

Small-farmer Behaviour Towards Bean Seed: Evidence From Colombia

Willem Janssen^{1,4}, Carlos Adolfo Luna² and Myrian Cristina Duque³

ABSTRACT

In many developing countries, factors which guide farmers in their behaviour towards seed are not well understood. This leads to erroneous designs of seed systems. How farmers in a bean-growing region of Colombia perceive the seed they use, how they manage their seed and why they use seed from different sources is described. Primary information was collected in an area where farmers plant "selected" seed from a co-operative specialising in bean seed production, commercial grain or their own farm-produced seed. Most farmers did not have their own seed available, and this was the principal reason for purchasing. There was no yield advantage for the "selected" seeds. This information was used to evaluate bean seed-purchasing behaviour and to produce guidelines for bean seed production and distribution systems.

Additional index words: *Phaseolus vulgaris*, seed production, seed selection, seed distribution, seed quality.

INTRODUCTION

Most seed for common bean (*Phaseolus vulgaris* L.) production in tropical countries is supplied by the farmer from his previous harvest. In ten diagnostic studies on bean production executed during the 1980s by national programmes and CIAT's Bean Programme, 65% of the farmers used their own seed. The remainder of the farmers obtained seed by exchange with neighbours, purchase of commercial grain and, occasionally, from a commercial bean seed producer.

A first reason to use farmers' own seed is that common bean is an autogamous crop. Once farmers obtain the variety they want, they can multiply it themselves. A second reason is that beans have a low multiplication rate. To harvest an average of some 500 kg ha⁻¹ (in Latin America), farmers plant between 30 and 50 kg ha⁻¹. Seed is an expensive input and farmers like to economise on it. Also, seed that farmers procure from their own crops is often as productive as the seed supplied by specialised seed producers. This may be because the farmers' seed was as good as the other, or because environmental conditions did not allow quality differences to express themselves in the final yield.

The autogamous nature, the low multiplication rate and the (frequent) absence of yield differences suggest that it is not easy to design and operate bean seed production and distribution systems. In the present paper, we have tried to describe and explain farmers' behaviour regarding bean seed in a specific region. By understanding how farmers think and decide about seed, we hoped to be able to propose guidelines for bean seed production and distribution systems.

OBJECTIVES

Seed production and distribution need to be designed

to respond to the seed user. Only when farmers feel that seed is properly supplied will they use the services of such a system. In the present paper, our aim was to understand how farmers perceive the quality of the seed they use; to describe how farmers manage their seed and how this changes according to the seed source; to identify the reasons for using seed from different seed sources; and to draw implications for the organisation of seed production and distribution.

METHODS

For the main harvest of 1988, a stratified sample of 98 farmers was taken. Twenty-two of the responses had to be eliminated for various reasons. This left 76 responses for analysis. In some of the tables, data from all 98 responses were included. One group of farmers was selected from a list of seed sales of COAGROSANGIL, a farmers' co-operative that produces selected bean seed. Farmers who did not purchase seed from this co-operative were selected by random visits to the local villages. The variety 'Radical' was grown by all farmers interviewed. Each farmer was visited twice. The first visit was made at 35 to 45 days after sowing. The second was made after farmers had harvested and sold their beans. To resolve some questions that arose in the course of the field work, an additional sample of 53 farmers was taken in February 1990.

The Study Area

The region comprising the municipalities of San Gil, Barichara and Villanueva is situated in the department of Santander, about 100 km south of Bucaramanga, the department capital. Farmers grow beans, tobacco, maize and cassava. Input use in bean production is high (Table 1). Bean production has grown rapidly in the region (Table 2),

¹ Economist, Bean Programme, CIAT, Cali, Colombia, corresponding author.

² Economist, CENICANA, Cali, Colombia.

³ Statistics Researcher, Data Services Unit, CIAT, Cali, Colombia.

⁴ Present address: ICARDA, PO Box 5466, Aleppo, Syria. Received for publication 2 August 1991.

because of good access to the wholesale market of the country's capital, Bogotá, favourable government policies (Luna and Janssen, 1990) and problems in tobacco production. Around 1977, merchants from the region took six bags of a medium-sized red round bean to the Bogotá wholesale market. Because of its resemblance to a more expensive bean type, it found very good acceptance. Low

production costs and a good price turned it into an attractive alternative to tobacco. Now this bean type, called 'Radical', is extensively grown in the region. The precise origin of 'Radical' has never been discovered. Some claim it is the variety Toné, released by the National Agricultural Research Institute (ICA) in 1974 (Voysesst, 1983). Others say it is a landrace.

Table 1. Technological characteristics of the 'Radical' bean production system in San Gil, Barichara and Villanueva (Santander), 1988.

Crop management decision	% of farmers
Application of:	
Fungicides	72
Insecticides	17
Foliar fertiliser	6
Chemical fertiliser	86
Organic fertiliser (chicken manure)	46
Herbicides	0
Irrigation	0
Land preparation:	
Mechanical	41
Manual	54
Credit use:	
From Agrarian Bank	26
From cooperatives and nonformal sector	45
Technical assistance	20
Average yield (kg ha ⁻¹)	1014

Table 2. Area planted to bean (ha) in study zone, 1982-1989.

Municipality	Year							
	1982	1983	1984	1985	1986	1987	1988	1989
Villanueva	700	n.a.	1200	1400	1700	1200	1600	4200
San Gil	400	n.a.	500	600	700	600	700	1200
Barichara	150	n.a.	300	350	400	400	450	900
TOTAL	1250	n.a.	2000	2350	2800	2200	2750	6300

n.a. = not available.

Source: URPA (Regional Agricultural Planning Unit) data; ICA diagnostics.

Beans have been planted on a small scale in the region for over 20 years. Over 60% of the farmers planted other varieties before planting 'Radical', mainly elongated red-mottled grain types. These varieties were intercropped with tobacco and maize. Ninety-five percent of the farmers said that before planting 'Radical', they planted only for on-farm consumption.

With the introduction of 'Radical', bean production started growing (Table 2). Nineteen percent of the farmers planted 'Radical' for more than 8 years, 39% for 5 to 8 years and 42% for less than 5 years. 'Radical' was planted in monoculture (98%), mostly on newly opened land. Some of the soils were difficult to cultivate, because of low organic matter content, pH near or under 5.0 and potential aluminium toxicity. The farmers were applying large quantities of poultry manure, as well as some lime and chemical fertilisers.

Two co-operatives sold bean seed: COAGROSANGIL and the Agricultural Savings and Credit Cooperative of VILLANUEVA. The former sold "selected" seed under the supervision of ICA. In 1989, COAGROSANGIL produced 27 tonnes of seed (Table 3).

It was also selling grain for consumption and supplying inputs to its 150 members. VILLANUEVA sold double the amount of seed (Table 3), without supervision by ICA. Seed is not a priority business for VILLANUEVA. It concentrates on credit supply for its 2700 members to allow bean, tobacco and maize production and to facilitate marketing agricultural production. The seed sold by VILLANUEVA was relatively cheap, which favoured sales. There was no strict seed selection. VILLANUEVA was considering some cheap phytosanitary practices, for example, treatment with Vitavax (carboxin).

VILLANUEVA sold seed for Col.\$430 kg⁻¹ and COAGROSANGIL for Col.\$700 kg⁻¹*. The price of commercial grain was Col.\$350/kg⁻¹. The demand for bean seed in the region surpassed the supply, but the high price charged by COAGROSANGIL might have caused it to lose part of the regional market. In addition to COAGROSANGIL and VILLANUEVA, some merchants sold bean seed. Merchants are the traditional agents for disseminating bean seed, but in the study region they account for only 10% of seed sales.

Table 3. Sales (t) of 'Radical' bean seed by the COAGROSANGIL and VILLANUEVA co-operatives, 1985-1989.

Co-operative	Year				
	1985	1986	1987	1988	1989
COAGROSANGIL	8.3	9.6	17.4	18.0	26.5
VILLANUEVA	38.0	43.0	52.0	58.0	57.0
TOTAL	46.3	52.6	69.4	76.0	83.5

Source: Internal data, COAGROSANGIL and VILLANUEVA cooperatives.

Table 4. Reasons for rating seed as "good", Santander, 1988 (% of farmers responding).

Reasons	Farm seed	COAGROSANGIL seed	VILLANUEVA seed	All sources
Good yield	92.9	62.1	81.3	78.1
Good-quality grain	43.0	44.8	37.5	42.5
Does not suffer from "frost"	24.9	3.5	37.5	19.2
Better selected, good germination & development	—	37.9	18.7	19.2
N =	28	28	16	73

Note: Farmers could mention more than one reason.

* The average exchange rate for the first semester of 1990 was US\$1 to Colombian \$475.

RESULTS AND DISCUSSION

Farmers' criteria for seed selection. Almost all farmers (97.5%) thought they used good-quality seed. Farmers were satisfied with seed if it produced good yields, which meant more income, the basic objective of commercial farmers such as the ones studied. Expected yield was the principal reason for using seed from a certain source, more so for farmers' seed (Table 4).

The second reason was the quality of the grain harvested. If the grains were heavy and had good colouring, the farmer received a premium price on the market. Grain quality was almost equally important for all seed sources (Table 4). In the 1988 crop cycle, there were excess rains in 91% of the plots, which caused problems with picking and threshing, and grain discolouration. Of beans produced from COAGROSANGIL seed, 8.1% were of poor quality, while 13.6% of beans from farmers' seed and 15.4% of beans from VILLANUEVA seed were of poor quality. It was not clear if the difference was due to seed quality or to climatic differences.

The third reason was that the plant would not get "burned from frost" (jargon for resistance to diseases, principally anthracnose). This was most important for farmers who planted seed from VILLANUEVA, somewhat less important for those who kept their own seed and least important for those who used COAGROSANGIL seed (Table 4). The final reason was the appearance of the seed before planting and the germination and vigour after planting. This reason was important for seed from COAGROSANGIL, less important for seed from VILLANUEVA and not important at all for farmers' own seed.

Farmers who saved seed. Farmers stored their own seed for an average of 4.3 months. Nearly all of these farmers planted in both the first and second semester, which significantly reduced storage time. This was a key to using farmers' own seed. Selection began in 31% of the cases in the field. Farmers selected a part of the field with abundant plant foliage and low incidence of diseases. Plants were pulled up, threshed and selected separately. The other 69% of the farmers harvested all beans at the same time and at home picked the best grains for seed. In this study (and other work such as that of Restrepo, 1979), almost all farmers who kept their own seed selected before planting. Selection was very strict. In 70% of the cases, it was done by the farmer himself.

Afterwards, the seed was winnowed to remove lightweight foreign matter and chaff. Then the seed was screened to remove clumps of dirt and small grains. Small grains eliminated were terminal grains, not well formed in the pods (shrivelled). The screener also removed small and pale grains, those that were broken, rotten or crushed, and seed from other varieties. Finally, the seed was dried on sisal sacks outside the house.

Sixty percent of the farmers who stored seed considered

that only the red colour was important for the quality of 'Radical' seed and that size was normally not a problem. On the contrary, small grains made the seed go further when planting (more seeds per kilogram). The other 40% of the farmers believed that colour and size determined seed quality.

In 87% of the cases, the seed received some form of treatment to prevent weevil attacks during storage. The products used were tablets ("Pastilla", 35%), Seven (carbaryl, 26%), an unidentified powder (8%), cooking oil (9%) and ashes plus the powder (6%). Some farmers who did not treat seed checked it periodically, placed it in the sun, removed weevils by hand or let the hens and chickens eat them. Others covered the seed with plastic sheets, rubbed the sacks with grease or "hid" the seed in high or enclosed places to avoid weevil penetration. Farmers did not know exactly how the weevil attacked. Nevertheless, 72% considered that they would be able to sow all the seed stored; 14% felt there was very little that should be thrown out (from 1% to 5%); and only 16% would carry out a final selection, depending on weevil damage. Only 12% of the farmers used fungicides (Ortavax). The strict selection process justified the low use of fungicides. On the other hand, weevils would merit further local research.

The seed was stored in sisal sacks (69%), synthetic sacks (12%), brown paper bags for animal feed (10%), or wooden boxes (2%), or was left loose in a room, spread on sisal sacks (7%). Farmers stored the seed in dark, closed rooms, where it was not exposed to heat, wind or sun (48%). Some stored the seed in well-ventilated parts of the house (22%); in the drying sheds for tobacco, open to the wind (22%); or in warehouses (7%). The sacks were stored on wooden planks (64%) or stored on the ground.

Farmers expected that their own seed would produce a good harvest, both in terms of quantity and commercial quality (70%), and that plants would be large and vigorous (23%) and free from diseases (7%). For the seed to express its full potential, the weather (principally rains) had to be good (63%). Farmers realised that seed was just the first factor needed for a good crop.

Most farmers who used their own seed had purchased it at some time. On average, the last time was two years previously, that is, four plantings ago. They purchased to increase the area planted to beans (34%), to begin planting beans (24%) or to renew their seed source (16%). Among the old clients of COAGROSANGIL, 87.5% felt that its seed was equal to their own and 12.5% that it was sometimes better than their own. They thought the selected seed was readily available (83%) but expensive (91%) in comparison with the price for commercial grains. Those who had not purchased seed from COAGROSANGIL (40%) did not know about it, although some had heard radio commercials.

All the farmers who kept their own seed planned to do so in the future if circumstances permitted. They would purchase seed if the quality of their harvest were bad

(excess humidity, discolouration, high disease presence) or if insufficient seed was available. They felt they would

always be able to save part of their seed needs.

Table 5. Reasons for purchasing seed, Santander, 1990 (N = 22).

Reason	% of farmers
To prevent grain discolouration	32.0
No technology for managing weevils	32.0
Grain produced was of bad quality	18.0
Bigger area planted	9.0
Cannot plant beans in the second season	4.5
Cash flow needs forced sales of own seed	4.5

Farmers who purchased seed. As shown in Table 5, problems of availability in 50% of the cases (reasons 2, 4, 5, 6) and low confidence in farmers' own seed quality in the other 50% (reasons 1, 3) were reasons for seed purchases. Farmers purchased seed because they believed that to prevent grain discolouration they should not use seed that came from the same plot where it would be planted. They also purchased seed because they did not know how to manage weevils. Most farmers who planted their own seed felt comfortable about weevil control, but among purchasers such confidence was absent.

Among clients of COAGROSANGIL, 83% stated that before the co-operative existed, buying seed was risky. It came mixed with other varieties, often with low vigour and was badly selected. In the future, 75% of the COAGROSANGIL clients plan to purchase seed from COAGROSANGIL. Many are faithful customers, having

made, on the average, six purchases. The decision of the other 25% depends on the quality of the grain they will produce.

Farmers bought seed at 43% above the grain price of the previous semester and at 81% above the grain price of the last year. One third of the farmers thought that the seed was expensive, but many had to buy it because their own seed supply was insufficient. A fifth of the farmers thought the seed was worth its price.

The main factor that prevented farmers who purchased seed from using their own is that they did not know how to control weevils during storage (Table 6). Another factor was the small volume of production, which did not allow setting away seed. Farmers with the fewest land resources had the most problems with their seed supply. This was also observed in Rwanda, East Africa (Sperling and Loevinsohn, 1990).

Table 6. Conditions under which seed purchasers would save their own seed, Santander, 1990, first semester (N = 21).

Condition	% of farmers
If they knew how to control the weevil	38.0
If they could get more land	33.0
If the grain they produced was of good quality	9.5
If they could plant during the second season	5.0

Strategies of bean farmers for renewing their seed were strongly defined by liquidity constraints. Often, they partially renovated their seed stock. They also selected with more care than usual an amount of grain equal to the seed needs, sold it at a higher price than normal grain and supplemented their receipts with some additional money to purchase seed. In other cases, they saved an amount equivalent to their needs and swapped it with another

farmer. Many farmers purchased seed only when they received credit.

Crop yields in 1988. There were no differences in the directly observed yields with respect to seed origin. Farmers' seed yielded as well as seed from COAGROSANGIL, and both yielded more than seed from VILLANUEVA (Table 7). The variation in yield was somewhat higher for farmers' seed than for the other sources.

Table 7. Yield parameters according to seed origin, Santander, 1988.

Yield parameter	Seed from farm itself	Seed from COAGROSANGIL	Seed from VILLANUEVA
Average (kg ha ⁻¹)	1129	1046	732
SD (kg ha ⁻¹)	563	401	284
CV	50	38	39
N	28	29	16

To correct for other variables that influence yield, such as climate, soil type, fertilisers or chemical control, the effect of seed origin was estimated in a production function. Climate and municipality (as an approximation of soil fertility), which were both better in the production

area of COAGROSANGIL seed, had a great effect on productivity (Table 8). When the seed came from the farm, this increased yield by 210 kg ha⁻¹ as compared with seed from COAGROSANGIL or VILLANUEVA.

Table 8. Linear regression parameters that help to explain yield per hectare for 'Radical' bean production, Santander, 1988.

Regression Explanatory variables	coefficient	Standard Unit	error
No. of plants sown	0.004	#/ha	0.001
Chemical fertilisation (P as proxy)	1.35	kg/ha	1.08
Number of days spent in weeding	6.94	#/ha	3.03
Rainfall to germination ¹	143.19	dummy	78.81
Rainfall to flowering ¹	213.87	dummy	100.08
Rainfall to pod formation ¹	298.11	dummy	80.25
Municipality of Barichara	221.99	dummy	110.20
Municipality of San Gil	247.55	dummy	109.51
Seed from farm itself	209.90	dummy	72.81
Presence of diseases that were not properly controlled	-238.1	dummy	77.08

R² = 0.68; N = 76.

Note: The intercept was not significant

¹ 0 = not adequate; 1 = adequate

The selected seed did not yield better. COAGROSANGIL seed came from farmers' fields, where varietal purity was pursued and disease transmission was controlled as much as possible; but the farmers who kept their own seed were also strict in selecting. When phytosanitary problems can be managed by farmer selection or by applying fungicides, it is highly probable that farmers' seed will yield equal to or better than the selected

"quality" seed.

These findings reconfirm a number of experiments done by CIAT to determine the effect of seed source on yield (Table 9). Only in a few cases did the clean seed of "quality" seed produce higher yields than the farmers' seed. It is not obvious *a priori* to expect an effect on productivity of the use of clean or selected seed.

Table 9. A summary of studies comparing farmer-saved and "clean seed".¹

Year	Responsible researchers	Site ²	Variety	Yields		95% statistical difference	No. of observations
				Farmer (kg ha ⁻¹)	"Clean"		
1974	G. Gálvez	CIAT	Gualí & ICA-TUI	85% increase		Yes	n.a.
1974	n.a.	Guatemala	Not reported	515	1545	Yes	Some farmers
1975	P.Pinstrup-A	Valle del Cauca	ICA-Pijao	906	1060	No	30
1976	G. Gálvez	CIAT	ICA-TUI	1691	2720	Yes	n.a.
1976	O. Voysest	Palmira, Popayán, Montería	ICA-TUI	Minimal effect		No	n.a.
1978	J. Sanders O. Herrera	Huila	Calima	1509	1630	No	15
1978	L.F. Restrepo	Huila	Calima	1000	1138	No	13
1978	M. Stabile	Restrepo	Calima	1341	1254*	No	12
1978	J. Sanders N. Ruiz de L.	Carmen de Viboral	Cargamanto	2019	1826	No	15
1979	J. Sanders N. Ruiz de L.	Carmen de Viboral	Cargamanto	2136	2168	No	15
1979	J. Sanders O. Herrera	Huila	Calima	1402	1333**	No	30
1983	J. Woolley J.A. Beltrán	Carmen de Viboral, Marinilla	Cargamanto	No difference found		No	n.a.
1983	J. Woolley J.A. Beltrán	El Tambo	Limoneño	557	514**	No	4 places 2 reps

n.a. = not available

* Seed produced in Chile; ** Seed produced in Dagua, Valle del Cauca, Colombia

¹ Clean seed refers to seed produced under special circumstances, which was physically clean and apparently free of diseases. In all cases, farmer seed and clean seed were of the same variety.

² Except for Guatemala, all sites are located in Colombia.

CONCLUSIONS

There are five reasons why a farmer would want to purchase bean seed:

1. Aspects that limit storage, such as weevil attack, heating due to storing moist seed and fungus attack. Farmers may not be able to keep seed due to a general

and persistent problem, or because of individual and/or sporadic problems, eg not being able to plant during the second season for climatic reasons or not having the technology to store seed for 8 months.

2. **Previous cash flow problems.** Farmers are well aware that purchased seed is expensive. Nevertheless, because of pressing temporary needs for cash, they may be forced to sell their best grain, which otherwise they would have used for seed. Prior to the next planting, they are forced to purchase seed.
3. **Crop yield.** When farmers obtain a low yield, they may attribute this not only to factors such as adverse climate or pest and disease attack, but also to worn out seed. It is possible that the grain may look bad, but even when it looks good, farmers tend to change the seed that did not perform well.
4. **Production planning.** If the farmer decides to increase the area planted to beans, his seed supply may be insufficient. Similarly, for some farmers, beans are an opportunity crop that they plant some years but not all. These producers will not keep seed, but will purchase it when necessary.
5. **Desire to try or switch to another variety.** If farmers feel that their seed is not the best adapted to the zone, they will look for seed with other characteristics. Farmers frequently experiment with new materials even if only to assure themselves of the superiority of the material they are sowing.

In the present study, the greatest advantage of a stable supply of quality seed was that it improved availability (reason 1) and that it allowed the expansion of land planted to beans (reason 4). Considerations of cash flow and change of variety (reasons 2 and 5) were of little importance. Problems of poor yield (reason 3) have led some farmers to change their seed. The COAGROSANGIL seed may not have yielded better than the farmers' own seed, but its availability has proven to be very useful. It allowed farmers greater flexibility in planning their production and in using their harvest.

To promote the purchase of bean seed and guarantee the viability of a bean seed enterprise, its seed prices should not be too distant from commercial grain prices. The lack of a noticeable difference in yield prohibits a premium price for the seed. This would suggest that bean seed production schemes be operated at low costs, maybe at the expense of some quality control. Seed of new, more productive varieties could fetch a higher price. The feasibility of producing and distributing seed improves considerably if new varieties are offered (Voyses and Pachico, 1991).

In general, purchased seed is only a small part of total seed use. One hypothesis that can be generated from this study is that farmers who would lose more than a third of the average regional yield by planting their own seed are potential seed purchasers. In the survey sample, approximately 30% of those who saved seed would improve their

expected yield with purchased seed. If it were possible to sell to half this group (ie 15%), this would be acceptable coverage.

It is difficult to make a more precise estimate of the demand for purchased seed as the relationship between price and demand was not established. Moreover, marketing strategies were not defined. Two alternative recommendations can be made. If bean seed is being sold through the market, it appears prudent to limit seed production to 10% of the total demand. For example, for an area of 10,000 hectares, where 50 kg of seed is required per hectare, the production of selected seed would be limited to 50,000 kg (10,000 x 50 kg x 0.10). If per-hectare seed production were around 1000 kg (based on average yield in the zone studied), then 50 hectares of quality seed could feasibly be produced and sold through the market.

If seed production and distribution can be integrated in farmers' organisations such as the VILLANUEVA co-operative, one might ask member farmers ahead of time how much seed they want to purchase and plan seed production accordingly. Such a strategy requires good farmer organisation and a time span between the harvest (when farmers will start to define their future production plans) and the next planting that allows growing a seed crop (eg five months). This is more feasible in areas with only one production cycle per year.

ACKNOWLEDGEMENT

The authors wish to express their gratitude to Norha Ruiz de Londoño, Trud Brekelbaum, John Ferguson and Adriel Garay for the comments they made on this document; to Bill Hardy for editorial help; and to Jairo Castaño for his support in processing the data. The authors remain the only persons responsible for any errors.

REFERENCES

1. CIAT. 1975, 1976 and 1979. Bean Program Annual Reports.
2. Luna, C.A. and Janssen, W. 1990. El impacto del comercio internacional sobre el sector frijolero colombiano: Consumo y crecimiento de la producción. *Coyuntura Agropecuaria* 7(1): 107-140.
3. Restrepo, Luis F. 1979. Evaluación agro-económica de nuevas tecnologías para la producción de frijol en la zona sur del Huila, Colombia. M.S. thesis, Universidad Nacional de Colombia, Bogotá, D.E.
4. Sperling, L. and Loevinsohn, M. 1990. La diffusion de nouvelles variétés de haricot au Rwanda. CIAT-ISAR, Butare, Rwanda. (In mimeograph).

5. Voystest, O. 1983. Variedades de frijol en América Latina y su origen. Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia. 87 p.
6. Voystest, O. and Pachico, D. 1991. Análisis de la problemática de la producción y suministro de semillas de frijol en América Latina. In: RELEZA II (Segunda Reunión de Leguminosas de Grano de la Zona Andina), resúmenes, (ed. M. Lobo), 101-110, ICA, Rionegro, Colombia.