wild Rose and Kinnikinnik. These various species were planted into the following waste materials: tailings, weathered granodiorite, unweathered diorite, weathered diorite, fault gouge and a control composed of a standard nursery potting mix. After four months of growth, the agronomic plants were clipped at the ground level and dry weights determined. Tissue samples from Crested Wheatgrass and Vernal Alfalfa were analized for Copper and Molybdenum levels. Native species, grown for seven months, were assessed for survival, growth and rooting.

Field trials were initiated on the waste dumps to determine which native species were most successful, methods of planting compacted surfaces and steep slopes, the best time of year for planting, and the effect of competition with agronomic species on native plant success. Trials were also established on the tailings area to assess the potential for various end land uses. Four revegetation alternatives, irrigated alfalfa, non-irrigated alfalfa, dryland grasses and legumes, and native trees and shrubs, were incorporated into the tailings trials.

RESULTS

The greenhouse studies indicated that under optimum growing conditions all of the waste materials supported good plant growth. There does not appear to be any particular chemical or physical limitations to the growth of native or agronomic species. In the agronomic trials, fault gouge materials supported the most growth, weathered diorite and tailings the next, followed by weathered granodiorite. The least growth occurred in the unweathered diorite material (Figure 1). The significant increase in growth from the unweathered to the weathered diorite material may be due in part to the decrease in pH from 9.1 in the unweathered to 8.8 in the weathered material (Figure 2). A decrease in pH with weathering also occurs in the granodiorite material.

A similar pattern of growth was observed in the native plant greenhouse trials. Tailings supported the greatest growth, followed by fault gouge, weathered diorite, and weathered granodiorite. The least growth occurred on the unweathered diorite (Figure 3). This pattern was somewhat different when rooting of the native species was considered (Figure 4). The best rooting was found in the tailings material, followed by the weathered diorite and fault gouge. The unweathered diorite and the weathered granodiorite supported only moderate rooting.

Copper to Molybdenum ratios in the tissues of the agronomic species grown in the waste materials were found to be less than the critical limit of 4 (Figure 5). A ratio of less than 4 (Cu/Mo) is generally considered dangerous to animal nutrition and can result in a condition known as Molybdenosis if the animals, particularly ruminants, are fed this as a constant diet.

The agronomic species which were established in the tailings trials were also analized for Copper and Molybdenum levels and were found to have high levels of Molybdenum resulting in Cu/Mo ratios of less than one. Good growth was established on the irrigated alfalfa trial, biomass sampling indicated that Vernal Alfalfa, under irrigation can produce 85 gm/m^ or 850 kg/ha (4.6 tons/acre).

Most of the native plant trials were established in the fall of 1984 and data on survival and growth are not yet available. Spring planting replicates will be installed in 1985. Some preliminary data from a Lodgepole pine planting in the spring of 1984, indicates that survival

FIGURE 1

MEAN DRY WEIGHT OF AGRONOMIC SPECIES GROWN ON LORNEX WASTE MATERIALS

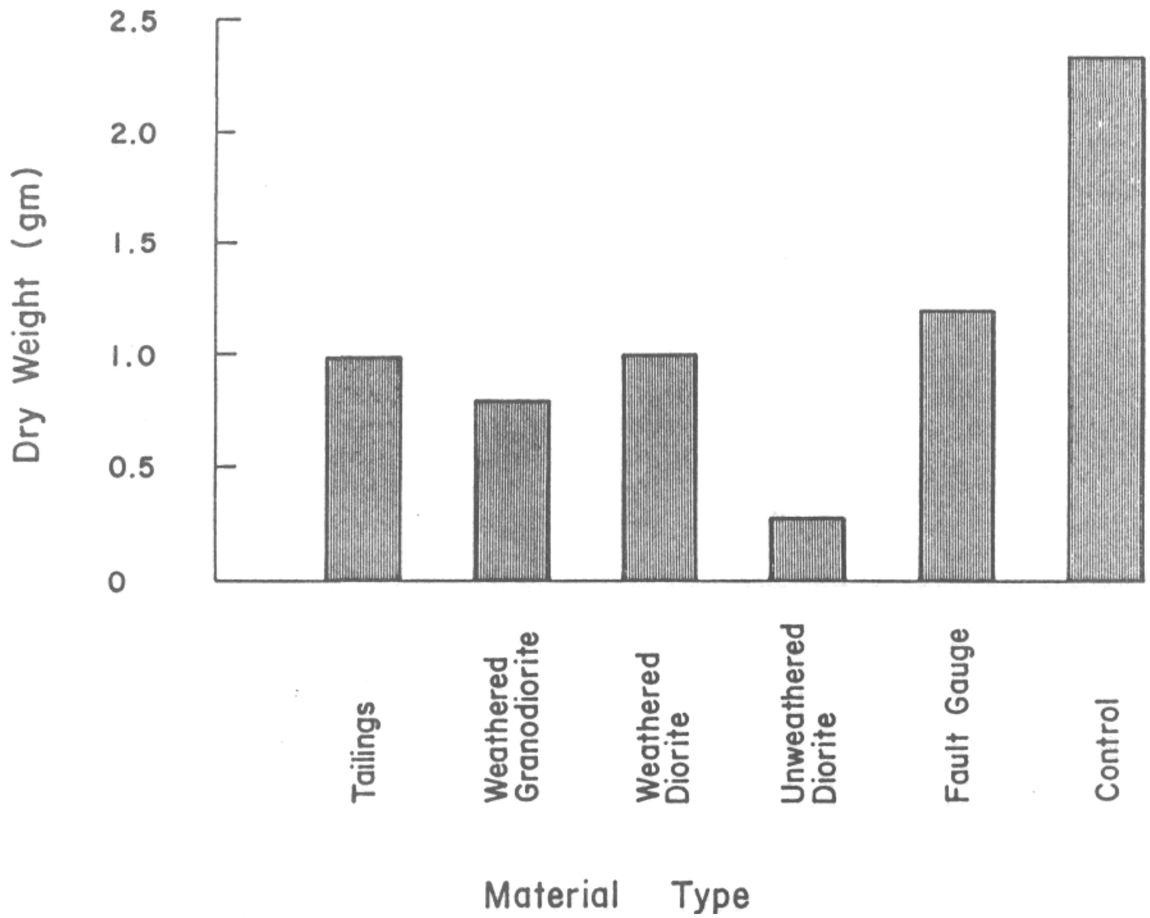


FIGURE 2

ph OF LORNEX WASTE MATERIALS

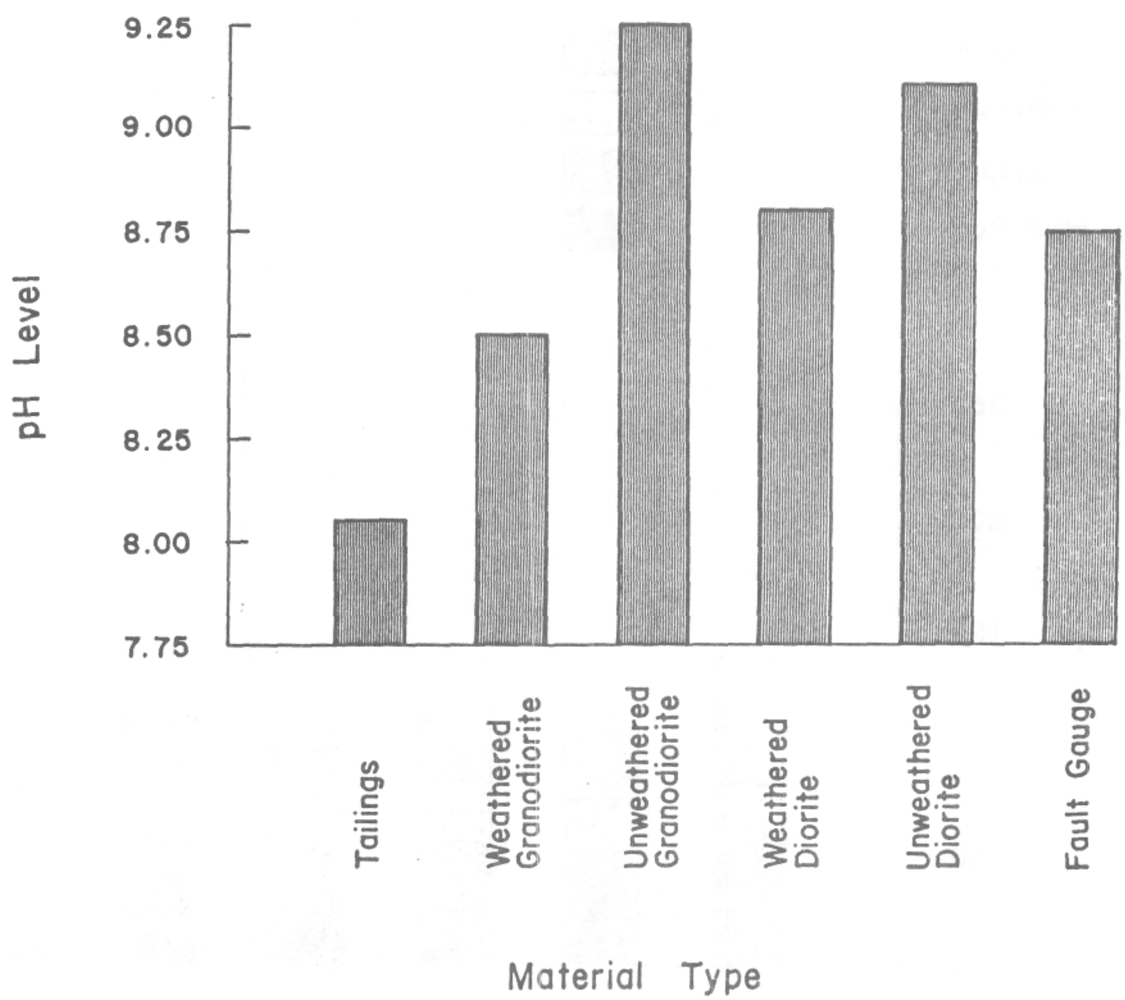


FIGURE 3

MEAN GROWTH OF NATIVE PLANTS IN LORNEX WASTE MATERIALS

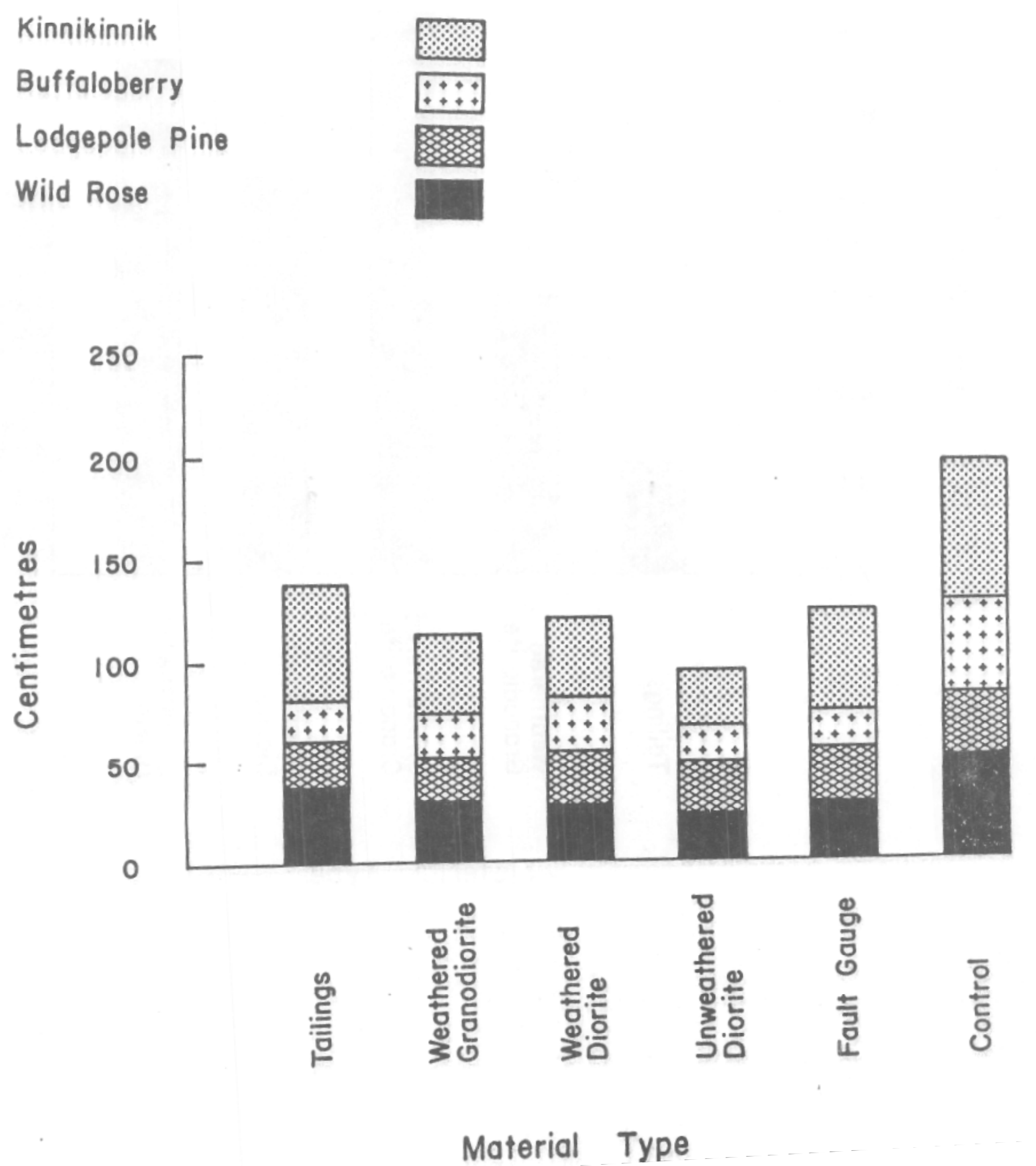


FIGURE 4

MEAN ROOTING OF NATIVE PLANTS GROWN
IN LORNEX WASTE MATERIALS

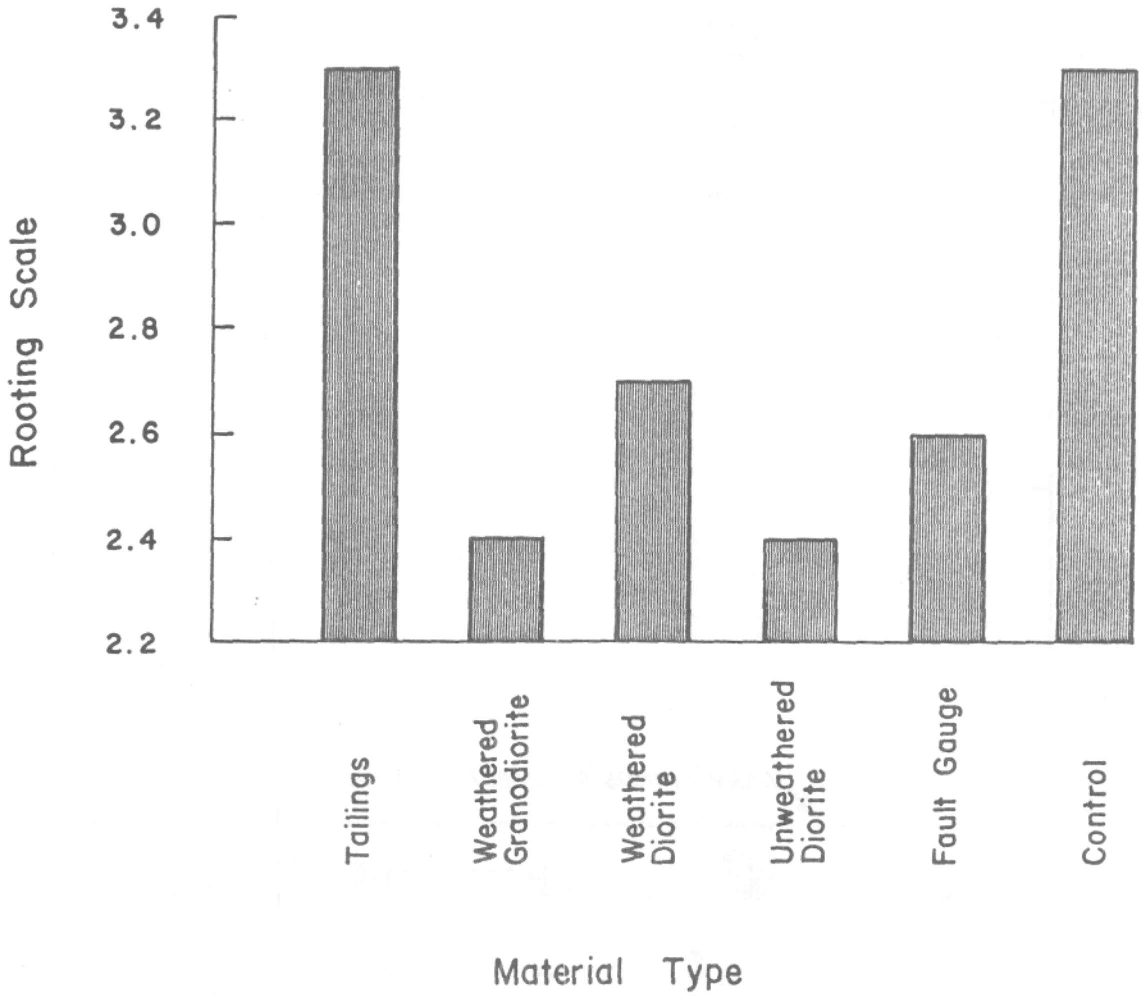
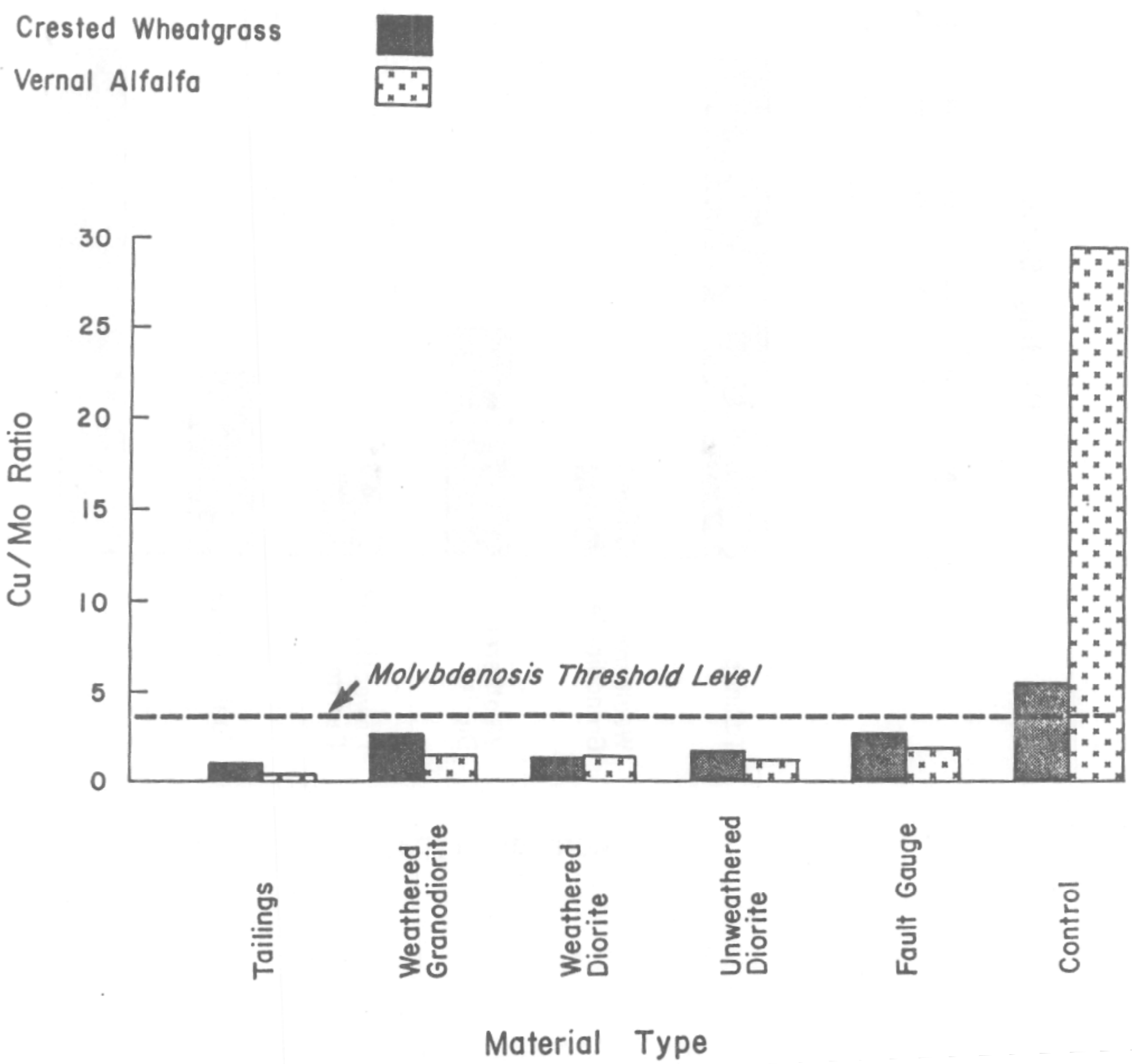


FIGURE 5

COPPER TO MOLYBDENUM RATIO IN AGRONOMIC PLANT TISSUE GROWN IN LORNEX WASTE MATERIALS



of conifers is improved by reducing their competition with grasses. This was achieved through discontinuing the maintenance fertilizer application to the grass cover.

DISCUSSION

The information gained from both the greenhouse studies and the field scale trials will be used to select the most practical end land use objectives for the various mine areas. This information has already indicated some potential uses and has also eliminated others. For example, irrigated alfalfa, although a highly successful producer, appears to have serious limitations in its use as a forage. This has not eliminated the potential use of irrigated agriculture on the tailings but it has reduced the types of crops which will be considered. Further studies will include the use of barley which is not believed to accumulate Molybdenum as readily as alfalfa. The results of the trials to determine the suitability of the other land use objectives are not yet available, but similar decisions will be made as this data is accumulated. As the research program continues the list of potential land uses will be refined and only those which have shown success will be incorporated into the final reclamation plan. Costly, impractical land uses will not be persued.