Annual Academic Sessions 2011
ISSN 2012-9912; ©2011 Open University of Sri Lanka

LUPIN (*LUPINUS* SPP.): A NEW PULSE CROP AND ITS YIELD PERFORMANCE UNDER DIFFERENT CLIMATIC CONDITIONS IN SRI LANKA

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INTRODUCTION

Lupin (*Lupinus* spp.), a pulse crop, is popular throughout the world as a protein rich healthy human and animal food. The economic and medicinal importance of lupins is traced back to the ancient botanical works of Theophrastus (272-288 BC) (Wink *et al.*, 1999). Lupins have been widely used as a source of protein and energy in livestock feeds. Their high protein content makes them a valuable resource for livestock production systems. Several varieties of *Lupinus luteus* (yellow-Lupin), *Lupinus albus* (white-Lupin) and *Lupinus angustifolius* (sweet-Lupin), are commercially cultivated. Lupin flour is used as a new ingredient of human food. At present lupins are cultivated in many countries including Australia, South America, France, Italy, Spain, Egypt, Sudan, Ethiopia, Syria, USA, Tropical and Southern Africa, Russia, and Ukraine.

Sri Lanka spends a considerable amount of foreign exchange on the import of food items including many protein rich pulses such as soya, lentils, green gram, chick pea, cowpea etc., amounting to an increase from 22,320 Mt of grain in 1985 to 97,170 Mt in 2005 (FAO, 2008). The balance between the export and import of the country for the year 2007 was US$ 3725.8 million (Department of Census and Statistics, 2007). A majority of the population in Sri Lanka falls under the low income due to lack of skills to obtain employment. This situation leads to poor buying for the food commodities. Malnutrition is an obvious manifestation of such communities particularly among the young children, pregnant mothers and the low-income group (FAO, 1992). Therefore, as a remedial measure, raising agricultural production of pulse crops may have positive impact on under- and mal nutrition.

The climate in Sri Lanka is broadly classified as tropical with rainfall, temperature, Relative Humidity and soil types varying widely in wet, dry, intermediate zones and central highlands (Domros, 1974; Panabokke, 1996). Sri Lanka is a country having diverse agro-climatic conditions with fertile soil in many areas. Therefore, there is a good potential of introducing commercially developed lupin varieties as a protein rich food for human or livestock and as a green manure. The main objective of the study was to evaluate the yield performance of lupins under field experimental conditions in the country and to select potential lupin varieties and growing areas for possible introduction of lupins to Sri Lanka.

METHODOLOGY

The field experiment was conducted in sites selected from Matale, Bandarawella and Nuwara Eliya Districts. The monthly rainfall and monthly temperature values for these districts were obtained from the meteorological records. Soil samples were collected from the sites and were analyzed for Soil pH, total carbon (SOC), macro- and micronutrients using standard methods. A total of ten commercially cultivated *Lupinus* genotypes comprising *L. albus* (var. Kiev mutant), *L. luteus* (var. Wodjil and Pootalong) and *L. angustifolius* (var. Ganguru, Tanjil, Walan, Belara, Donja, Kalya and Mandelup) were used in the experiments. The seed yield per plant was calculated using number of pods per plants multiplied by number of seeds per pod. The total biomass of individual plant at maturity was determined by measuring the constant weight of samples kept in oven at 105°C and expressed as g/plant. Since there were a number of variables

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measured or recorded in the study, Classification and regression trees (CART) was chosen and performed (Brieman *et al.*, 1984). Two regression trees were built to model the seed yield and the whole plant biomass

RESULTS AND DISCUSSION

The CART selected two splitting variables out of a number of parameters, site and lupin varieties and produced a decision tree for seed yield (Figure 1A). The decision tree showed that the entire data set was split into five terminal nodes based on the different splitting criteria. The first split was based on the cultivation sites. This resulted in a node (node 1) with a mean value of seed yield of 9.223 seeds/plant. This node represented the lupin varieties grown in the Matale site. Based on the varietal composition, Node 1 was further split into two terminal nodes to include varieties Pootalong and Woodjil into Node 3 (Mean 12.083) and the rest of the varieties into Node 4 (8.521). The varieties grown in Bandarawela and Nuwara Eliya fell within Node 2 with a mean yield of 34.480. This node was split on the composition of the varieties and resulted in the terminal node (5) with a mean value of 29.975 (varieties Donja, Kalya, Pootalong and Woodjil) and a node (6) with a mean value of 37.483 (Ganguru, Tanjil, Walan, Belera, Mandelup and Kiev Mutant), which was further split on the basis of geographical location of the site into two terminal nodes (Node 7, Mean yield 32.867; and Node 8, mean yield 42.100). The varieties grown in Nuwara Eliya produced higher yield than Bandarawela and Matale.

The results of CART analysis of total biomass data is shown in Figure 1B. The decision tree provided a total of five terminal nodes. The splitting criteria were similar to the criteria those applied in the analysis of yield. But in the geographic location the biomass data set has split into two nodes to include Node 1 (Matale site; Mean 117.933 g/plant) and Node 2 (Bandarawela and Nuwara Eliya; Mean 139.920 g/plant). At Matale site, the varieties Ganguru, Tanjil, Belera, Donja and Mandelup formed a low biomass group (Node 3; Mean 113.167 g/plant) and Walan, Kalya, Pootalong, Woodjil and Kiev Mutant included in the high biomass group (Node 4, Mean 122.700 g/plant). The Node 2 split further into Bandarawela (Node 5; Mean 136.600 g/plant) and Nuwara Eliya which becomes a terminal Node 6 (Mean 143.240 g /plant). Based on the varietals composition, the Node 5 was divided into two terminal nodes. The varieties Walan and Kalya were included in Node 7 (Mean 138.800 g/plant) and varieties Ganguru, Tanjil, Belera, Donja, Mandelup, Pootalong, Woodjil and Kiev Mutant were included in Node 8 (Mean 135.050 g/plant). Comparison of regression trees indicated that different lupin varieties have different yield performances with respect to seed yield and biomass. Comparison of both decision trees clearly showed that seed yield and biomass production of different varieties vary with respect to the district where they are cultivated.

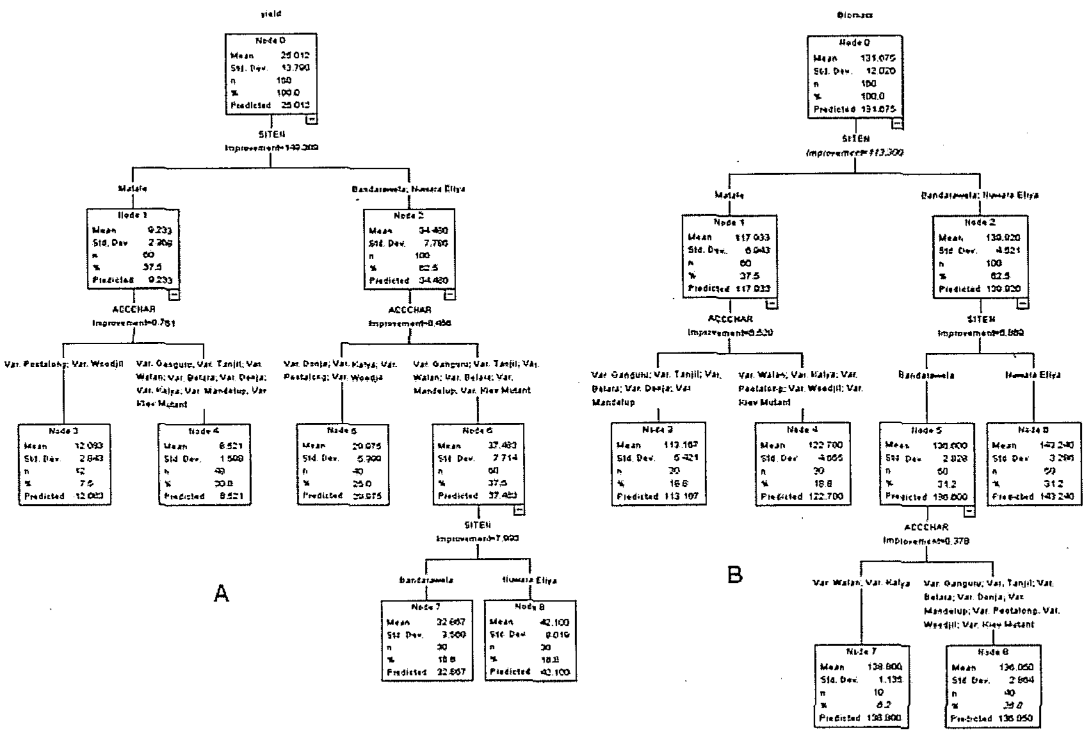

Figure 1. Decision trees constructed for seed yield (A) and total biomass (B) variation in the lupin species grown at different sites.
ACCCHAR = Lupin varieties; SITEN = Study site

CONCLUSIONS/RECOMMENDATIONS

The use of CART in analysis of complex data provides an objective variable selection method in a system and close visualization and easy interpretation of the patterns reflected from the data. The seed yield is ranged from higher in Nuwara Eliya followed by Bandarawela and lower in Matale. The varieties Pootalong and Woodjil in L. *luteus* produced higher seed yield in Matale and the varieties Ganguru, Tanjil, Walan, Belera, Donja, Kalya, Mandelup in *Lupinus angustifolius* and Kiev Mutant in *L. albus* were lower. Therefore, varieties which produced higher biomass could be recommended for growing for forage and green manure in Matale. The varieties, Tanjil, Walan, Belera, Mandelup and Kiev Mutant produce higher yield at Nuwara Eliya followed by Bandarawela and these species could be recommended for growing as a pulse crop in these two areas.

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