Effects of Fertilizer, Rhizobium Inoculation and Lime Rate on Growth and Yields Field Pea in Horro and Gedo Highlands

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Abstract

Integrated inputs of production enhance the production and productivity of field pea (*Pisum sativum*). The effect of fertilizer, rhizobium strain and lime rate and their interaction on nodulation and grain yield of field pea was conducted with factorial arrangement in randomized complete block design with three replications. NP fertilizer rate significantly increased mean seed yield of field pea at both locations. Application of rhizobium strains significantly reduced mean seed yield as compared to untreated one indicating the presence of suitable local strain in the soil or high amount of nitrogen in the soil. Application of lime significantly reduced number of nodule plant^{-1}. Mean seed yield of field pea significantly increased with increase in lime rate at both locations. Interaction of NP fertilizer rate with rhizobium inoculation and application of lime significantly increased mean seed yield of field pea at both locations indicting the importance of using integrated inputs production for field pea production. Therefore, application of 23/25 kg NP ha^{-1} fertilizers, 6 kg lime ha^{-1})

Materials and Methods

T e experiment was conducted in Horro and Gedo highlands during the 2007 and 2008 cropping seasons. Horro lies between 9°34'N latitude and 37°06'E longitude at an altitude of 2400 meter above sea level. Mean annual rainfall of 1,695 mm [26]. It has a cool humid climate with the mean minimum, mean maximum, and average air temperatures of 8.15, 15.72 and 11.94°C, respectively. Gedo lies between 9°03'N latitude and 37°26'E longitude at an altitude of 2400 meter above sea level receiving mean annual rainfall of 1,026 mm [26]. It has a cool humid climate with the mean minimum, mean maximum, and average air temperatures of 8.51, 18.48 and 13.49°C, respectively. T e soil in both sites is Nitisols [27] and the properties are indicated in Table 1.

Soil	Horro	Gedo
pH (H_2O)	5.2	5.7
Total N (%)	0.343	0.36
O C	3.272	4.44
C:N (%)	10	12
Available P (ppm)	5	14.8
K (Meq 100 gm $Soil^{-1}$)	0.74	3.95
Texture	Clay	Clay loam

Table 1: Soil properties of the experimental site.

T e experiment was laid in Randomized Complete Block Design in factorial arrangement with three replications. T e factorial arrangement were fertilizer rate as factor A, rhizobium inoculation as factor B and lime rate as factor C. T ree levels of fertilizer rates were; 13.5/15, 18/20 and 22.5/25 kg NP ha^{-1}. Rhizobium inoculation consisted of: without inoculation and with inoculation (10 g kg of $seed^{-1}$). Lime rates included; 0, 2, 4 and 6 t $CaCO_3$ ha^{-1}, respectively. T e feld pea varieties used was Tegegnech. T e source of fertilizer was Diammonium phosphate. T e weighed rate of fertilizer was applied at time of planting. Rhizobium strains (EAL-300) was used at the rate of 10 g per 1 kg seed, and then pelleted with sugar to insure attachment of the inoculants with seed. Lime was weighed and applied to each plot three weeks ahead of seeding feld pea and incorporated to soil in 2007 and the residual efect was used in 2008. T e recommended seed rate used was 150 kg ha^{-1}. T e plot size used was 4 m × 4 m. All cultural practices were done as per the available research recommendation for feld pea production.

T e soil pH was measured with digital pH meter potentiometrically in the supernatant suspension of 1:2.5 soils to distilled water ratio. Organic carbon was determined following wet digestion methods as described by Walkley and Black [28] whereas kjeldahl procedure was used for the determination of total nitrogen (N) as described by Jackson [29]. T e available phosphorus (P) was measured by Olsen method as described by Olsen et al. [30] and available potassium (K) was measured by fame photometry.

Plant data collected included: nodule $plant^{-1}$ at early pod setting; plant height; pods $plant^{-1}$ seeds pod

4	13	15	14	109	137	123	8	9	8
6	13	11	12	110	136	123	9	9	9
LSD (5%)	Ns	1.4572	1.8678	Ns	Ns	Ns	Ns	Ns	Ns
CV (%)	24.31	22.64	11.55	12.69	9.1	11.55	22.3	28.26	27.31

combined over locations (Table 5). Significantly higher mean seed yield of field pea was produced with increased lime application. Liming increased the grain yield of field pea by 22% in conventional tillage and by18% in non-tillage system [44]. Buerkert et al. [45] reported lime application resulted in a yield increase of 76 to 313% above unlimed controls across locations. At both locations better, mean seed yield of field pea was recorded at higher rate of lime treated fields. Liming of acidic soils can improve yield substantially [46,47]. This indicates use of lime gradually improves the yield of field pea at Horro and Gedo highlands. Therefore, increasing rate of lime application with rhizobium inoculation and NP fertilizer rate significantly improved field pea production at Horro and Gedo highlands.

Interaction effects

Interaction of NP fertilizer with rhizobium inoculation significantly affected combined mean seed yield of field pea (Table 6).

NP (kg)+Rl (g 1 kg Seed) +Lime Rate (t) ha^{-1}	Seed Yield kg ha^{-1}						
	Horro			Gedo			Combined Mean
	2007	2008	Mean	2007	2008	Mean	
75-0-0	1572	973	1273	1951	2900	2426	1849
75-0-2	1970	847	1408	1998	3329	2663	2036
75-0-4	2089	1269	1679	1950	3233	2592	2135
75-0-6	2244	1097	1671	2389	3451	2920	2295
75-10-0	1786	869	1327	1831	3101	2466	1897
75-10-2	2323	888	1605	2023	3090	2556	2081
75-10-4	2575	1020	1797	1858	3173	2515	2156
75-10-6	2156	1221	1687	2144	3097	2620	2154
100-0-0	2362	941	1651	1813	3215	2514	2083
100-0-2	2114	1331	1722	2259	3310	2785	2253
100-0-4	2719	1283	2001	2351	2584	2468	2234
100-0-6	2710	1343	2026	2073	3012	2542	2284
100-10-0	2083	884	1484	2603	3076	2839	2161
100-10-2	1698	1024	1361	1722	3357	2539	1950
100-10-4	2284	1344	1814	1980	3257	2618	2215
100-10-6	2249	1073	1661	2311	2783	2547	2104
125-0-0	1925	973	1449	2090	3094	2592	2021
125-0-2	2204	1269	1736	2299	3073	2686	2211
125-0-4	2047	1105	1576	2610	3011	2810	2193
125-0-6	2681	1632	2156	2349	3158	2753	2455
125-10-0	2349	1460	1904	2271	3444	2857	2381
125-10-2	2609	1353	1981	2302	3203	2753	2409
125-10-4	2203	1310	1756	1940	2731	2336	2046
125-10-6	2262	1559	1910	1885	2685	2285	2097
LSD (5 %)	211.2	163.7	203.2	232.8	276.6	266.8	Ns
CV (%)	5.8	8.53	10.5	6.67	5.43	8.93	27.15

References

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