Performance and influence of multipurpose legumes and their residues on maize in the cold semi-arid area of Laikipia district, Kenya

Mwangi, Peter Wanjohi
Date: 2010

Abstract:

The challenge for increasing agricultural productivity in the cold semi-arid region of Laikipia district is how to improve and maintain soil fertility despite the low incomes of the farmers. Integration of the appropriate legumes into the existing maize based farming system is one low cost alternative for improving soil fertility and food security in the region. Studies were conducted at Matanya location in Lamuria division of Laikipia distrct, Kenya for five seasons from 2006 long rains season to 2008 long rains season. The objectives were: (a). To identify 'promising' multipurpose legumes for the cold semi-arid areas (b). To determine the influence of intercropping and nitrogen fertilizer on performance of 'promising' multipurpose legumes and maize and (c). To determine the composition, decomposition rates, and influence of residues of 'promising' legumes on maize performance and soil nutrient status. The experiments were laid out in randomized complete block design and replicated three times. In the first experiment, conducted in 2006 long rains season (April-September) and short rains season (October 2006-March 2007), two varieties each of six legume species including butter bean (Phaseolus coccineus) (Ex-kasuku and Ex-miharati), grass pea (Lathyrus sativus) (selection 1321 and Selection 1325), soya bean (Glycine max) (TGX1895-33F and TGX1989-12F), garden pea (Pisum sativum) (Oregon sugar and Green feast), hyacinth bean (Lablab purpureus) (Highworth and Rongai) and lima bean (Phaseolus lunatus) (Bush henderson and Dixie) were tested for agronomic performance. One variety each of common bean (Phaseolus vulgaris) (Katumani 3330) and chickpea (Cicer arietinumy (Desi) were used as the local checks. The legumes were assessed based on emergence, pest infestation, survival rate, ground cover, biomass yield, grain yield, water use efficiency and nitrogen use efficiency. Results indicated differential performance between and within legume species. Chickpea, butter bean (variety ex-kasuku), grass pea (Selection 1325) and common bean showed the best performance in biomass yield, grain yield, nitrogen yield, nitrogen use efficiency and water use efficiency. In the second experiment (conducted in 2007 long rainS and short rains seasons) 'promising' legumes selected from the first trials (i.e. butter bean variety Ex-kasuku, grass pea Selection 1325, chickpea Desi, and conunon bean Ka\UD1ani 3330) were intercropped with maize grown with (60 kg N/ha) and without (0 kg N/ha) inorganic N fertilizer. The intercrops were assessed based on biomass yield, grain yield, nitrogen yield, land use advantages and monetary advantage index. Plant competitiveness was assessed on the basis of aggressivity and competition ratio of maize and the legumes. The legumes were also assessed for nitrogen fixation potential. Performance of these legumes was redUced when they were interCrapped with maize with highest and lowest percent reduction in performance being observed in chickpea and butter bean respectively. Butter bean had the most depressing effects on maize performance attributes while chickpea had the least influence. Addition of nitrogen in the intercropping systems increased maize performance and

reduced thai of the legumes. Monetary benefits and land use advantage of the interCrops for dry matter, nitrogen and grain yield were in the order maize/butter bean > maize/grass pea > maize/conunon bean > maize/chickpea intercrop. Grass pea, butter bean and common bean were comparable in nitrogen flXalion potential while chickpea had significantly the least nitrogen fixation potential. CompositioU, decomposition and influence of the 'promising' legumes' residues on maize and on soil nutrient status were studied in the third experiment (conducted in 2007 short rains and 2008 long rains seasons). Decomposition and nutrient release from the residues were assessed using the nylon mesh method. Performance of maize planted with the residues and either supplemented with nitrogen (60 kg N/ha) or not (0 kg N/ha) was assessed based on growth (height, leaf area index and dry matter accumulation) and yield (biomass yield, grain yield and nitrogen yield) attributes. Mean dry matter decomposition rate of grass pea residue (0.80 and 0.51 %/week in 2007 short rains and 2008 long rains seasons, respectively) was significantly higher than observed in chickpea, common bean and butter bean residues. Nutrient loss from the residues was in the order K>P>N>Mg>Ca. Application of legume residues generally resulted in positive changes in soil nutrients. During the wetter 2007 short rains season, residue and nitrogen application significantly increased maize growth and yield parameters (dry matter, nitrogen and grain yields). Percentage increase in maize growth and yield parameters was higher where butter bean or grass pea residue was applied than where chickpea residue was applied. Grass pea (Selection 1325) and butter bean (variety Ex-kasuku) are 'promising' legumes for the cold semi-arid region. Maizelbutter bean (variety Ex-kasuku) and maize/grass pea (Selection 1325) intercrops may serve as alternative systems for crop diversification in the region. Butter bean (variety Ex-kasuku) and grass pea (Selection 1325) residues through their decomposition can potentially provide N, P, K and Mg to cropping systems in the region. Supplementing butter bean (variety Ex-kasuku) and grass pea (Selection 1325) residues with nitrogen has significant positive influence on maize performance when moisture is adequate.