



# Evaluering van plantproduksie op gedegradeerde myngrond behandel met kombinasies van Klas F-vliegas en dieremis

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## Evaluation of plant growth on degraded mine soils amended with class F fly ash and animal manures

The coal power generation, livestock production and coal mining industries are three of the largest roleplayers in South Africa's economy and environment. These industries respectively produce huge volumes of fly ash, organic wastes and degraded land, resulting in both financial and ecological impacts. The need, therefore, exists to explore the recycling potential of fly ash, and combinations of fly ash with cattle and chicken manure. The aim of this study is to determine whether class F fly ash and combinations of class F fly ash with cattle and chicken manure can serve as alternative soil amendments to establish a more sustainable plant production system on degraded soils. Phytotron pot trials simulating the post-mining land capability class for pastures and fodder crop production, were planted with winter rye (*Secale cereale*), Japanese millet (*Echinochloa frumentacea*) and forage sorghum (*Sorghum vulgare*). Two soils, cover soil and acid mine drainage impacted soil (AMD), were amended with twelve treatment combinations at two different levels, optimum and 2X optimum. Treatments included combinations of agricultural lime, fertiliser, chicken manure, cattle manure, and class F fly ash.

Biomass production for 2x optimum (B) application is either comparable or higher than that of optimum (A) application level for all soils and crops. Slightly higher biomass production was also found on AMD soils than on cover soil. Above-ground dry biomass production for treatments containing fly ash was initially comparable or higher than treatments containing agricultural lime, but production decreased with time. Cattle and chicken manure treatments initially produced higher biomass than agricultural fertiliser treatments, with chicken manure treatments giving the highest overall biomass. Germination was the least affected plant parameter, as it showed a poor correlation and significances for both soils and all crops on treatments and levels. Average dry above-ground biomass production and average dry root biomass production showed very high to high correlations and significances for both soils and all crops on treatment and levels. The results therefore indicate that fly ash and animal manures can serve as alternative amendments for conventional agricultural lime and fertiliser for the rehabilitation of degraded mine soils.

Steenkoolkragopwekking, veeproduksie en oopgroef-steenkoolmynbou is drie groot rolspelers in Suid-Afrika se ekonomie en omgewing. Hierdie bedrywe produseer onderskeidelik massiewe hoeveelhede vliegas, organiese afval en gedegradeerde myngrond, wat beide finansiële en ekologiese impakte het. Die behoefte bestaan dus om die herwinningspotensiaal van vliegas en dieremis te ondersoek. Die doel van hierdie studie is om te bepaal of Klas F-vliegas en kombinasies van die Klas F-vliegas met bees- en hoendermis, as alternatiewe grondbehandelings kan dien om 'n meer volhoubare plantproduksiestelsel op gedegradeerde gronde te vestig. Phytotron-potproewe wat die grondgebruikklas vir weiding en veevoerproduksie ná staking van mynbou simuleer, is beplant met Winterrog ('Winter Rye' - *Secale cereale*), Japannese Broodmanna ('Japanese Millet' - *Echinochloa frumentacea*) en Voersorghum ('Forage Sorghum' - *Sorghum vulgare*). Twee gronde, gedegradeerde bogrond en versuurde myngrond, is met kombinasies van landboukalk, kunsmis, hoendermis, beesmis, en Klas F-vliegas behandel. Die twaalf kombinasies van behandelings is toegepas op twee verskillende toedieningsvlakke, optimum (A) en 2X optimum (B), en vyf herhalings elk.

Biomassaproduksie vir 2X optimum (B) behandelings is óf vergelykbaar of hoër as dié van optimum (A) behandelings vir alle gronde en gewasse. Effens hoër biomassaproduksie is op

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versuurde myngrond as op gedegraderte bogrond gevind. Bogrondse droë-biomassaproduksie vir behandelings met vliegkas was aanvanklik soortgelyk of hoër as behandelings met landboukalk, maar die produksie daal met tyd. Bees- en hoendermisbehandelings het aanvanklik hoër biomassas geproduseer as kunsmisbehandelings en hoendermisbehandelings het die hoogste algehele biomassas gelewer. Ontkieming was die minste geaffekteerde parameter en toon 'n swak korrelasie en beduidendheid vir beide gronde

en al die gewasse op alle behandelings en toedieningsvlakke. Gemiddelde droë bogrondse biomassaproduksie en gemiddelde droë wortelbiomassaproduksie toon 'n baie hoër tot hoër korrelasies en beduidendheid vir beide gronde en al die gewasse op alle behandelings en toedieningsvlakke. Die resultate dui gevolglik daarop dat vliegkas en dieremis as alternatiewe behandelings tot landboukalk en kunsmis kan dien vir die rehabilitasie van gedegraderte myngronde.