

ISSN impreso: 0258-5936
ISSN digital: 1819-4087



Ministerio de Educación Superior. Cuba
Instituto Nacional de Ciencias Agrícolas
<http://ediciones.inca.edu.cu>

DOI: 10.13140/RG.2.1.1419.4161
<http://dx.doi.org/10.13140/RG.2.1.1419.4161>

PARTICIPATORY VARIETAL SELECTION OF CHICKPEA (*Cicer arietinum* L.) IN DIVERSITY FAIR OF SAN ANTONIO DE LOS BAÑOS, ARTEMISA, CUBA

Selección participativa de cultivares de garbanzo (*Cicer arietinum* L.) en Feria de Diversidad de San Antonio de los Baños, Artemisa Cuba

Regla M. Cárdenas Travieso, Carlos F. de la Fé Montenegro, Anayza Echevarría Hernández, Rodobaldo Ortiz Pérez and Alexis Lamz Piedra

ABSTRACT. In Cuba, agrobiodiversity fairs have been increased within the implementation framework of Local Agricultural Innovation Program (LAIP), where participatory varietal selection (PVS) has been documented in crops as bean, tomato, rice and others; however, there are not any evidence of the impact of this activity on chickpea (*Cicer arietinum* L.). Therefore, this work was conducted with the objective of contributing to improve the documentary fund related with PVS in chickpea crop. In November 2009, 26 chickpea (21 foreign and 5 national) cultivars were seeded in areas from “Gilberto León” Agricultural Production Cooperative (APC), San Antonio de los Baños municipality, Artemisa province. Diversity fair was held during pod filling phase where participants implemented PVS. Results showed a high diversity of criteria when selecting cultivars of interest and the most frequently used were vegetative vigor, pod number per plant and grain size. Then, 20 promising lines were selected for the area. The study shows that there are great potentialities for the introduction, evaluation and participatory selection of foreign and national materials, with the aim of achieving diversity increases in chickpea cultivars of interest that are better adapted to local conditions.

Key words: cooperative, selection criteria, innovation, pods, vigor

RESUMEN. En Cuba las ferias de agrobiodiversidad se han incrementado en el marco de la ejecución del Programa de Innovación Agropecuaria Local (PIAL), donde la selección participativa de variedades (SPV) ha sido documentada en los cultivos de frijol, tomate, arroz y otros, pero no existen evidencias del impacto de esta actividad en el caso del garbanzo (*Cicer arietinum* L.). Por tal motivo, se realizó el presente trabajo, con el objetivo de contribuir al incremento del fondo documental relacionado con la SPV en el cultivo del garbanzo. En noviembre del 2009 se sembraron 26 cultivares de garbanzo (21 foráneos y cinco nacionales) en áreas de la Cooperativa de Producción Agropecuaria (CPA) “Gilberto León” del municipio San Antonio de los Baños en la provincia Artemisa. Durante la fase de llenado de las vainas se realizó una feria de diversidad en la que los participantes practicaron la SPV. Los resultados mostraron una alta diversidad de criterios en la selección de cultivares de interés, siendo el vigor vegetativo, el número de vainas por planta y el tamaño del grano, los utilizados con más frecuencia. Se seleccionaron 20 líneas promisorias para la zona. El estudio demuestra que existen grandes potencialidades en la introducción, evaluación y selección participativa de materiales foráneos y nacionales, con vistas a lograr incrementos en la diversidad de cultivares de garbanzo de interés, mejor adaptados a las condiciones locales.

Palabras clave: cooperativa, criterio de selección, innovación, vainas, vigor

INTRODUCTION

Chickpea ranks the third world place among grain legumes and it is considered a good readily available and inexpensive source of carbohydrates and proteins

Instituto Nacional de Ciencias Agrícolas, gaveta postal 1, San José de las Lajas, Mayabeque, Cuba. CP 32 700

✉ rmaria@inca.edu.cu

for human consumption (1). Its grain is also used after processed as an energy and protein extract to supplement forage for feeding dairy cows (2).

In Cuba, its seeding has become very important in recent years (3, 4, 5), not only to replace imports but also to enable to achieve food security and sovereignty. Although more than 80 varieties coming from other legume-producing countries^A have been evaluated, only nine varieties are registered in the official list of commercial varieties in our country; thus, the genetic base of this crop is limited, which affects the availability of cultivars that respond to different soil and climate requirements.

The introduction of new cultivars in order to broaden the genetic base of this species and assess its behavior dates from the early years of the XXI century, despite that none of the introduced varieties initially exceeded the behavior of national cultivars (6).

However, several promising chickpea lines derived from the germplasm bank of the Research Institute in Dry Areas (ICARDA) in Syria have been recently introduced and a group of their cultivars have been selected (4).

In this regard, it should be noted that, in both cases, these results were based on non-participatory centralized methods; that is, evaluations only reckoned with researchers working in the areas of their own investigation centers.

With the beginning of participatory plant breeding in Cuba (PPB), agrobiodiversity fairs also started to take place, which have been systematized in the Local Agricultural Innovation Program (LAIP) (7, 8, 9), where participatory varietal selection (PVS) has been a tool that contributes to increase plant diversity in the local rural sector. The work platform has been based on two variants: one is aimed at the varietal diversification of important food species, such as basic grains -rice, bean and corn- and the other is aimed at introducing improved species for different stresses.

Like other actions developed in local contexts, agrobiodiversity fairs have the purpose of leaving the installed capacity in the territories where they are made, to ensure its replicability and sustainability.

San Antonio de Los Baños municipality is among the locations linked to LAIP in Artemisa, which does not have any historical records to document chickpea cultivation in the territory; however, "Gilberto Leon" Agricultural Production Cooperative (APC) members and other actors have been interested in its cultivation, so that by taking into account the availability of improved cultivars (4), a diversity fair was organized with the aim of gradually making those concerned aware of the active use of available species diversity by means of participatory methods of cultivar selection (10).

Consequently, the present work was carried out with the objective of identifying the most useful agronomic criteria, from the producers' and consumers' viewpoint, for the participatory selection of chickpea cultivars adapted to local conditions.

MATERIALS AND METHODS

The work was conducted in areas from "Gilberto Leon" Agricultural Production Cooperative (APC), San Antonio de los Baños municipality, Artemisa province, located at 22°53'20" North latitude; 82°29'56" West longitude and 54 m over sea level. The climate is Aw (tropical with dry winter), according to Köppen's and Geiger's classification.

Thus, 21 foreign chickpea cultivars, coming from the Research Institute in Dry Areas (ICARDA) of the Syrian Arab Republic, and five national cultivars, from the Fundamental Research Institute in Tropical Agriculture (INIFAT), which were conserved in the genebank of the National Institute of Agricultural Sciences (INCA), were seeded in November, 2009.

To standardize nomenclature and make feasible the interpretation of results, cultivars were coded according to the recommendations established for LAIP's diversity coding (11), in which foreign cultivars are represented by Ga-DI whereas national cultivars by Ga-DN, in both cases followed by a number representing the accession (Table I).

Cultural practices during crop vegetative cycle followed the technical instructions for chickpea crop (12), except the applications of pest control products.

The experimental design consisted of single plots made up by four 5-m-long rows at plant spacing of 0,70x0,10. Cultivars were identified with a consecutive number from 1 to 26.

^A Varela, P. J. "Más tierras para el garbanzo", *Granma*, Nacionales, 159.^a ed., La Habana, Cuba, 8 de junio de 2011, ISSN 0864-0424, [Consultado: 26 de febrero de 2016], Disponible en: <<http://www.granma.cu/granmad/2011/06/08/nacional/artic09.html>>

Table I. Foreign cultivars coming from ICARDA's genebank and national cultivars derived from INIFAT, exhibited at "Gilberto León" APC chickpea fair, San Antonio de los Baños, Artemisa, 2009-2010

Nursery	Cultivar	PIAL code
International	FLIP 01-29C	Ga-DI-8
Latin America Elite	FLIP 03-26C	Ga-DI-12
	FLIP 03-110C	Ga-DI-18
	FLIP 03-120C	Ga-DI-21
	FLIP 03-121C	Ga-DI-22
	FLIP 04-13C	Ga-DI-29
	FLIP 04-16C	Ga-DI-31
International Ascochyta blight	FLIP 97-220C	Ga-DI-41
	FLIP 03-37C	Ga-DI-54
	FLIP 03-73C	Ga-DI-61
	FLIP 03-129C	Ga-DI-67
	FLIP 04-25C	Ga-DI-74
International Fusarium wilt	FLIP 04-32C	Ga-DI-75
	FLIP 00-1C	Ga-DI-82
	FLIP 01-57C	Ga-DI-96
International Leaf miner	FLIP 03-26C	Ga-DI-106
	ILC1929	Ga-DI-117
	LMR 125	Ga-DI-131
	LMR 133	Ga-DI-132
NaTional	LMR 186	Ga-DI-155
	ILC 3397	Ga-DI-159
	Nacional-6	Ga-DN-1
	Nacional 5HA	Ga-DN-11
	Nacional-27	Ga-DN-3
	Nacional-29	Ga-DN-4
	Jamu-96	Ga-DN-9

Prior to PVS, a sensitization process was performed with the purpose of training participants in chickpea crop, providing them documentation with relevant information (folding and technical instruction) and explaining the work steps for cultivar selection.

The list of participants with names, occupations, place of origin, selected varieties and selection criteria based on their visual observation of the entire cultivar behavior was used to collect information about cultivar selection.

All information was tabulated by *Microsoft Office Access 2007*, whereas for the statistical data processing, the issued votes, either for selection criteria or selected cultivars, were transformed by the

expression $\sqrt{x + \frac{3}{8}}$ to complete the normal distribution assumption.

To measure selection efficiency, the effective diversity percentage (ED %) was calculated by the following formula:

$$\% \text{ ED} = \frac{\text{selected cultivars}}{\text{all cultivars exposed}} \times 100$$

Statistical data were processed through Statgraphics Plus program for Windows 5.1 (13).

RESULTS AND DISCUSSION

For selecting adapted materials to local conditions, 31 persons were involved, which is an acceptable figure if one considers that the average reported exceeds 28 participants/fair, according to the analysis of participation recorded in more than 200 fairs celebrated in different provinces of Cuba (9).

With regard to occupations, selectors were grouped into three categories: professionals, administratives and beneficiaries (Table II).

Table II. Amount of participants in chickpea varietal selection at "Gilberto León" APC, San Antonio de Los Baños, Artemisa

Groups	Quantity	Percentage
Professionals	8	26
Administratives	7	22
Beneficiaries	16	52
Total	31	100

Professionals consisted of four researchers, a specialist, an extensionist and two technicians; Administratives were represented by the president of "Gilberto León" APC, an economist, a president of the Credit and Service Cooperative (CSC), three production managers and trade officer; Beneficiaries were composed of eight farmers, two workers, four students and two domestic workers.

It is appropriate to clarify that some APCs in Cuba lacking correspondence between them and their members could not achieve the expected results in practice (14), as for instance "Gilberto León" APC, so that when this work was done, such cooperative had been turned to another productive way.

Then, 42 % fair participants were women, a figure that shows gender change in this activity, as an action aimed at promoting equal rights, responsibilities and opportunities for women and men. Within this context, it is worth remembering that by developing PPB, an active and growing female participation has started in the local agricultural innovation activities; in fact, the percentage of women's participation in this first chickpea fair surpassed those obtained in previous fairs with other crops, such as cassava, held in 2003, which recorded 30 % female participation (15).

With regard to women's participation in fairs, it has been reported that in Latin American rural areas, women sell backyard vegetables directly in the fairs, so that they help as food and income providers, and they can acquire other assets with what they obtain from sale; in this manner, they not only enable to improve garden diversity but also diversify food diet of farmer families (16).

On the other hand, members from "Gilberto León" APC, as well as from other cooperatives and institutions took part in the activity, who established a steady exchange of knowledge (empirical, scientific, market and others), so that it was a good opportunity to develop productive partnerships in the local context (17).

In addition, a typical dish contest was held and supported by awards to the most tasteful dishes with seed donations of different chickpea varieties provided by farmers from other cooperatives.

A gender sensitization workshop was aimed at analyzing men's and women's roles in society; thus, the diversity fair became a socio-cultural activity with unifying and energizing effect. In this regard, the socio-cultural developing factor deserves to be treated with the same priority and importance as the economic one in the cooperative management (18).

Ten criteria identified by participants are listed in Table III, highlighting the number of times they were used during assessments.

It is important to note that beneficiaries are mainly composed of farmers (Table I), who have proved to have holistic thoughts to make their selections (19), so they usually state more criteria depending on their interests.

Table IV shows that the most useful participants' criteria are related to yield, which were vegetative vigor and pod number per plant, followed in order of priority by grain size.

Results from similar studies with other crops demonstrate that selection criteria differ between species, even in the same family; for example, in the case of string bean (*Phaseolus vulgaris*), health is the most significant criterion, as it influences product quality and market access (19).

Vegetative vigor represents a visual estimate of yield potential that participants perceived as a good to very good category in 80 % selected cultivars, since 70 % showed more than 115 pods per plant, which is consistent with the results from studies made with foreign cultivars in Cuba, which proved to have good yield per plant (20).

Table III. Participants' criteria during participatory assessment of 26 chickpea lines at "Gilberto León" APC, San Antonio de los Baños, Artemisa

Criteria	Number of times indicated			Total
	Administratives	Beneficiaries	Professionals	
Vegetative vigor	12	24	6	42
Pods per plant	8	14	12	34
Grain size	7	9	6	22
Plant erection	1	8	8	17
Height	2	8	4	14
Health	5	3	6	14
Grains per pod	4	4	3	11
Cycle	1	7	1	9
Maturity	0	1	0	1
Population	1	7	3	11
Total	41	85	49	175
Percentage (%)	23,40	48,60	28,00	100

Table IV. Behavior of each criterion in the participatory selection of 26 chickpea lines at “Gilberto León” APC, San Antonio de los Baños, Artemisa

Criteria	Transformed media	Typical deviation	SE _x
Cycle	0,9782 ef	0,7461	0,1179
Grain number per pod	1,1125 ef	0,8985	0,1420
Grain size	2,1912 c	1,5927	0,2518
Maturity	0,6260 f	0,0887	0,0140
Pod number per plant	3,6446 b	1,7072	0,2699
Plant height	1,3407 de	1,1103	0,1755
Population	1,1851 de	0,9715	0,1536
Plant erection	1,4234 de	1,1760	0,1859
Health	1,6901 cd	1,3562	0,2144
Vigor	4,3423 a	1,4391	0,2275
General mean	1,8534	1,6511	0,0825

(p≤0,05). Transformed data

In addition, 50 % cultivars were chosen for its large grains (mass exceeding 40 g/100 grains). This is a “Kabuli” chickpea quality closely related to its marketing quality (21), which is an important link of agricultural chains enhanced by productive partnerships among actors (17); so this criterion should be considered in future studies as an indicator for providing access of new cultivars to the market.

The effective diversity percentage was 76,9 %, which demonstrates a high acceptance of this species and that most materials were adapted to the soil and climatic conditions of this locality. Discarded cultivars were visibly damaged by bollworm (*Heliothis virescens*), which has been declared as the main insect pest affecting the crop throughout American continent, even in Cuba its damage has been reported in Las Tunas province (3, 5).

Table V shows that most cultivars (75 %) were selected by both, the three groups and their dual combination, indicating a high selection coincidence, which in turn corroborates the high acceptance of this species by selectors.

Ga-DI-61 cultivar was the favorite for selectors (Table VI), which was characterized by good vegetative vigor and high pod number per plant, short cycle ranging from 100 to 115 days (22), large grains and two grains per pod, plant erection to semi-erection and good health aspect.

It should be recalled that environmental factor and its interaction with genotypes generally determine more than half the phenotypic effect; thus, the selection of materials for its exploitation in target environments provides great advantages in adaptive terms (21).

Table V. Amount and percentage of chickpea cultivars chosen by three groups of participants in the selection made at “Gilberto León” APC, San Antonio de los Baños, Artemisa

Participants	Selected cultivar number	(%)	Selected cultivars
B-A-P	9	45	Ga-DI-82, Ga-DI-8, Ga-DI-75, Ga-DI-74, Ga-DI-61, Ga-DI-29, Ga-DI-22, Ga-DI-18, Ga-DN-3
B-A	2	10	Ga-DN-9, Ga-DN-1
B-P	3	15	Ga-DI-31, Ga-DI-21, Ga-DI-159
A-P	1	5	Ga-DI-12
Subtotal	15	75	
A	2	10	Ga-DI-155, Ga-DI-117
B	1	5	Ga-DN-11
P	2	10	Ga-DI-67, Ga-DN-4
Subtotal	5	25	
Total	20	100	

(p≤0,05). Transformed data

B: beneficiaries

A: administratives

P: professionals

Table VI. Cultivar comparison based on the number of times they were selected at “Gilberto León” APC, San Antonio de los Baños, Artemisa

Cultivars	Mean	Typical deviation	Standard error
Ga-DI-117	0,6400 e	0,1254	0,0280
Ga-DI-12	0,6865 e	0,2369	0,0529
Ga-DI-155	0,6865 e	0,2369	0,0529
Ga-DI-159	0,7477 de	0,3486	0,0779
Ga-DI-18	2,0695 b	1,1886	0,2657
Ga-DI-21	1,3445 c	0,9274	0,2073
Ga-DI-22	1,0027 bcde	0,6643	0,1485
Ga-DI-29	1,1079 bcd	0,7590	0,1697
Ga-DI-31	0,8217 cde	0,4581	0,1024
Ga-DI-61	3,1528 a	0,9920	0,2218
Ga-DI-67	0,6400 e	0,1254	0,0280
Ga-DI-74	1,2220 bc	0,8470	0,1893
Ga-DI-75	1,1079 bcd	0,7590	0,1697
Ga-DI-8	1,0027 bcde	0,6643	0,1485
Ga-DI-82	1,0027 bcde	0,6643	0,1485
Ga-DN-1	1,3445 c	0,9274	0,2073
Ga-DN-11	0,9070 cde	0,5637	0,1260
Ga-DN-3	0,7477 de	0,3486	0,0779
Ga-DN-4	0,6865 e	0,2369	0,0529
Ga-DN-9	0,7477 de	0,3486	0,0779
General mean	1,0834	0,8589	0,0429

CONCLUSIONS

- ◆ The most frequently used criteria in chickpea cultivar selection were vegetative vigor, pod number per plant and grain size. Thus, 20 promising lines were chosen for the locality.
- ◆ The study showed that there are great potentialities in the introduction, evaluation and participatory selection of foreign and national materials, in order to increase diversity in chickpea cultivars of interest that are better adapted to local conditions.

ACKNOWLEDGMENTS

To Rafael Torres Garcia, Liuber Cedeño Rodriguez, Janette Portelles Lechuga and Oadasvel Diaz Hidalgo, who are INCA's technicians, for their dedication to fair assembly and collection of information.

BIBLIOGRAPHY

1. Cota, A. G.; Yañez, G. A.; Esquer, E. J. y Anduaga, R. “Efecto de la variedad y la fertilización en indicadores de calidad proteica *in-vitro* de dos variedades y una línea de garbanzo (*Cicer arietinum*)”. *Revista Chilena de Nutrición*, vol. 37, no. 2, junio de 2010, pp. 193-200, ISSN 0717-7518, DOI 10.4067/S0717-75182010000200008.
2. Wattiaux, M. A. y Howard, T. *Guía Técnica Básica de lechería Universidad de Wisconsin-Madison* [en línea]. edit. Instituto Babcock para la Investigación y Desarrollo Internacional de la Industria Lechera Esenciales Lecheras Universidad de Wisconsin-Madison, Madison, USA, 2011, 140 p., [Consultado: 18 de diciembre de 2015], Disponible en: <<http://es.scribd.com/doc/71923814/Guia-Tecnica-Basica-de-lecheria-Universidad-de-Wisconsin-Madison>>.
3. Pérez, J. C. y Suris, M. “Insectos asociados al cultivo del garbanzo (*Cicer arietinum* L.) en la provincia Las Tunas”. *Revista de Protección Vegetal*, vol. 26, no. 3, diciembre de 2011, pp. 191-193, ISSN 1010-2752.
4. Cárdenas, T. R. M.; Ortiz, P. R.; Echevarría, H. A. y Shagarodsky, S. T. “Caracterización y selección agroproductiva de líneas de garbanzo (*Cicer arietinum* L.) introducidas en Cuba”. *Cultivos Tropicales*, vol. 33, no. 2, junio de 2012, pp. 69-74, ISSN 0258-5936.
5. Suris, C. M.; Pérez, Z. J. C. y Miranda, I. “Competencia interespecífica entre *Heliothis virescens* (F.) y *Spodoptera frugiperda* Smith (Lepidoptera: Noctuidae) en el cultivo del garbanzo (*Cicer arietinum* L.)”. *Revista de Protección Vegetal*, vol. 28, no. 3, diciembre de 2013, pp. 171-177, ISSN 1010-2752.
6. Shagarodsky, T.; Chiang, M. L. y López, Y. “Evaluación de cultivares de garbanzo (*Cicer arietinum* L.) en Cuba”. *Agronomía Mesoamericana*, vol. 12, no. 1, 2001, pp. 95-98, ISSN 1021-7444, 2215-3608.
7. Guevara, H. F.; Cruz, R. G.; Crespo, M. A.; Ortiz, P. R. y Rodríguez, L. L. “Percepciones de productores sobre el impacto del programa de innovación agropecuaria local (PIAL) en Pinar del Río, Cuba”. *Cultivos Tropicales*, vol. 33, no. 3, septiembre de 2012, pp. 69-79, ISSN 0258-5936.
8. Ortiz, R. “Herramientas más utilizadas por el programa de innovación agropecuaria Local para diseminar la biodiversidad agrícola”. En: Ortiz R., *La biodiversidad agrícola en manos del campesinado cubano*, edit. Ediciones INCA, Mayabeque, Cuba, 2013, pp. 63-83, ISBN 978-959-7023-63-0.
9. Ortiz, P. R.; Angarica, L. y Guevara, H. F. “Beneficios obtenidos en fincas participantes en el Programa de Innovación Agropecuaria Local (PIAL) en Cuba. Análisis costo/beneficio de la intervención”. *Cultivos Tropicales*, vol. 35, no. 3, septiembre de 2014, pp. 107-112, ISSN 0258-5936.
10. Marzin, J.; Benoit, S.; Betancourt, T. L.; Lazo, G. C.; Padilla, O. V. P.; Perez, N. A.; Altuve, J. A. H. y Mercoiret, M. R. *Herramientas metodológicas para una extensión agraria generalista, sistémica y participativa* [en línea]. edit. Editora Agroecológica, La Habana, Cuba, 2014, 150 p., ISBN 978-959-7210-70-2, [Consultado: 1 de marzo de 2016], Disponible en: <http://publications.cirad.fr/une_notice.php?dk=573725>.

11. Cárdenas, R. M. y Ortiz, R. "Tipificación y descripción de la diversidad manejada en instituciones vinculadas al Programa de Innovación Agrícola Local". En: Ortiz R., *La biodiversidad agrícola en manos del campesinado cubano*, edit. Ediciones INCA, Mayabeque, Cuba, 2013, pp. 27-38, ISBN 978-959-7023-63-0.
12. Shagarodsky, T.; Chiang, M. L.; Cabrera, M.; Chaveco, O.; López, M. R.; Dibut, B.; Dueñas, M.; Vega, M.; Permy, N. y García, E. *Manual de instrucciones técnicas para el cultivo del Garbanzo (Cicer arietinum L.) en las condiciones de Cuba*. edit. Instituto de Investigaciones Fundamentales en Agricultura Tropical, La Habana, Cuba, 2005, 24 p., ISBN 959-246-133-3.
13. Statistical Graphics Corp. *STATGRAPHICS® Plus* [en línea]. (ser. Profesional), versión 5.1, [Windows], 2000, Disponible en: <<http://www.statgraphics.com/statgraphics/statgraphics.nsf/pd/pdpricing>>.
14. Matías, G. A. "Ensayo crítico sobre el cooperativismo agrícola en Cuba". *Observatorio de la Economía Latinoamericana*, no. 135, 2010, ISSN 1696-8352.
15. Guerra, S. L.; Hernández, E. M.; Ríos, L. H. y Varcárcel, G. M. "Gran fiesta social campesina en Cuba. Primera feria del cultivo de la yuca (*Manihot esculenta* Crantz)". *Temas de Ciencia y Tecnología*, vol. 12, no. 34, 2008, pp. 51-56, ISSN 2007-0977.
16. Bonilla, A. M. E.; Salcido, R. B. A.; Paredes, S. J. A.; Aguirre, Á. L.; Méndez, C. M. E. y Hernández, R. M. de L. "La diversidad hortícola para la seguridad alimentaria en municipios marginados del estado de Puebla". *Ra Ximhai*, vol. 9, no. 2, 22 de enero de 2016, pp. 151-163, ISSN 1665-0441.
17. Cardona, M. A.; Álvarez, C. P. y Sáenz, S. "Sistema, cadena, empresa y negocios: desafíos en conceptualización y articulación para la competitividad del agro". *Suma de negocios*, vol. 1, no. 1, 2010, pp. 59-71, ISSN 2215-910X.
18. Arteaga, H. C. M.; Hernández, M. A.; Fernández, D. P. A.; Vinci, M.; Bu, W. Á.; Gómez, B. J.; Paul, F.-A. V.; Dalmau, E.; Rodríguez, I.; Álvarez, L. M. D.; Arronte, L. N. y Mireles, T. M. *Aspectos básicos sobre gestión integral cooperativa. Manual para productoras y productores*. 2.ª ed., edit. MINAG, La Habana, Cuba, 2013, 72 p., ISBN 978-959-7210-65-8.
19. Morros, M. y Pire, A. "Evaluación participativa de materiales promisorios de vainita *Phaseolus vulgaris* L. en las zonas altas del estado Lara". *Revista de la Facultad de Agronomía*, vol. 20, no. 1, 2003, pp. 21-33, ISSN 0378-7818.
20. de la Fé, C. F. y Hernández, P. J. "Descripción de seis nuevas líneas de garbanzos (*Cicer arietinum* L.) en fincas de productores". *Cultivos Tropicales*, vol. 32, no. 4, diciembre de 2011, pp. 44-48, ISSN 0258-5936.
21. Ortiz, R.; Ríos, H.; Ponce, M.; Acosta, R.; Miranda, S.; Cruz, M.; de la Fe, C.; Martín, L.; Moreno, I. y Varela, M. "Agricultores creando sus variedades". En: *Fitomejoramiento participativo: los agricultores mejoran cultivos*, edit. Ediciones INCA, 2006, pp. 29-46, ISBN 978-959-7023-33-3.
22. Muy, R. M. D.; Verdugo, P. M.; Osuna, E. T.; Báez, S. M. A.; Basilio, H. J.; Valdez, T. B.; Contreras, M. R.; Sañudo, B. J. A. y Campos, S. J. P. "Caracterización del garbanzo verde (*Cicer arietinum* L.) y tecnologías poscosecha para mantener su calidad". *Revista Chapingo. Serie horticultura*, vol. 17, no. 1, abril de 2011, pp. 39-45, ISSN 1027-152X.

Received: July 23th, 2014

Accepted: June 28th, 2015