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Research article

IMPACT OF CORN AND BEAN INTERCROPPING ON GRAIN ELEMENTS CONTENT OF BEAN

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ABSTRACT: An experiment as randomized complete block design with 3 replications was conducted in order to study of intercropping corn and red bean on qualitative traits of bean grains in Zanjan university research farm in 2011. The experimental treatments included: T1: monoculture of corn, T2: replacement intercropping system 1:1 ratio (50% of corn + 50% of bean), T3: replacement intercropping system 1:2 ratio (67% of corn + 33% of bean), T4: replacement intercropping system 2:1 ratio (33% of corn + 67% of bean), T5: replacement intercropping system 2:2 ratio (50% of corn + 50% of bean), T6: intercropping additive system with 100% of corn + 5% of bean ratio, T7: intercropping additive system with 100% of corn + 15% of bean ratio, T8: intercropping additive system with 100% of corn + 25% of bean ratio, T9: intercropping additive system with 100% of corn + 35% of bean ratio, T10: monoculture of bean. Investigations indicated significant difference among intercropping treatments at 0.01 probability level. The results showed that the highest protein and nitrogen content belonged to T6 (intercropping additive system with 100% of corn + 5% of bean ratio) with mean of 27.39% and 4.383, respectively in bean grains.

Keywords: corn, bean, intercropping system, grain content

INTRODUCTION

Intercropping is being advocated as a new and improved approach to farming. However, it has been avoided because of the complications of planting and harvesting. Intercropping involves competition for light, water and nutrients. However, intercropping usually benefits from increased light interception, root contact with more soil, increased microbial activity and can act as a deterrent to pests and weeds of the other crop. There is also evidence that suggests intercropping may benefit a non-legume which needs nitrogen if the other crop is a legume, since legumes will fix nitrogen in the soil [14, 1]. Producers and researchers carry out different cropping systems to increase productivity and sustainability by practicing crop rotations, relay cropping, and intercropping of annual cereals with legumes. Intercropping of cereals with legumes has been popular in tropics [10, 19] and rain-fed areas of the world [5, 9, 2, 7] due to its advantages for soil conservation [3], weed control [13, 5], lodging resistance [3], yield increment [3, 6], hay curing, forage preservation over pure legumes, high crude protein percentage and protein yield [15, 12], and legume root parasite infections control [8].
The objective of the present study was to evaluate the intercropping corn and red bean on qualitative traits of bean grains.

MATERIALS AND METHODS

Study area and trial procedure

This experiment was conducted in Zanjan university research farm. This experiment was done as randomized complete block design with 3 replications. The study of phosphorus, potassium, nitrogen and protein contents in the grains of bean (*cv. Local*) was carried out in 2011.

The experimental treatments included:

T1: monoculture of corn,
T2: replacement intercropping system 1:1 ratio (50% of corn + 50% of bean),
T3: replacement intercropping system 1:2 ratio (67% of corn + 33% of bean),

T4: replacement intercropping system 2:1 ratio (33% of corn + 67% of bean),
T5: replacement intercropping system 2:2 ratio (50% of corn + 50% of bean),
T6: intercropping additive system with 100% of corn + 5% of bean ratio,
T7: intercropping additive system with 100% of corn + 15% of bean ratio,
T8: intercropping additive system with 100% of corn + 25% of bean ratio,
T9: intercropping additive system with 100% of corn + 35% of bean ratio,
T10: monoculture of bean.

The soil was harrowed 10 days before planting, after which 100 kg ha^{-1} of N was broadcast and disked to produce a smooth seed bed. After 2 weeks of corn seeding, corn mono cropping plots received an extra 50 kg N ha^{-1} by hand-broadcasting to give a total of 75 kg ha^{-1} in each plot. Corn and bean were simultaneously seeded in June 1. Each plot was 4 m long in which corn was planted by hand in four rows with 75 cm row spacing. Legumes were also sown by hand between each corn rows or on the corn rows in intercropped plots.

Table 1. Physical and chemical properties of experimental soil before planting

Depth (cm)	O.C. (%)	N (%)	P (ppm)	K (ppm)	Texture	pH	EC (ds/m)
0-30	1.21	0.07	14.2	266	Clay-loam	8.18	0.7

Mineral analysis

First, collected grains carefully rinsed with distilled water, and then they were dried by oven at 60 ° C for 24 h. The next step, the grains were ground fine enough to pass a 0.5-mesh screen. After the content extracted by freshwater digestion procedure and analyzed for macronutrient content according to the guidelines of the Association of Official Analytical Chemists (AOAC 1990). In this regards, The phosphorus was analyzed spectrophotometrically by the phospho-vanadate colorimetric method (Hewlett Packard 8452A, Ontario, Canada); K was determined by flame photometry (Corning 405, Halstead, UK), and nitrogen was determined by Kjeldahl analysis. Crude protein concentrations were calculated by multiplying total N by 6.25. Data are given as % of DW.

Statistical Analysis

The data on quality characteristics were analyzed by Fisher's analysis of variance technique and Duncan test at 0.05 probability level to compare the treatment means (Steel and Torrie, 1984). Data analysis was conducted using of SAS [16] as RCBD with three replicates.

RESULTS AND DISCUSSION

The obtained results revealed that intercropping system had significant effect ($p< 0.01$) on phosphorus content of bean (Table 2). The mean comparison of data showed that the higher phosphorus content was found in T5 (replacement intercropping system 2:2 ratio (50% of corn + 50% of bean)) with mean of 0.59% that with T6 (intercropping additive system with 100% of corn + 5% of bean ratio) and T9 (intercropping additive system with 100% of corn + 35% of bean ratio) was in a common statistically group (Figure 1). The results indicated the effect of intercropping system was significant ($p< 0.01$) on potassium content of bean (Table 2). The treatment of T6 (intercropping additive system with 100% of corn + 5% of bean ratio) with mean of 2.303% had the most potassium content in bean grains (Figure 2). The analysis of variance table showed that intercropping system was significant effect ($p< 0.01$) on nitrogen content (Table 2). Results indicated T6 (intercropping additive system with 100% of corn + 5% of bean ratio) with mean of 4.383% had the most nitrogen content in grain of bean (Figure 3). Investigations indicated significant difference among intercropping treatments at 0.01 probability level (Table 2). The mean comparison of treatments showed that the highest protein content belonged to T6 (intercropping additive system with 100% of corn + 5% of bean ratio) with mean of 27.39% in bean grains (Figure 4).

Table 2: The variance analysis of experimental treatments effect on studied traits.

S.O.V	d.f	Phosphorus	Potassium	Nitrogen	Protein
Replication	2	0.0001	0.001	0.005	0.213
Intercropping Culture	8	0.014 **	0.242 **	0.381 **	14.887 **
Error	16	0.001	0.003	0.005	0.216
CV %		5.47	3.59	1.95	1.96

Note. ** – significant at 1%

Herbert et al. [11] stated that the legume component of mixture fixing N from the atmosphere increased crude protein content and total yield and also enhanced the height and yield of the component crops. Singh et al. [17] reported that legumes have a significant role on enrichment of soil nitrogen and N uptake of accompanying corn crop. Armstrong et al. [4] also noted that beans increased the crude protein concentration of all mixtures when intercropped with corn.

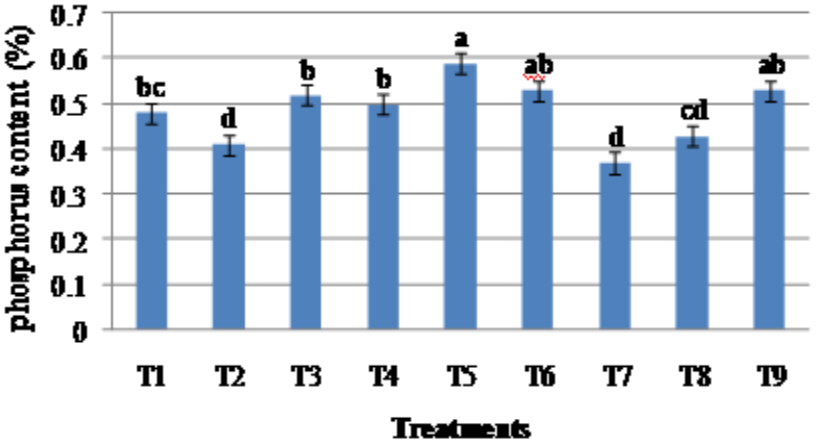

Figure 1. Effect of intercropping system treatments on phosphorus content of bean. Error bars represent the standard deviations of the means of phosphorus content.

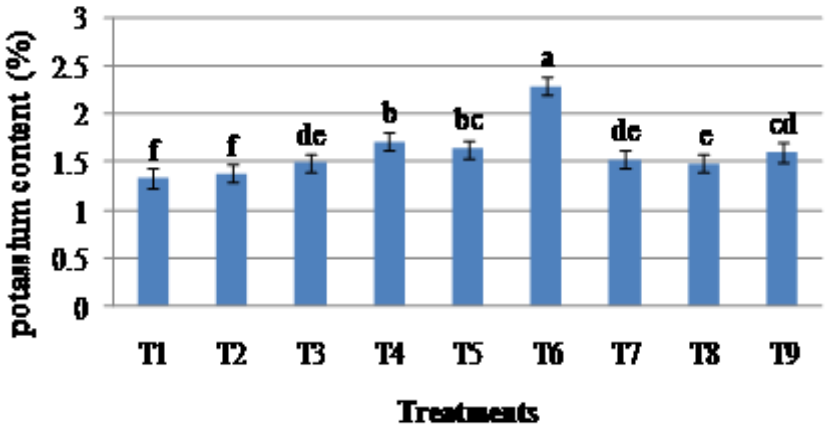

Figure 2. Effect of intercropping system treatments on potassium content of bean. Error bars represent the standard deviations of the means of potassium content.

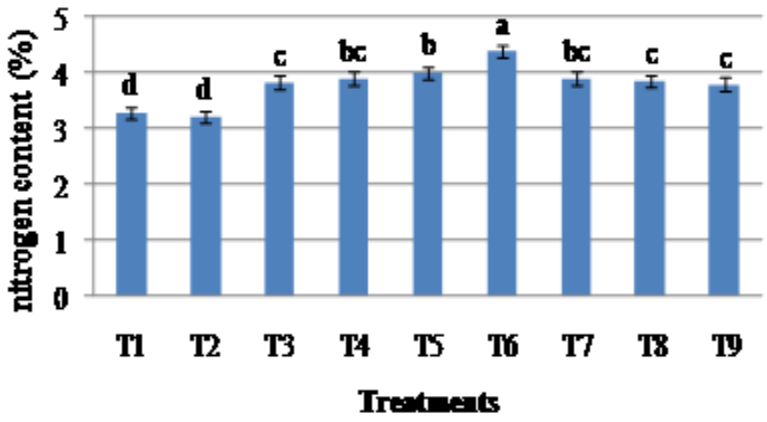

Figure 3. Effect of intercropping system treatments on nitrogen content of bean. Error bars represent the standard deviations of the means of nitrogen content.

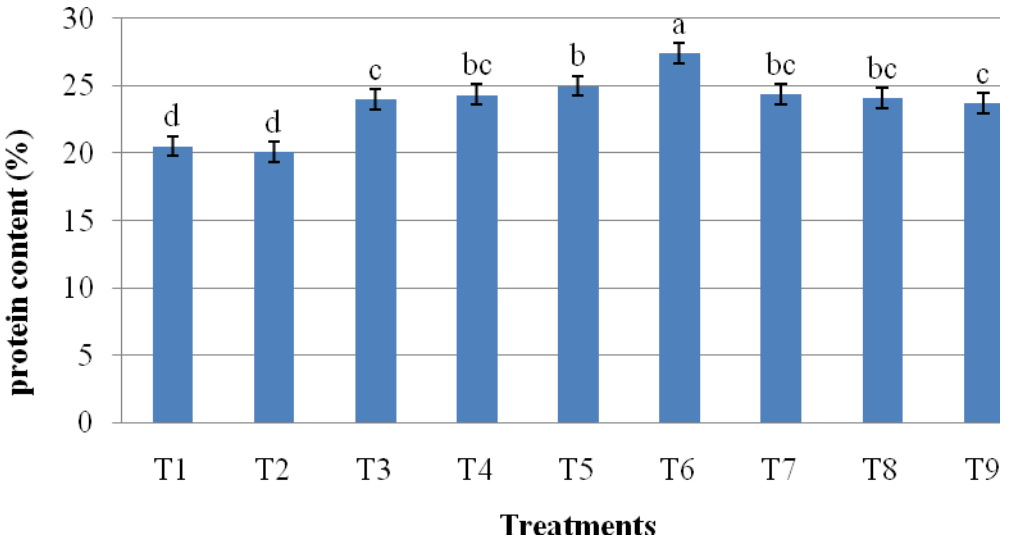

Figure 4. Effect of intercropping system treatments on protein content of bean. Error bars represent the standard deviations of the means of protein content.

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