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EVALUATION OF BEAN VARIETIES IN THE SANTO DOMINGO VALLEY, BAJA CALIFORNIA SUR

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Abstract: Bean cultivation is important in the country's agricultural economy, both because of the surface area allocated to it and because of the economic benefits it generates. The present work was established with the objective of evaluating bean varieties with acceptance characteristics in the national market and adapted to the water, climate and soil conditions of Baja California Sur. Therefore, 14 bean varieties were evaluated: Pinto Saltillo, Pinto Durango, Pinto Centauro, Pinto Salinas, Raramuri, P-14036, Max, Chasse, San Rafael, Bill-z, Az. Regional 33, Az. Regional 87, Az. Fig tree and Aluyori. A Randomized Block experimental design was used. A non-significant difference was found between treatments or varieties ($p \geq 0.05$). The highest yields were: 2,273, 2,215, 2,100, 2,018, 1,973 and 1,936 t ha^{-1}, obtained with the varieties Max, Bill-z, San Rafael, Az Regional 87, Az Higuera and Pinto Saltillo, respectively. The Raramuri and P-14036 varieties had the lowest yield, obtaining 1,665 and 1,647 t ha-1, respectively. A significant difference was found between varieties ($p \leq 0.05$), according to the analysis of variance (ANOVA), so their behavior was different in specific weight. The varieties, Az Regional 87, Az Regional 33, and Pinto Salinas, had the highest specific weight, with 86.1, 81.4 and 81.1 kg hL-1 respectively. The productive comparison showed a potential gap of 50% in performance, the deviation in the b/c ratio was 41% and in productivity in relation to the water used, rates of 7.11 $ m-3 and 0.699 kg m^{-3} were achieved. of water with the Max variety; which represents a deviation of 163% with respect to the regional average.
Keywords: Beans, varieties, management.

INTRODUCTION

Bean cultivation occupies an important place in the country's agricultural economy, both because of the surface area allocated to it and because of the economic benefits it generates. Together with corn, they constitute the basic diet of the Mexican people and consequently are the products of greatest socioeconomic importance both in terms of the planted area and the amount consumed per capita. The importance of beans in the human diet lies in their protein content (22-28%), their caloric intake (341 cal/100 g), fiber, iron, zinc, potassium, vitamin B6 and folic acid, among other essential elements. (Piza, 2012). It is now known that the bean grain has many compounds with functional biological activity related to health, particularly in the control of chronic-degenerative diseases. However, the availability of this grain has been limited in recent years by adverse climatic factors in the various producing regions. It is now known that the bean grain has many compounds with functional biological activity related to health, particularly in the control of chronic-degenerative diseases. However, the availability of this grain has been limited in recent years by adverse climatic factors in the various producing regions. In the last five cycles, an average of 357 ha have been established in B.C.S. where 464 t have been harvested with an average yield of 1,299 t ha^{-1} (SIAP, 2021).

MATERIALS AND METHODS

The present work was carried out in the P-V cycle of the year 2022, at INIFAP, Campo Experimental Valle de Santo Domingo, B.C.S, in arid conditions typical of the area, with geographical location at the coordinates 24º 30' north latitude and 111º 41' longitude west. The type of tillage consisted of a cross-tracking to properly condition the land for planting, considered as minimum tillage. 14 varieties of beans were evaluated, they were sown on February 10, 2022, dry, manually leaving 20 seeds per linear meter, with beds 1.60 meters wide, with two rows separated by 0.3 m between them. 60 kg ha were used. -1 seed. Fertilization was carried out with 90 kg ha-1 of nitrogen and 20 kg ha-1 of phosphorus, applied after germination; phosphorus in the first stages of the developing crop, and nitrogen (N) fractionated on three occasions. To control weeds, manual weeding was carried out, without herbicide application. Three applications of soapy water + 1.0 L of seaweed and two applications of Imidacloprid insecticide and biological fungicide with trichoderma were made at doses of 1.0 + 2.0 L ha-^{1}, to control whiteflies and sucker complexes. Likewise, 15 frequent irrigations were carried out using 6.0 mil drip tape, the cost of which was 4.35 lhm, with a total sheet of 32.5 cm. The agronomic variables of the plant were evaluated, such as weight of 100 seeds, specific weight, number of pods, grains per pod, plant height and grain yield.

RESULTS AND DISCUSSION

The treatments of bean varieties, according to the ANOVA analysis of variance, showed a non-significant difference (Table 1).

They behaved in a similar way when considering the yield obtained by genotype ($p \geq 0.05$), the highest values were: 2.273, 2.215, 2.100, 2.018, 1.973 and 1.936 t ha-1, obtained with the genotypes Max (7), Bill -z (10), San Rafael (9), Az Regional 87 (12), Az Higuera (13) and Pinto Saltillo (1), respectively. Pinto Saltillo is an improved bean variety generated by INIFAP. Its grain has a light cream-colored testa (shell) that darkens longer than others of its type. Its development solved the problem of traditional pinto-type varieties with reduced shelf life due to the darkening of the testa. This variety tolerates diseases such as anthracnose and rust, and shows intermediate susceptibility to common bacteriosis. The average yield is 1434 kg ha-^{1} and yields up to 3431 kg ha-^{1} have been obtained. The Saltillo Pinto bean variety is resistant to intermittent drought and slow grain browning. This last characteristic provided longer shelf life and solved the depreciation problem that pinto-type grain varieties had. Another characteristic is the reduced cooking time, which reduces gas consumption in homes and in companies that sell cooked beans. (Rosales et al, 2015).

The varieties Raramuri (5) and P-14036 (6) had the lowest yield, obtaining 1,665 and 1,647 t ha^{-1}, respectively. Significant differences were found between varieties ($p \leq 0.05$), according to the analysis of variance (ANOVA), so their behavior was different in specific weight. The varieties Az Regional 87 (12), Az Regional 33 (11), and Pinto Salinas (4) had the highest specific weight, with 86.1, 81.4 and 81.1 kg hL^{-1} respectively (Figure 1).

The characteristics of the soil used for the evaluation of bean varieties with drip irrigation were: medium sandy clay loam texture, cc: 33.0, pmp: 13.3, da: 1.25, PH: 8.26, EC: 1.25 dS m-1, and MO: 0.67%. They resulted with a regular concentration of nitrogen in the soil 42 mg Mg-1, high potassium 150 mg Mg-1, moderately alkaline pH 8.26 and electrical conductivity 1.25 dS·m-1, denoting a very slightly saline condition in the plot. Carrying out consecutive soil analyzes according to the production cycles allows us to know the use of nutrients in soils with arid conditions, recognize the edaphic conditions and predict the productive response capacity according to the technological level that is implemented. Beans require 56 kg ha^{-1} of N for each ton of grain produced (IPNI, 2007). Therefore, to produce, for example, 2.0 t ha^{-1} of grain, the crop must have around 112 kg of N ha^{-1} to be absorbed by the crop. The recommended dose for planting beans in the Santo Domingo Valley under irrigation conditions is 90-20-

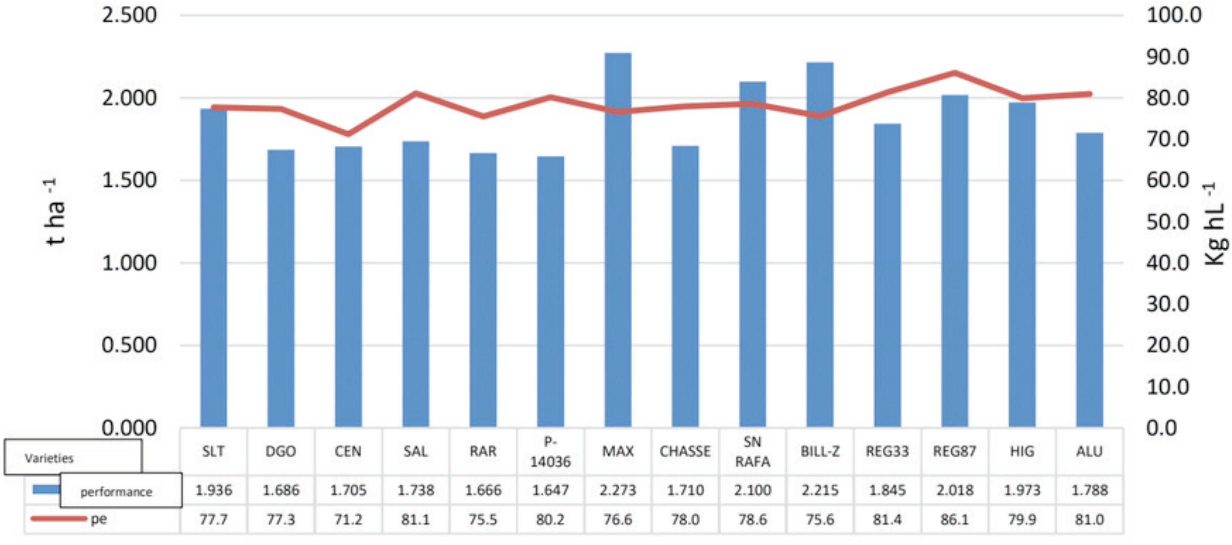

Figure 1: Yield of 14 bean varieties in B.C.S. INIFAP 2022

	Productive Indices								
Treatment	R	P	b	c	b/c	utility	leaf	productivity	
	t ha^{-1}	\$ t^{-1}	\$ ha^{-1}	\$ ha^{-1}		\$ ha^{-1}	m^3	\$ m^{-3}	kg m^{-3}
Max	2.273	26000	59098	35978	1.64	23120	3250	7.11	0.699
Average DDr	1.510	26000	39260	33905	1.16	5355	5700	0.94	0.265
Deviation%	50		50		41				163

Table 1: Productivity per unit area and use of irrigation water of the outstanding bean genotype (INIFAP, 2022).

R= performance, P= price, b= profit, c= cost, bean 12% hum.

00 of nitrogen, phosphorus, and potassium, respectively.

This practice was generated for intermediate and early cycle varieties; However, for later varieties, a variation in the requirements of nutritional elements would be expected. Therefore, it is necessary to generate new fertilization formulas that, if the demand for fertilizer were greater, would have an impact on the contamination of aquifers, on production costs, on the profitability of the crop, and on the size and quality of the grain. The bean plant demands a greater amount of nitrogen than other nutrients, since it is involved in the formation of the proteins contained in the seed (20 to 22%) and nitrogen requirements increase during the pod formation and filling phases. In addition to being considered the nutrient that has greater mobility in the soil and high solubility. Tests of fractional applications of this element carried out by these authors indicate that it is better to apply it all at sowing. Various studies have shown that nitrogen fertilization can increase bean yield (Padilla et al, 2009).

The use of the varieties with the highest yield, Max (7), Bill-z (10), San Rafael (9), Az Regional 87 (12), Az Higuera (13) and Pinto Saltillo (1) compared to the average yield regional, means a gap of 50%, the deviation of 41% in the benefit-cost relationship (b/c), productivity in relation to the water used obtained rates of 7.11 \$ m-3 and 0.699 kg m-3 of water with the genotype (7) Max which represents deviations of 163% with respect to these indices (Table 1).

The economic productivity indices and water use indices were low. Therefore, the validation of varieties in situ with producers must continue. However, economic pressures induce farmers to produce a particular crop as profitably as possible, leading them to ignore sustainable practices (FAO, 2002).

CONCLUSIONS

The outstanding varieties were: Max, Bill-z, San Rafael, Az Regional 87, Az Higuera and Pinto Saltillo. The productive comparison showed that the yield with the best variety means a potential gap of 50%, the deviation in the b/c ratio was 41% and in productivity in relation to the water used, indices of 7.11 were achieved \$ m^{-3} and 0.699 kg m^{-3} of water with the Max variety; which represents a deviation of 50% with respect to the regional average performance. To improve the productive capacity of beans in arid conditions, a lower-cost technological package is recommended, exceeding the limit of 2.0 t ha^{-1}, having support for the use of high-yield varieties and promoting the product system chain.

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