CANOPY REFLECTANCE AND YIELD IN COMMON BEAN PLANTS (*Phaseolus vulgaris* L.). II. EFFECT OF PHOSPHOROUS

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Introduction

It is widely recognized that phosphorous (P) directly affects both the rate of crop growth and the quality of grain. Growth and yield of common bean plants (*Phaseolus vulgaris* L.) are increased by P supply (an important element in nodule metabolism) (Blevins, 1995). The spectral reflectance vegetative index (i.e. green normalized difference vegetation index, GNDVI) is particularly useful for assessing physiological parameters (leaf area index, absorbed radiation, total chlorophyll, etc.), and it can be used to estimate canopy biomass and seed yield (Araus *et al.*, 2001; Gutiérrez, 2002). For that reason, the objective of the present work was to determine whether GNDVI can be related to yield in bean plants under different P rates (0, 100 y 200 kg ha^{-1}).

Material and methods

The study was carried out in Montecillo, Mexico (19°19' N, 98°54' W, 2250 of altitude) under rainfed conditions (June-September, 2001). Seeds of bean plants (*Phaseolus vulgaris* L.) cv. Flor de Durazno were sowed in plots with a density of 25 plants m^{-2} using a randomized complete block design with four replications. Different P rates; 0, 100 and 200 kg ha^{-1} (P0, P100 and P200, respectively) were applied during the sowing. Canopy reflectance was measured with a portable spectroradiometer (FieldSpec, USA) at 14, 25, 32, 39, 50, 84 and 88 days after the sowing (das). Leaf area index, intercepted radiation, biomass and yield components were determined in each treatment.

Results and discussion

The data showed that seed yield was increased with 100 and 200 kg of P ha^{-1} (323 and 468 g m^{-2} respectively), while the P0 had lower seed yield (248 g m^{-2}). These changes were related with raceme number, pod number and seeds m^{-2}.

Biomass and harvest index were also higher in P100 (932 g m^{-2} and 35% espectively) and P200 (1058 y 44% respectively), compared with P0 (852 g m^{-2} and 29% respectively).

GNDVI values did not show differences in early stages (vegetative and at beginning of reproductive stage). The maximum GNDVI value occurred during the flowering and grain-filling stage (50-84 das) when the plants began to senescence the GNDVI values decreased.

GNDVI showed a high relationship with absorbed radiation (r^2=0.62-0.81), biomass (r^2=0.73-0.92), and leaf area index (r^2=0.85-0.97) from an early stage (vegetative growth) until pod-filling stage (Figure 2a, b, c).

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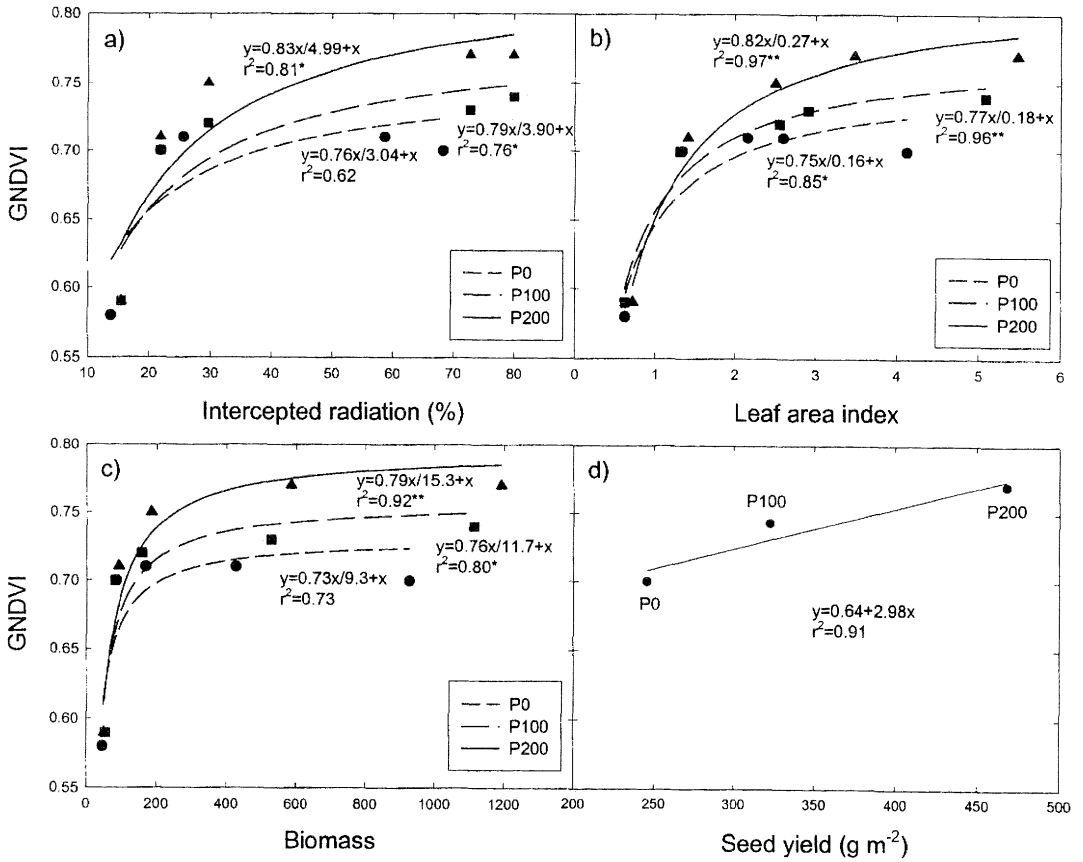

Figure 1. Relationship among GNDVI, intercepted radiation, leaf area index, biomass and seed yield in bean plants (*P. vulgaris* L.) under different P rates. (*,**) significant at p≤0.05 and 0.01 respectively. Montecillo, México.

GNDVI at pod-filling stage (84 das) showed a high relationship with seed yield (r^2=0.91) (Figure 1d).

Conclusions

In conclusion, GNDVI provides a good estimate yield in bean plants when influenced by different P fertilization rates.

Literature cited

Araus, J.L.; J. Casadesus; J. Bort. 2001. Recent tools for the screening of physiological traits determining yield. pp. 59-77. *In:* M.P. Reynolds,; J.I. Ortiz-Monasterio; A. McNab (eds.) *Application of physiology in wheat breeding*. CIMMYT. México, D.F.

Blevins, D.G. 1995. Uptake, translocation, and function of essential mineral elements in crop plants. pp259-275. In: K.J. Boote; J.M. Bennet; T.R. Sinclair; G.M. Palusen. Physiology and determination of crop yield. American Society of Agronomy. Madison, Wisconsin.

Gutierrez R., M. 2002. La radiometría como estimador del rendimiento en frijol (*Phaseolus vulgaris* L.) y trigo (*Triticum aestivum* L.). Tesis de Maestría. Colegio de Postgraduados. Montecillo, México. 85 p.