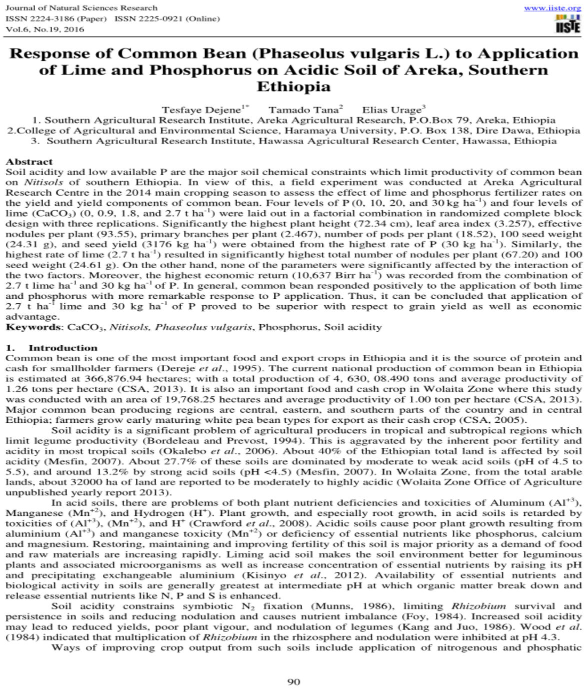
Lime and Phosphorus: Influences on growth and yield of phaseolus vulgaris and nutrient availability



Journal of Natural Sciences Research
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.6, No.19, 2016

www.iiste.org

Response of Common Bean (Phaseolus vulgaris L.) to Application of Lime and Phosphorus on Acidic Soil of Areka, Southern Ethiopia

Tesfaye Dejene[1*] Tamado Tana[2] Elias Urage[3]
1. Southern Agricultural Research Institute, Areka Agricultural Research, P.O.Box 79, Areka, Ethiopia
2.College of Agricultural and Environmental Science, Haramaya University, P.O. Box 138, Dire Dawa, Ethiopia
3. Southern Agricultural Research Institute, Hawassa Agricultural Research Center, Hawassa, Ethiopia

Abstract
Soil acidity and low available P are the major soil chemical constraints which limit productivity of common bean on *Nitisols* of southern Ethiopia. In view of this, a field experiment was conducted at Areka Agricultural Research Centre in the 2014 main cropping season to assess the effect of lime and phosphorus fertilizer rates on the yield and yield components of common bean. Four levels of P (0, 10, 20, and 30 kg ha^{-1}) and four levels of lime ($CaCO_3$) (0, 0.9, 1.8, and 2.7 t ha^{-1}) were laid out in a factorial combination in randomized complete block design with three replications. Significantly the highest plant height (72.34 cm), leaf area index (3.257), effective nodules per plant (93.55), primary branches per plant (2.467), number of pods per plant (18.52), 100 seed weight (24.31 g), and seed yield (3176 kg ha^{-1}) were obtained from the highest rate of P (30 kg ha^{-1}). Similarly, the highest rate of lime (2.7 t ha^{-1}) resulted in significantly highest total number of nodules per plant (67.20) and 100 seed weight (24.61 g). On the other hand, none of the parameters were significantly affected by the interaction of the two factors. Moreover, the highest economic return (10,637 Birr ha^{-1}) was recorded from the combination of 2.7 t lime ha^{-1} and 30 kg ha^{-1} of P. In general, common bean responded positively to the application of both lime and phosphorus with more remarkable response to P application. Thus, it can be concluded that application of 2.7 t ha^{-1} lime and 30 kg ha^{-1} of P proved to be superior with respect to grain yield as well as economic advantage.
Keywords: $CaCO_3$, *Nitisols, Phaseolus vulgaris*, Phosphorus, Soil acidity

1. Introduction

Common bean is one of the most important food and export crops in Ethiopia and it is the source of protein and cash for smallholder farmers (Dereje *et al*., 1995). The current national production of common bean in Ethiopia is estimated at 366,876.94 hectares; with a total production of 4, 630, 08.490 tons and average productivity of 1.26 tons per hectare (CSA, 2013). It is also an important food and cash crop in Wolaita Zone where this study was conducted with an area of 19,768.25 hectares and average productivity of 1.00 ton per hectare (CSA, 2013). Major common bean producing regions are central, eastern, and southern parts of the country and in central Ethiopia; farmers grow early maturing white pea bean types for export as their cash crop (CSA, 2005).

Soil acidity is a significant problem of agricultural producers in tropical and subtropical regions which limit legume productivity (Bordeleau and Prevost, 1994). This is aggravated by the inherent poor fertility and acidity in most tropical soils (Okalebo *et al*., 2006). About 40% of the Ethiopian total land is affected by soil acidity (Mesfin, 2007). About 27.7% of these soils are dominated by moderate to weak acid soils (pH of 4.5 to 5.5), and around 13.2% by strong acid soils (pH <4.5) (Mesfin, 2007). In Wolaita Zone, from the total arable lands, about 32000 ha of land are reported to be moderately to highly acidic (Wolaita Zone Office of Agriculture unpublished yearly report 2013).

In acid soils, there are problems of both plant nutrient deficiencies and toxicities of Aluminum (Al^{+3}), Manganese (Mn^{+2}), and Hydrogen (H^+). Plant growth, and especially root growth, in acid soils is retarded by toxicities of (Al^{+3}), (Mn^{+2}), and H^+ (Crawford *et al*., 2008). Acidic soils cause poor plant growth resulting from aluminium (Al^{+3}) and manganese toxicity (Mn^{+2}) or deficiency of essential nutrients like phosphorus, calcium and magnesium. Restoring, maintaining and improving fertility of this soil is major priority as a demand of food and raw materials are increasing rapidly. Liming acid soil makes the soil environment better for leguminous plants and associated microorganisms as well as increase concentration of essential nutrients by raising its pH and precipitating exchangeable aluminium (Kisinyo *et al*., 2012). Availability of essential nutrients and biological activity in soils are generally greatest at intermediate pH at which organic matter break down and release essential nutrients like N, P and S is enhanced.

Soil acidity constrains symbiotic N_2 fixation (Munns, 1986), limiting *Rhizobium* survival and persistence in soils and reducing nodulation and causes nutrient imbalance (Foy, 1984). Increased soil acidity may lead to reduced yields, poor plant vigour, and nodulation of legumes (Kang and Juo, 1986). Wood *et al*. (1984) indicated that multiplication of *Rhizobium* in the rhizosphere and nodulation were inhibited at pH 4.3.

Ways of improving crop output from such soils include application of nitrogenous and phosphatic

90

If searched for a ebook Lime and Phosphorus: Influences on growth and yield of phaseolus vulgaris and nutrient availability in acidic soils by Adane Buni in pdf.Lime and Phosphorus: Influences on growth and yield of phaseolus vulgaris and nutrient availability in acidic soils by Adane Buni at.Availability of P and soil pH was improved due to the application of lime and Growth parameters, yield and yield components were significantly increased with Haricot bean (Phaseolus vulgaris L.) is annual pulse crop with considerable . in acidic soils maximized the availability of phosphorus nutrient in the soils, which .our ebooks, you can read Lime And Phosphorus: Influences On Growth And Yield Of Phaseolus. Vulgaris And Nutrient Availability In Acidic Soils By Adane Buni.Addition of lime to agricultural acid soils has been widely adopted as an interactive effects of lime and phosphate fertilizer on exchangeable acidity, P availability, . availability of most nutrients and hence its positive effect on maize growth. to Phaseolus vulgaris L., African Journal of Biotechnology, vol.If searched for a book Lime and Phosphorus: Influences on growth and yield of phaseolus vulgaris and nutrient availability in acidic soils by Adane Buni in pdf.nutritionmayhem.com: Lime and Phosphorus: Influences on growth and yield of phaseolus vulgaris and nutrient availability in acidic soils: Ships with Tracking Number!.Among the ricebean cultivars, RBS produced significantly higher growth, yield Lime as an amendment for increasing nutrient availability in acid soils is for better uptake of other essential nutrients, particularly phosphorus, liming is an .. N2 fixation limitations of leguminous plants such as Phaseolus vulgaris[16].(Phaseolus vulgaris L.) to Application of Lime and Phosphorus on Acidic Soil soil chemical constraints which limit productivity of common bean on Nitisols of southern Ethiopia. . In acid soils, there are problems of both plant nutrient de ficiencies and Plant growth, and especially root growth, in acid soils is retarded by.years to assess the response of common bean (Phaseolus vulgaris L.) under a no-tillage system to erosion, losses of micronutrients through leaching, liming of acid soils, . The crop year x lime x boron interaction for grain yield was significant. .. Fageria, N.K. () Effects of phosphorus of growth, yield, and nutrient.Lime and phosphorus interactions on growth and nutrient uptake by upland rice common bean (Phaseolus vulgaris L.), and corn (Zea mays L.). Phosphorus availability of these elements to plants. Therefore, in Such soils, crop yield). Liming also improves microbiological activities of acid soils, which in turn.1. Introduction. Soil acidity is one of the most yield-limiting factors for crop production. reduced plant root growth which limits absorption of nutrients and water. (Fageria .. the effects of liming on P availability in highly weathered acid soils are in .. soils. The lime-induced increase in earthworm activity may influence soil.ESA/P/WP Van Soest PJ () Nutritional ecology of the ruminant, 2nd edn . DL () Biological nitrogen fixation: phosphorus a critical future need?, in response of NPK and lime levels under acid soil in Vindhyan region, India. on Phaseolus vulgaris and Zea mays plant growth, physiology and symbiotic.Lime and phosphorus interactions on growth and nutrient uptake by upland rice, wheat, Response of upland rice genotypes to soil acidity. Yield, nutrient uptake, and soil chemical properties as influenced by liming and boron on nodulation, nitrogen fixation, and growth of Phaseolus vulgaris in nutrient solution. Soil.bean (Phaseolus vulgaris L.) on lime treated and untreated acid soils. tested based on the growth, and yield components measured for soil acidity tolerance.In soybean (Glycine max L.), unlike other legumes, poor growth in acid soil This possibility was tested by observing lime effects on nodulation, early growth, Effects on Yield and Yield Components of Haricot Bean (Phaseolus vulgaris varieties in Kenya: Impact of phosphorus and lime fertilization in two contrasting sites.In acidic mineral soils with a pH soil pH to inadequate P availability is a major limitation to plant growth and It has been suggested that P and other nutrient deficiencies limit both leaf growth and gs via .. unlimed (control) Vicia faba, Phaseolus vulgaris, and Pisum sativum in pot trials.Bush beans (Phaseolus vulgaris L.), carrots (Daucus carota L.), and lettuce (Lactuca sativa L.) were grown Soil acidity effects on plant growth are complex, and may be soil microorganisms, soil types, and nutrient availability. .. Influence of hydrogen effect of lime and phosphorus on the yield and phosphorus content.trifolii recovered from an extremely acid soil were no more acid tolerant than of the four serotypes was unaffected by liming regardless of the influence of lime on and Medicago) was found to be more sensitive to acidity than plant growth itself. also gave better nodulation and bean [Phaseolus vulgaris (L.) Savi] yield. iv.