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Effects of Liming and Phosphorus Levels on Yield and Yield Components of Haricot Bean (*Pharsalus vulgarism* L.) Varieties on Nitosols at Wolaita Zone, Ethiopia

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ABSTRACT

A field experiment was conducted at 2 locations (Bolosso Sore and Damot Sore) in Wolaita Zone of SNNPRS to evaluate the response of 2 varieties of haricot bean (*Phaseolus vulgaris* L.) to phosphorus fertilizer rates and liming on acidic soils. Combinations of 4 levels of P (0, 10, 20 and 30 kg ha^{-1}) with 2 rates of lime (0 and 0.4 t ha^{-1}) were used on 2 varieties. The treatments were arranged in factorial RCBD with 3 replications. Analysis result of soil samples showed that OC, Av.P, TN and soil pH values were very low. Application of lime with P resulted significant changes on these chemical properties of the soils in the 2 locations. Availability of P and soil pH was improved due to the application of lime and maximum values of these parameters were recorded at 30 kg P ha^{-1}. Growth parameters, yield and yield components were significantly increased with increasing rates of P, both with liming and no liming at the 2 locations (year 1 and 2). Maximum grain yields (1488.40 and 1523.7 kg ha^{-1} for Hawasa Dume at Gununo and Dolla, respectively and 1242.12 and 1352.01 kg ha^{-1} for Omo-95 at Gununo and Dolla, respectively) were recorded at rates of 30 kg P ha^{-1} with lime of 0.4 t ha^{-1} at both locations. From the result of this study, it could be conclude that liming improve soil pH, Av.P and performance of haricot bean varieties but till now there is some gap on correcting acidity of the soils and also grain yield of the varieties. So, application of lime should be repeated in the coming season until soil comes to neutral and increased the production of the crops.

Key words: Hawasa dume, omo-95, soil acidity, yield

INTRODUCTION

Haricot bean (*Phaseolus vulgaris* L.) is annual pulse crop with considerable variation in habit, vegetation characters, flower color and the size, shape of pods and seeds (Onwueme and Sinha, 1999). It was probably 1st cultivated with maize and it seems likely that the 2 crops evolved together in a cereal-legume farming system in much the same way as cowpeas and sorghum in West Africa. It is widely cultivated thought out different parts of Ethiopia. It is produced in 4 major agro ecological zones, including the central, Eastern, Southern and Western zones. Haricot bean is mainly used as source of food and cash. It is exported to earn foreign exchange and is also one of the cash crops locally used by farmers as source of food. Additionally, farmers also grow the bean to use as forage for livestock and mulching. Haricot bean cultivation can be carried out without large input and intensive practices and this makes it suitable for poor farmers where the need in food supply is important. It can be used in intercropping system with maize and between young trees until canopy closure.

Yield of legumes in farmer's field is usually less than 0.65 t ha^{-1} against the potential yield of 1.2 t ha^{-1} suggesting a large yield gap (CACC, 2002). Low yield potential of legumes has made them less competitive with cereals and other high value crops. The yield of haricot bean increase with P application and its nodulation and fixation of N can be also improved with the application of P (Gedno, 1990). The average national productivity of haricot bean is 0.72 t ha^{-1} (CACC, 2002) and its regional productivity is 0.81 t ha^{-1}.

The major bean producing area in the Southern zone includes Gamo Goffa, Sidamo and Wolaita (Gedno, 1990). Haricot bean is also one of the most communal cultivated pulse crops in the Wolaita area where its yield is lower than regional and national yields. The low yield is contributed from acidity of soils which reduce availability of P and basic cations as Ca and Mg and also affect activities of soil microorganisms (Havlin *et al.*, 1999).

Lime application neutralizes soil acidity, reduces toxicity levels of Al, Fe and Mn and improves physiological, chemical and biological properties of soils (Kisinyo *et al.*, 2005). It also improves soil productivity by providing Ca and Mg (Oster, 1982). It is found that as the lime and P application to acid soils increased plant available Fe, Mn, Zn and Cu but B contents of soil decreased, whereas pH, Ca, Mg and available P increased which in turn improve crop performance (Ponette *et al.*, 1996). The extension of this approach in semiarid region of Ethiopia appears to be promising.

Even though application of lime with P brings positive effect on soil conditions and crop performance, in Wolaita area where the problem of soil acidity is very chronic, little or no work is done to verify whether there is response of crops to P application rates with liming or not. Furthermore, to use fertilizer with lime as source of nutrients, there should be site specific recommendation to maintain optimum level of nutrients. Therefore, this study was initiated with the following objectives:

- To evaluate the response of haricot bean varieties to different rates of P fertilizer
- To compare the performance of haricot bean varieties with liming
- To observe the interaction effect of P with lime on haricot bean varieties

MATERIALS AND METHODS

Description of the study site: The researches were conducted during the 2012-2013 rainy season at 2 locations, which is located in Wolaita Zone, Southern Nations Nationalities and People's Regional State (SNNPRS). The 1st one was at Boloso Sore district, which is located at 307 km south of Addis Ababa and 5 km from Areka town, at 7°04.196' N and 37°41.330' E and altitude of 1790 m above sea level. The 2nd location was Damot sore district, which is located 330 km south of Addis Ababa and 2 km from Gununo town, at 6°56" N and 37°.39' E and altitude of 1790 m above sea level. There was no meteorological station in the study area, which is found 3 km far from Boloso Sore district. The 2 districts are with mean annual rainfalls of 1460 mm with a bimodal pattern, which extends from March to September. The peak rainy months are April, July, August and September. The mean minimum and maximum temperatures are 15 and 26 °C, respectively. The representative date was collected from Areka Agricultural Research Center.

Methods and approaches: To fill the knowledge gap on application of liming with fertilizer rate on acidic soil, various knowledge enhancement activities were carried out. They included training of 30 subject matter specialists, 30 farmers and 8 development workers, introduction of liming application on acidic soils on selected 2 farmers training centers in 2 woredas.

Treatments and experimental design: Hawassa Dume and Omo-95 haricot bean varieties were used for test crop to compare its response to phosphorus fertilizer rates and liming materials. The levels used were 0, 10, 20 and 30 kg P ha^{-1} and lime (0 and 0.4 t ha^{-1}). The treatments were arranged in factorial RCBD with 3 replication. Five rows each have 15 plants were used on plot having size of 2.0 by 1.5 m. Spacing of 10, 40, 50 and 100 cm were used between plants, rows, plots and blocks, respectively. Urea at rate of 50 kg ha^{-1} and all doses of P were applied at planting time. TSP for P and urea for N were used as source of fertilizer. All cultural practices such as weeding, hoeing, etc., were kept uniform for all treatments.

Agronomic data collection: Flowering and maturity dates (when 50% of the plants were at respective phonological stage), number of branches per plant, plant height, number of pods per plant, number of leaf per plants, pod length, number of seeds per pod and seed yield were recorded. The 3 central rows were harvested for determination of grain yield and total biomass.

Soil sampling and analysis: The soil samples were air-dried and ground to pass 2 and 0.5 mm (for total N) sieves. All samples were analyzed following standard laboratory procedures as outlined by Taye *et al.* (2000). Organic carbon and total N contents of the soil were determined following the wet combustion method of Walkley and Black and wet digestion procedure of Kjeldahl method, respectively. Available P was extracted by Olsen method (Olsen *et al.*, 1954). Soil texture was analyzed by Bouyoucos hydrometer method. The pH (H_2O) of the soils was measured in water using pH meter with glass-calomel combination electrode.

Statistical analysis: The data obtained from soil and crop, were statistically analyzed using the PROC ANOVA function of SAS and means were compared using LSD at a probability level of 5%.

RESULTS AND DISCUSSION

Physicochemical properties of soil: Soil analysis of the 2 locations before sowing in 2 years (Table 1) showed that pH values (5.0 and 5.6) found in the range of strong acid based on Herrera (2005) classification. Whereas the application of lime resulted in a significant increase in soil pH compared to 0 t ha^{-1}, the application of lime combined with P 30 kg ha^{-1} it's led to slight decrease soil acidity in both year 1 and 2 but this was not significant (Table 2 and 3). Lime combined with P fertilizer gave the mean highest value of soil pH (6.3) at Dolla site while P fertilizer applied alone had the least (5.2) at Gununo site. This result clearly indicated that the area is seriously affected by soil acidity, which is not satisfactory for growth of most crops (Havlin *et al.*, 1999).

The range of available phosphorous contents of the 2 locations (0.6 and 1 mg kg^{-1}) before sowing was very low (Table 1) this was in range of very low based on (Herrera, 2005). This

Table 1: Physiochemical properties of the soil before sowing at Dolla and Gununo (2012-14)

	Soil pH		Av. p (mg kg^{-1})		TN (%)		OC		
	Year								
Location	1	2	1	2	1	2	1	2	Textural class
Dolla	5.3	5.6	1.00	6.12	0.15	1.75	0.15	0.31	Sandy loam
Gununo	5.0	5.4	0.60	5.22	0.12	0.18	0.10	1.70	

Table 2: Mean interaction effect of lime and phosphorus on soil chemical properties at Gununo (2012-2013)

Treatment	Lime (t ha^{-1})							
	0				0.4			
p	Soil pH	Av. p	TN	OC	Soil pH	Av. p	TN	OC
0	5.20^{a}	0.80	0.3	0.80	5.60^{a}	2.90^{a}	0.23	1.10
10	5.20^{a}	0.90	0.3	0.80	5.80^{a}	3.20^{a}	0.23	1.10
20	5.30^{a}	0.90	0.3	0.80	5.90^{a}	3.20^{a}	0.23	1.10
30	5.30^{a}	0.90	0.3	0.80	6.00^{a}	3.30^{a}	0.23	1.10
LSD 5%	0.33	0.03	1.3	0.03	0.33	0.03	1.30	0.03
CV	4.40	65.00	18.0	39.00	4.40	65.00	18.00	39.00

Table 3: Mean interaction effect of lime and phosphorus on soil chemical properties at Dolla (2012-2013)

Treatment	Lime (t ha^{-1})							
	0				0.4			
p	Soil pH	Av. p	TN	OC	Soil pH	Av. p	TN	OC (%)
0	5.50	0.60^{c}	0.10	0.40	05.90^{b}	3.70^{c}	0.18	1.10
10	5.60	1.10^{b}	0.22	0.40	106.00^{a}	3.60^{b}	0.18	1.10
20	5.60	1.70^{a}	0.23	0.40	206.20^{a}	3.90^{a}	0.18	1.10
30	5.70	1.70^{a}	0.36	0.40	306.30^{a}	4.00^{a}	0.18	1.10
LSD 5%	0.33	0.03	1.30	0.03	0.33	0.03	1.30	0.03
CV	4.40	65.00	18.00	39.00	4.40	65.00	18.00	39.00

low concentration of available P may be related to acidity of the soil which bring fixation of P (Havlin *et al*., 1999). The available phosphorous concentration increased with increased liming. The highest concentration of Av.P (5.2-6.1 mg kg^{-1}) was recorded under year 2 in Gununo and Dolla site, respectively, whereas the lowest Av.P was found at year 1 at 0 t ha^{-1} liming at 2 locations. The differences in concentration in soil might be resulted from changes in biological and geochemical processes at different activities after human disturbances.

Application of lime might contributed in releasing some amount of fixed P to be available for the crop. But application of lime alone could not help haricot bean production to be increased. This also indicates that deficiency of P cannot be replaced by lime. As a result in acidic soils which are deficient in Av.P, OC and TN are important to apply P together with lime to increase crop production. The same result was obtained in the year 1 and 2 of the OC and TN in experiment site. The 1st and 2nd years lime application with fertilizer had been affect haricot bean production. This is in agreement with Anetor and Akinrinde (2007) who indicated that lime increased pH and available P in Nigeria. However, potassium (K) and exchangeable acidity were decreased with increasing application. On the other hand lime did not influence TN and OC of the soil. This indicates that application of lime is required to increase the soil nutrient availability. Textural analysis showed that the same textural class according to the present study soil textural class was sandy loam in both locations and textural class there are no significantly difference between year 1 and 2. The lack of soil textural class difference between year 1 and 2 at both location its might be attributed to the similarity in parent material from which the soils originate.

Soil analysis results of soil sample showed that pH values at harvested were higher than values before sowing both in year 1 and 2, which may be attributed to application of P fertilizer and the positive effect of lime in neutralizing acid soils (Table 2 and 3). Statistically, there was no significant difference on TN and OC of soils in both locations except for available P of Dolla soil with the absence of liming. On the other hand, application of lime resulted significant variation on soil pH and available P in the 2 locations of year 1 and 2 (Table 2 and 3). These changes of soil pH and Av.P of soil may be attributed to the neutralizing of acid soil due to application of lime and also application of P fertilizer at increasing rates (Tisdale *et al*., 1993). Soil pH, Av.P, OC and TN were measured by year 2 with lime rates (0.4 t ha^{-1}) exhibited significant effect on soil pH and Av.P. These dates were year 1 and 2 content of the soil exhibited an increasing trend with increasing rates of liming material application. The lime (0.4 t ha^{-1}) produced the highest mean phosphorus concentration (4.0 mg kg^{-1}), implying a greater effect of the applied lime material on the availability of phosphorus in 2 years. Therefore; aplying higher amounts of liming materials in acidic soils maximized the availability of phosphorus nutrient in the soils, which is very important for crop production (Smith *et al*., 1994). The highest phosphorus value (30 kg ha^{-1}) and the lowest phosphorus value (0 P kg ha^{-1}) was obtained from 2 years.

Effects of lime and phosphorus on phenological stage of haricot bean varieties: Dates of flowering and maturity of the 2 verities were the same at both locations.

Interaction effect of lime and phosphorus on growth performance of haricot bean varieties: Application of P at different rates resulted significant variation on growth parameter of plant in the 2 locations both with and without lime (Table 4). Growth parameters such as plant height, leaf and branches number were increased significantly as the rates of P increased.

Table 4: Mean interaction effect of lime and phosphorus on growth performance of haricot bean varieties at Gununo and Dolla (2011-2013)

Gununo						Dolla		
Lime (t ha^{-1})	V	P	Height	Br. No.	Leaf No.	Height	Br. No.	Leaf No.
0	Omo-95	0	26.86^{c}	2.21^{b}	6.70^{d}	36.33^{c}	3.73^{c}	8.73^{d}
		10	38.70^{bc}	2.30^{b}	8.50^{c}	68.60^{b}	4.45^{c}	10.46^{c}
		20	47.80^{a}	2.80^{a}	13.80^{a}	69.50^{a}	5.25^{b}	16.73^{a}
		30	57.16^{a}	2.90^{a}	12.70^{a}	73.98^{a}	5.80^{a}	16.73^{a}
	Haw	0	26.03^{c}	3.00^{a}	7.00^{c}	20.36^{c}	3.07^{c}	8.67^{d}
		10	41.02^{b}	2.80^{a}	10.50^{b}	48.67^{b}	4.87^{b}	14.47^{b}
		20	41.02^{b}	2.70^{a}	11.70^{b}	53.13^{b}	4.07^{b}	14.47^{b}
		30	43.90^{b}	2.80^{a}	12.30^{a}	57.20^{ab}	6.25^{a}	16.93^{a}
0.4	Om	0	32.71^{b}	2.60	6.60^{d}	46.73^{bc}	4.00^{b}	9.67^{c}
		10	44.96^{a}	2.80	7.10^{d}	51.60^{b}	2.87^{c}	9.53^{cd}
		20	44.73^{a}	2.70	11.60^{b}	75.30^{a}	5.60^{a}	16.00^{a}
		30	50.60^{a}	2.70	13.60^{a}	76.07^{a}	4.40^{b}	17.07^{a}
	Haw	0	30.16^{b}	2.70	6.60^{d}	33.33^{c}	3.53^{b}	8.00^{d}
		10	33.87^{b}	2.70	10.10^{b}	40.60^{c}	3.80^{b}	13.40^{b}
		20	36.80^{a}	2.80	8.60^{c}	44.13^{b}	3.97^{b}	12.27^{b}
		30	46.52^{a}	3.20	10.30^{b}	93.23^{a}	4.68^{a}	16.20^{a}
CV			39.59	17.40	31.70	35.70	28.50	16.27
LSD			4.37^{g}	0.58	1.53	13.03	0.99	1.65

Values followed by the same letter(s) within a column are not significantly different at $p \leq 0.05$, NS: Not significant

Maximum values of plant heights, leaf and branches numbers were recorded at application rates of 30 kg P ha^{-1} in the 2 locations, both with and without lime (Table 4). Additionally, Hawassa Dume had better performance than Omo-95. In line with this result Kisinyo *et al*. (2005) indicated that growth of plant increased in acid soil as application of P increased with and without lime. This positive growth response of haricot bean for application of P in acidic soil may be a related with better availability of P as the rates of P application increased. Furthermore, plant did have better performance due to liming (Table 4) which may come from the effect of lime in neutralizing soil acidity and in turn improve the availability of P for crops. Similar result was also reported by Singh and Tripathi (1994).

Interaction effect of lime and phosphorous on yield and yield component of haricot bean varieties

Pods number and length: Analysis of variance showed that there was significant interaction effect of lime and phosphorus rates on number and length of pods for both varieties in 2 locations. Maximum number and length of pods were recorded at rate of 30 kg P ha^{-1} with the absence and also application of lime for Hawassa dume while Omo-95 had lower performance (Table 5). Such increment of pods number and length with increasing rate of P may be attributed to the better availability of P for plants as the rate of external P application increase which in turn observed on better plant performance. Furthermore, better performance of both varieties with liming may be related with neutralizing of acid soil by lime which in turn increases availability of P for plant uptake (Kisinyo *et al*., 2005). Interaction effect of lime and haricot bean verities was significant, whereas P fertilizer had interaction with lime and haricot bean verities were

Table 5: Mean interaction effect of lime and phosphorus on yield and yield components performance of haricot bean varieties at Gununo and Dolla (2012-2013)

			Gununo				Dolla			
Lime (t ha^{-1})	V	P	PN	SN	PL	SY	PN	SN	PL	SY
	O	0	7.40	5.2^{bc}	7.4^{c}	671.27^{b}	7.9^{cd}	5.9^{a}	8.5	682.28^{c}
		10	6.80	4.9^{c}	8.3^{b}	768.61^{b}	6.6^{d}	4.8^{c}	8.1	790.28^{bc}
		20	10.10	5.7^{a}	8.8^{a}	819.29^{b}	10.1^{b}	5.8^{a}	9.1	872.07^{bc}
		30	10.90	5.9^{a}	8.9^{a}	1046.11^{a}	10.8^{b}	6.0^{a}	9.2	1156.07^{a}
	H	0	5.20	4.5^{c}	7.4^{c}	715.44^{b}	4.9^{e}	4.7^{c}	7.7	795.43^{bc}
		10	8.80	5.4^{b}	8.8^{a}	926.14^{a}	8.4^{c}	5.3^{b}	9.0	972.61^{ab}
		20	10.10	5.1^{bc}	8.8^{a}	990.50^{a}	8.3^{c}	5.1^{bc}	8.9	1013.37^{ab}
		30	12.90	5.7^{a}	8.9^{a}	1089.12^{a}	12.9^{a}	6.1^{a}	9.3	1110.46^{a}
0.4	O	0	7.10^{d}	5.1^{c}	8.0^{b}	834.27^{cd}	7.3^{b}	5.6^{a}	8.9	854.37^{d}
		10	8.10^{cd}	4.7^{b}	7.8^{b}	1088.38^{bc}	5.6^{c}	4.3^{b}	8.2	1098.15^{bc}
		20	11.10^{a}	5.5^{a}	9.0^{a}	1152.83^{b}	11.1^{a}	5.5^{a}	9.5	1185.81^{b}
		30	8.80^{b}	4.8^{b}	7.9^{b}	1242.12^{b}	7.1^{b}	4.2^{b}	7.5	1352.01^{ab}
	H	0	5.80^{e}	4.8^{b}	8.0^{b}	984.78^{c}	5.7^{c}	5.2^{a}	8.3	995.87^{cd}
		10	9.50^{b}	5.5^{a}	9.2^{a}	1205.02^{b}	7.3^{b}	4.9^{b}	8.4	1250.01^{b}
		20	8.30^{cd}	4.8^{b}	8.3^{b}	1451.76^{a}	7.7^{b}	5.5^{a}	8.6	1498.40^{ab}
		30	9.80^{b}	5.6^{a}	8.4^{b}	1488.40^{a}	14.0^{a}	5.3^{a}	8.3	1523.70^{a}
CV			27.70	17.14	9.5	34.27	22.70	11.9	0.79	46.00
LSD			1.43	0.44	0.57	201.00	1.65	0.65	3.11	200.00

Values followed by the same letter(s) within a column are not significantly different at $p \leq 0.05$, NS: Not significant significantly ($p<0.05$) affected pod number of the hawassa dume verity (Table 5). Highest number of pods per plant (14. 0) was produced when the crop was grown in lime. Interaction effect of lime and P fertilizers on pod per plant and pod number recorded from lime treated alone hawassa dume verity (12.9) alone was not significantly different. This may be because lime created better soil environment for naturally existing haricot bean verities. This finding is also in line with reports of (Malik *et al.*, 2006) who indicated more pod number per plant of soybean.

Seeds number and seed yields: There was significant variation on seed number per pod and seed yield ha^{-1} due to application of lime and phosphorous for the 2 varieties. Maximum number of seeds per pod and seed yield ha^{-1} at the 2 locations were recorded at 30 kg P ha^{-1} for both varieties while they were treated by 0 and 0. 4 t ha^{-1} of lime (Table 5). Seeds number and seed yield were increased with increasing rates of P for the 2 varieties which were treated by lime at rates of 0 and 0.4 t ha^{-1}. As stated earlier available P was increased when rates of P application increased and lime was applied, this in turn improve crop performance such as seeds and pod number and at the end seed yield. So, this result indicated that liming improves availability of P for crops and also external P application improved crop yield performance. The result may be attributed to the fact that applying phosphorus fertilizer increases crop growth and yield on soils which are naturally low in P and in soils that have been depleted (Mullins, 2001).

The interaction effect of lime, haricot bean verities and P fertilizer was significantly ($p<0.05$) in case of seed number per pod of the haricot bean (Table 5). Regardless of P fertilization, lime and hawass dume gave significantly higher seeds per pod. Phosphors fertilized haricot bean produced significantly ($p<0.05$) more seed number than 0 P kg ha^{-1} under this haricot bean verity whereas P fertilizer had no effect when the crop was grown without liming (Table 5). This is in agreement with reports of (Cassman *et al.*, 1980; Taye *et al.*, 2000) on nodulation parameters of soybean. Significantly lower number of seeds was recorded from haricot bean grown without lime and P fertilizer. Seed yield of the crop was significantly affected by the interaction effect of lime and phosphorus fertilizer (Table 5). When the crop was grown with lime and P fertilizer had no significant effect whereas the effect of the fertilizer was significant when the haricot bean was grown without lime (Table 5). Under both location limes with P fertilizer had significant effect on seed yield of the crop. However, P with and without lime gave significantly more seed yield under the use of harass dume verity (Table 5). This result is supported by (Chalk *et al.*, 2010; Bekere *et al.*, 2013) who reported beneficial effect of lime for legumes grown in acidic soil. When lime was applied, acidic soils was significantly increased seed yield of the haricot bean. This may be because of the fact that acidic soil environment was neutralized by the applied lime. Earlier findings also showed that rhizobium and P fertilizer give almost similar weight in legumes like soybean, haricot bean and mung bean (Cassman *et al.*, 1980).

CONCLUSION

Field experiments were conducted at the 2 locations on acidic soil to study the effect of lime and phosphorus application on haricot bean verities at Dolla and Gununo in Wolaita Zone, Southern Ethiopia. The research work was initiated to evaluate the response of haricot bean varieties to different rates of P fertilizer and liming on acid soils. The experiment was laid out in factorial randomized complete block design with 3 replications. Hawasa dume and Omo-95 were treated by combination of four rates of P (0, 10, 20 and 30 kg P ha^{-1}) with 0 and 0.4 t ha^{-1} of lime.

Soil samples were collected from 2 locations before sowing and at maturity for analysis of some selected physical and chemical properties of soil (texture, Soil pH, Av.P, OC and TN). Laboratory analysis result of the soil samples taken before sowing and at harvest revealed that all the soil parameters were at lower rates even though the soil was treated by different rates of P and lime.

Available phosphorus showed increasing tendency with increasing soil pH and liming on both location with 2 seasons. The overall result of chemical properties in this study, demonstrated that most soil parameters were significantly different with lime application at 2 areas.

There was a significant increase on growth parameters of the 2 varieties as rates of P fertilizer increased both during liming and no liming at Dolla and Gununo. Maximum values of plant height, leaves and branches number were recorded at application rates of 30 kg P ha^{-1} at both location with liming and no liming in year 1 and 2. Similarly, the highest grain yield and yield components were obtained at 30 kg P ha^{-1} with lime 0 and 0. 4 t ha^{-1} on both varieties at 2 locations. Furthermore, application of lime improved soil conditions and in turns varieties performance at both locations.

Therefore, applying of liming materials in acidic soil maximize the availability of nutrients especially phosphorus in the soil, which is very important for better performance of crops. In general liming is important in the study area, this is because of strong acidity and low values of some chemical properties of the soil. The application of P fertilizer increased yields of haricotbean, however, the grain yields were low compared with crop potential (25000 ha^{-1}). This indicates that a 2 season treatment of lime can correct problem of soil acidity. So, it is recommended that correcting of soil acidity should be done for growth seasons until soil comes to neutral conditions and increased crop production.

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