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EVALUATION OF BARLEY VARIETIES IN THE SANTO DOMINGO VALLEY, SOUTHERN BAJA CALIFORNIA

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Abstract: Due to the introduction of barley varieties to produce quality beer and the lack of knowledge of the risks involved in agronomic and economic (profitability) issues, among others, as well as the lack of research on the subject in the state of Baja California Sur, the present work was established with the objective of evaluating barley varieties and inducing producers' interest in the technology for the production of the crop. The present work was established with the objective of evaluating barley varieties and inducing producers' interest in technology for the production of the crop, so 10 varieties of barley were evaluated: Esperanza, Esmeralda, Alina, Guanajuato, Josefa, Brennus, Prunella, Metcalfe, Estelar and Maravilla. A Randomized Block experimental design was used. Significant difference was found between treatments or varieties ($p \leq 0.05$). The highest yields were: 5.8, 5.5, 5.3, 4.8 and 4.7 t ha^{-1}, obtained with the varieties Estelar, Maravilla, Josefa, Esmeralda, and Alina, respectively. The Guanajuato and Esperanza varieties, with similar behavior, obtained 4.3 and 4.2 t ha^{-1}, respectively. The varieties Guanajuato, Brennus and Estelar had the highest hectoliter weight, with 63.3, 60.2 and56.6 kg hL^{-1}, respectively. The productive comparison showed that the highest yield means a potential gap of 39%, the deviation in the b/c ratio was 39% and in productivity in relation to the water used, indexes of 1.19 \$ m^{-3} and1.183 kg m^{-3} of water were achieved with the Estelar variety; which represents a deviation of 39% with respect to the Esperanza variety.
Keywords: Barley, varieties, management.

INTRODUCTION

Malting barley (*Hordeum vulgare* L.) is an economically important crop for Mexican producers, mainly those established in the Valles Altos and El Bajío regions of Mexico; its production concentrates about 95% of the national total in an area of about 250,000 ha (SIAP, 2020). Recent studies have defined that the temperature of agricultural areas in Mexico has increased significantly since the nineties of the last century. This increase in temperature brings with it alterations in agroclimatic variables such as the accumulation of cold in the winter period. A rise in temperature accelerates the process of crop maturity, reduces the duration of leaf area and thus the total water requirement at plant maturity (Medina *et al.*, 2016). Due to the introduction of barley varieties to produce quality beer and the lack of knowledge of the risks involved in agronomic and economic (profitability) issues, among others, such as the lack of research in this regard in the state of Baja California Sur. This research was carried out with the objective of evaluating barley varieties in Baja California Sur, and to induce producers' interest in barley production technology for different uses.

MATERIALS AND METHODS

The present work was carried out at INIFAP, Campo Experimental Valle de Santo Domingo, B.C.S., under arid conditions typical of the area, with geographical location at coordinates 24°30' north latitude and 111°41' west longitude. The type of tillage consisted of a cross-trailing to properly condition the soil for planting, being considered as minimum tillage. It was sown on January 18, 2021, dry, manually leaving50 a 60 seeds per linear meter, with furrows of0.80 metros wide, with two rows separated at0.30 m between them. Seed80 kg ha^{-1} was used. Fertilization was carried out with160 kg ha^{-1} of nitrogen and40 kg ha^{-1} of phosphorus applied after germination;

phosphorus in the early stages of crop development, and nitrogen (N) fractionated on two occasions. For weed control, manual weeding was carried out, an application of 150 l ha^{-1}, of amine herbicide 2-4 d. Without insecticide application. Thirteen frequent irrigations were carried out using a 6.0 mil drip tape, with a total irrigation rate of 4.35 lhm, with a total irrigation sheet of49.4 cm . The agronomic variables of the plant were evaluated, such as hectoliter weight (He) and grain yield.

RESULTS AND DISCUSSION

The barley variety treatments, according to the ANOVA analysis of variance, showed significant differences (Table 1). They behaved differently when considering the yield obtained by genotype ($p \leq 0.05$), the highest values were: 5.8, 5.5, 5.5, 5.3, 4.8 and 4.7 t ha^{-1}, obtained with the genotypes Estelar (9), Maravilla (10), Josefa (5), Esmeralda (2), and Alina (3), respectively. The varieties Guanajuato (4) and Esperanza (1), maintained a similar behavior among them, obtaining 4.3 and 4.2 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 hectoliter weight. Varieties (4) Guanajuato, (6) Brennus, and (9) Estelar had the highest hectoliter weight, with 63.3, 60.2.1 and56.6 kg He^{-1}, respectively (Figure 1).

The characteristics of the soil used for the evaluation of the barley 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 %. The results showed a regular concentration of nitrogen in the soil 42 mg Mg^{-1}, high potassium 150 mg Mg^{-1}, medium 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 analyses according to the productive cycles allows knowing the nutrient utilization in soils with arid conditions, recognizing the edaphic conditions and predicting the productive response capacity according to the technological level implemented. Barley requires26 kg ha^{-1} of N for each ton of grain produced (IPNI, 2007). Thus, to produce for example 7.0 t ha^{-1} of grain, the crop should have about182 kg of N ha^{-1} to be absorbed by the crop. The recommended dose for barley planting in El Bajío under irrigated conditions is 180-60-00 of nitrogen, phosphorus, and potassium, respectively. This practice was generated for intermediate and early varieties; however, for later varieties, such as the recently introduced two-row foreign varieties, a variation in the requirements of nutritional elements would be expected. Optimum malting barley protein standards are between 10 and 12% due to the effects on the brewing process and the final quality of the barley, and crop fertilization is a determining factor. Nitrogen (N) is the most important element affecting parameters related to quality, such as protein concentration and hectoliter weight, as well as grain size and weight (Navarrete, 2015). An alternative to obtain an adequate balance between yield and protein of barley grains could be to supplement nitrogen fertilization between sowing and tillering with foliar applications during gleaning, since late nitrogen applications do not generally increase yields, but have an effect on protein (Bulman and Smith, 1993). On the other hand, the use of biofertilizers represents an important alternative for the partial or total substitution of mineral fertilizers and, as a consequence, an option for the sustainable management of barley. Maleki et al. (2011) mention that, in sustainable agricultural systems, the application of integrated fertilization, which includes vermicompost and biofertilizers together with chemical fertilizer, has the capacity to supply a barley grain with good mineral contents. On the other hand, and related to varieties grown in contrasting environments, the sowing date

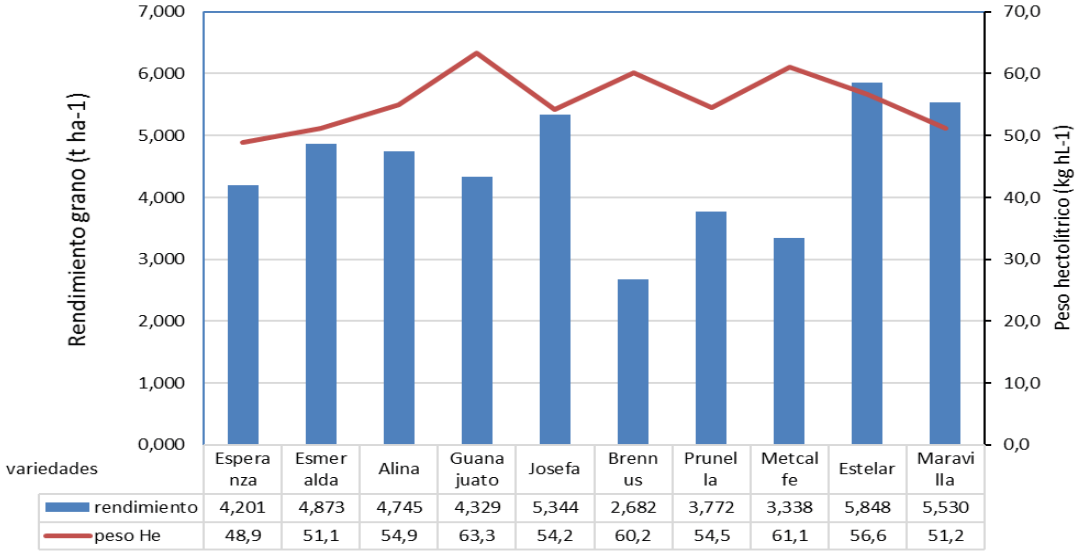

Figure 1. Yield of 10 barley varieties in B.C.S. INIFAP 2021.

	Productive Indexes								
Treatment	R	P	b	c	b/c	utility	foil	productivity	
	t ha^{-1}	\$ t^{-1}	\$ ha^{-1}	\$ ha^{-1}		\$ ha^{-1}	m^3	\$ m^{-3}	kg m^{-3}
Star	5.848	5000	29240	24600	1.19	5905	4940	1.19	1.183
Esperanza	4.201	5000	21005	24600	0.85	-3595	4940	-073	0.850
Deviation	39		39		39				39

Table 1. Productivity per unit area and per irrigation water use of two barley genotypes (INIFAP, 2021). R= yield, P= price, b= profit, c= cost, barley12 % hum,

(FS) is an important aspect in the agronomic management of the barley crop, because it is directly related to grain yield and its industrial quality (O'Donovan et al., 2012). The FS depends on soil characteristics and temperature, harvest date of the previous cycle, farmer priorities, and current and expected precipitation (Tabarzad et al., 2016). The optimum FS for barley in El Bajío under irrigated conditions is from 01 to 30 December (García et al., 2008); which depends on the variety to be used due to differences in crop cycle and environmental adaptation (Solano et al., 2010). However, Perez et al. (2016) observed that the highest values of agronomic characteristics, physical grain quality and barley yield, were presented in sowings carried out in late autumn (15-30 November). Similarly, the longest period of physiological maturity was observed in this establishment period, while the shortest duration of the cycle was detected in sowings from December 30 to January 15, which was associated with the oscillation of maximum and minimum temperatures during the final stage of grain filling (Pérez et al., 2015).

The use of the varieties with the highest yield, (9) Estelar, (10) Maravilla, (5) Josefa, (2) Esmeralda, and (3) Alina compared to (1) Esperanza, means a gap of 39 %, the deviation of 39 % in the benefit-cost ratio (b/c), in the productivity in relation to the water used, indexes of 1.19 \$ m3- and 1.183 kg m3- of water were obtained with genotype (9) Estelar, which represents deviations of 39 % with respect to these indexes (Table 1).

Economic productivity indices and water use indices were low. Therefore, in situ variety validation with farmers should be continued. 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: Estelar, Maravilla, Josefa, Esmeralda and Alina. The productive comparison showed that the yield with the highest, means a potential gap of 39 %, the deviation in the b/c ratio was 39 % and in the productivity in relation to the water used, indexes of 1.19 $ m^{-3} and 1.183 kg m^{-3} of water were achieved with the variety Estelar; which represents a deviation of 39 % with respect to the variety Esperanza. To improve the productive capacity of barley in arid conditions, it is advisable to have a lower cost technological package , to exceed the limit of 5.0 t ha^{-1}, to have support for the use of high-yielding varieties and promotion of the product system chain.

REFERENCES

Bulman P. and D. L. Smith. 1993. Yield and yield component response of spring barley to fertilizer nitrogen. Agron. J. 85: 226-231.

FAO.2002. Seguridad alimentaria y medio ambiente. Cumbre mundial sobre desarrollo sostenible. disponible en: www.fao.org/3/y1780s/y1780s06.htm#TopOfPage. Consultado el 15 de agosto de 2021.

García R. J. J., F. P. Gámez V., M. Zamora D., S. Solano H., A. J. Gámez V. 2008. Guía para producir semilla de cebada maltera en surcos en El Bajío. Desplegable para productores no. 8. INIFAP. Celaya, Guanajuato, México.

IPNI. 2007. Informaciones agronómicas del cono sur, No 33. Requerimientos nutricionales. absorción y extracción de macronutrientes y nutrientes secundarios. cereales, oleaginosos e industriales. Archivo agronómico 11:13-16.

O'Donovan J. T., T. K. Turkington, M. J. Edney, P. E. Juskiw, R. H. McKenzie, K. N. Harker, G. W. Clayton, G. P. Lafond, C. A. Grant, S. Brandt, E. N. Johnson, W. E. May, E. Smith. 2012. Effect of seedling date and seedling rate on malting barley production in western Canada. Can. J. Plant Sci. 92: 321-330.

Pérez R. J. A., J. A. Mejía C., M. Zamora D., S. Solano H., A. Hernández L. 2015. Evaluación de la fecha de siembra de diez genotipos de cebada maltera, región Bajío. Ciencia desde el Occidente 2(2):18-28.

Pérez R. J. A., M. Zamora D., J. A. Mejía., A. Hernández L., S. Solano H. 2016. Evaluación de 10 genotipos de cebada (Hordeum vulgare L.) en cinco fechas de siembra y dos ciclos agrícolas. Agrociencia 50: 201-213.

Maleki F. S., M. R. Chaichi, D. Mazaheri, R. Tavakkol A., Gh. Savaghebi. 2011. Barley grain mineral analysis as affected by different fertilizing systems and by drought stress. J. Agr. Sci. Tech. 13: 315-326.

Medina G. G., J. A. Ruiz C., V. M. Rodríguez M., J. Soria R., G. Díaz P., P. Zarazúa V. 2016. Efecto del cambio climático en el potencial productivo del frijol en México. Rev. Mex. C. Agríc. Pub. Esp. 13: 2465-2474.

Navarrete R. D. 2015. Rendimiento y calidad de grano en líneas experimentales de cebada de dos hileras (*Hordeum distichum* L.). Tesis M. C. Colegio de Postgraduados. Montecillo, Texcoco, Estado de México.

Servicio de Información Agroalimentaria y Pesquera (SIAP), SAGARPA. 2020. Indicadores económicos. Disponible en: www.siap.gob.mx Consultado el 29 de Julio de 2024.

Tabarzad A., A. Asghar G., S. Zand P. 2016. Barley grain yield and protein content response to deficit irrigation and sowing dates in semi-arid region. Modern Applied Science 10 (10): 193-207.