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FARMERS' ADOPTION OF IMPROVED MAIZE VARIETIES IN THE HUMID FOREST AREA OF CAMEROON

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Key words: Adoption; farmer; survey; humid forest; maize production.

Abstract

The adoption of improved maize varieties remains an important issue in the developing countries in general and particularly in Africa. A survey was conducted in fives villages in the Bimodal Humid forest zone (BHFZ) of Cameroon from April to May 2013. The objectives of the study were to identify farmer selection criteria in the adoption of improved maize varieties and to identify their needs and constraints on maize production. A total of 178 farmers were individually and randomly interviewed in five villages of the region. Data were analyzed using Statistical Package for Social Scientists (SPSS) version 17. Results showed that maize farmers preferred their local maize varieties compare to the improved. They have poor soil fertility problem mainly due to aluminum toxicity. The practice of appropriate agricultural system associated with the utilization of improved and adapted varieties (acid tolerant maize varieties) could significantly increase their maize yield. Smallholder farmers in that area of the country prefer high-yielding maize varieties tolerant to low soil fertility, which produce good quality grain, soft and sweet tasting, and which are pests and diseases resistant with short maturation period if possible. If such hybrid maize could be developed by breeders, farmers would be willing to adopt it.

Key words: Adoption; farmer; survey;

humid forest; maize production.

Introduction

Production of maize in Cameroon is mainly in the hands of resource-poor farmers. Farmers grow the crop in highly variable and stress-prone environments (Banziger and Meyer, 2002). Some better maize cultivars have not been adopted by farmers even when available. One of the reasons given is that farmers' selection criteria were generally not considered in the breeding process. In most cases, commercial breeders fail to consider the special and unique preferences of small-scale farmers in rural areas (Banziger and Cooper, 2001; DERERA, 2007). According to Bänziger et al., (2004), regional programs have a tendency to focus their breeding goals on the requirements of the commercial farming sector. Effective breeding should be based on clear identification of farmers' preferences for cultivars through participative breeding research. Most of the breeders have focused more on increasing yields in control, agronomically well-managed conditions and farmers perceive little advantage in growing these varieties because they are not fitted their needs (Reeves and Cassaday, 2002) and sometime farmers are not aware on the existence of the improved variety. For effective breeding, farmers' preferences for varieties should be clearly identified (Sibiya *et al.*, 2013). As breeders involve farmers in their breeding programs, they learn more about the most important selection criteria of gender issues for the cultivars preferred in the rural environment (Danial *et al.*, 2007). This encourages the use of locally adapted cultivars resulting in less dependence on foreign materials. It has therefore become clear that breeders must be well acquainted with the farmer selection criteria such as the requirements for specific agronomic, storage, processing and marketing traits for high adoption rate (Danial *et al.*, 2007).

In the Bimodal Humid Forest Zone (BHFZ) of Cameroon, most of the soils are acidic, decreasing the yield of crops (Njomgang *et al.*, 2010). The Acid Tolerant Population (ATP) introduced to the area decreases in yield when grown under acid soil conditions (The *et al.*, 2006). With the farmers' inability to correct acidity of the soils by liming, it has become imperative to develop adapted high-yielding acid tolerant maize hybrids. The development of successful hybrids require the identification of farmers 'selection criteria in terms of their ideal maize variety and also their specific needs vis-à-vis the cropping of the crop.

The objectives of this study were to:

- Identify farmer selection criteria on maize cultivars
- Identify farmers' needs and constraints during maize production process.

Materials and Methods

Study site

The study was conducted in the BHFZ of Cameroon where three regions out of 10 were covered in the country. Five villages (Asso'osseng, Biyeyem, Djop, Ndengue and Nkoemvone) were inveolved in the study. Annual rainfall is 1800 mm with bimodal distribution (The *et al.*, 2001). The soils are Oxisols and typically Kandiudox. These soils are highly weathered and dominated by kaolinitic clay with high Aluminium toxicity (The *et al.*, 2005). The study site mainly has forest vegetation with mixed cropping as the main farming system. The crops grown

include cocoa, maize, groundnut, cassava and yam. The villages were selected based on the possession of acidic nature of the soils.

Sampling procedure and data collection

A structured questionnaire was prepared based on the general observation in the villages. A questionnaire was drafted to elicit individual household information in each village. Individual interviews were used to assess thoughts, opinions, and feelings of individual farmers of the humid forest area of Cameroon during the period from April to May 2013. A total of 178 farmers were individually interviewed in those villages.

Data analysis

Data were analyzed using least square means of the Statistical Package for Social Scientists (SPSS) version 17.

Results

Farmers activities

The main activity practiced in all the five villages was agriculture involving 178 farmers (Figure 1). The distribution of farmers based on their main activity per village (Table 1). At Asso'osseng and Nkoemvone, 2.4% and 17.9% of farmers were temporary workers in the Research Institute. Few of them manage small businesses (2.4% at Asso'osseng, 3.3% at Ndengue and 7.7% at Nkoemvone) while most of them farmed (Table 1).

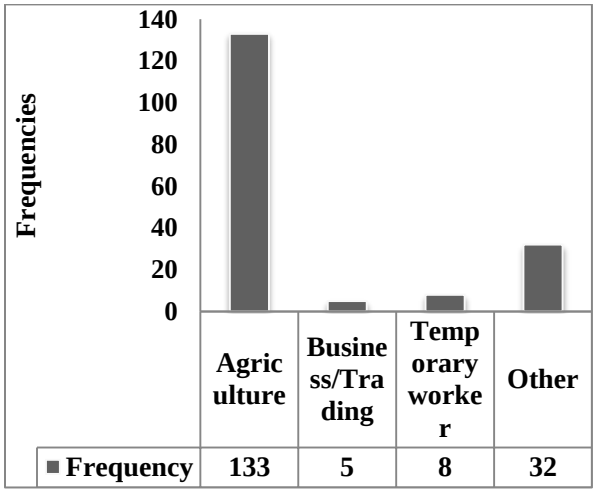

Figure 1: Sample distribution of farmers according to their main activity

Table 1: Sample distribution according to the main activity by village (%)

		Main activity				TOTAL
		Agriculture	Business/Trading	Temporary	Other	
VILLAGE	ASSO'OSSENG	70.7	2.4	2.4	24.4	100.0
	BIYEYEM	93.3	0.0	0.0	6.7	100.0
	DJOP	96.4	0.0	0.0	3.6	100.0
	NDENGUE	96.7	3.3	0.0	0.0	100.0
	NKOEMVONE	43.6	7.7	17.9	30.8	100.0
	OTHER	30.0	0.0	0.0	70.0	100.0
ALL		**74.7**	**2.8**	**4.5**	**18.0**	**100.0**

Maize varieties used as seed

Some improved maize varieties developed at the Institute of Agricultural Research for Development (IRAD) were grown. Among them were the most acid tolerant population adapted in the South Region of the country (ATP SR Y). Most farmers preferred their local variety, compared to the improved genotypes (71.3% of farmers grew it). Few farmers (7.8%) grew the ATP SR Y (Table 2). Moreover at Ndengue village, 17.1% of farmers grew CMS 8501 which is a white open-pollinated variety. Most of the farmers did not grow the single cross hybrids like CLH 101(7% of the farmers) and CLH 103 (2.3% of the farmers) (Table 2).

Table 2: Agricultural system used and type of maize variety grown by farmers (%)

	Villages					
	Asso'ossen g	**Biye yem**	**Djop**	**Ndengue**	**Nkoemvone**	Total
Provenance of water for crop						
Rain	92.3	96.2	92.3	100.0	88.2	94.5
Irrigation	0.0	0.0	0.0	0.0	0.0	0.0
Rain and irrigation	0.0	3.8	0.0	0.0	0.0	0.8
Maize varieties grown						
ATP SR Y	17.2	3.6	7.4	0.0	14.3	7.8
CMS 8704	31.0	96.4	81.5	85.7	57.1	71.3
CMS 8501	44.8	10.7	11.1	0.0	21.4	17.1
CLH 101	10.3	0.0	18.5	0.0	7.1	7.0
CLH 103	0.0	0.0	3.8	0.0	7.1	2.3
Local variety	62.1	92.9	65.4	95.8	64.3	72.7
Other variety	11.1	0.0	0.0	0.0	46.7	16.4

Sources of maize seed

Almost sixty percent (60%) of farmers bought their seed from the local market, 37% of them used saved seeds and only 17% of farmers bought seed from the Research Institute (Table 3).

Table 3: Farmers' distribution according to the sources of seed (%)

		Seed's provenance		
		Research Institute (IRAD)	**Local Market**	**Personal seed**
VILLAGE	ASSO'OSSENG	10.7	39.3	53.6
	BIYEYEM	14.3	82.1	25.0

DJOP	14.8	44.4	40.7
NDENGUE	6.9	69.0	24.1
NKOEMVONE	47.1	64.7	52.9
OTHER	33.3	66.7	0.0
ALL	**16.7**	**59.8**	**37.1**

Criteria that determine the choice of farmers' maize seed variety

Farmers chose their variety based on 3 criteria (Tables 4 and Table 5): the consumption purpose; the commercialization and the availability of seed. The best three criteria on maize seed preferences listed by farmers were: sweet taste (68.9%), high-yielding (72.6%) and seeds availability (50.9%). Most of the men (72.5%) preferred the sweet taste in maize and 66.1% of female preferred that trait (Table 4). More men (82.4%) preferred high-yielding varieties compared to females (64.3%). Similarly with availability of seeds, men (56.9%) were more concerned than females (44.6%).

Table 4: Farmers' seed selection criteria across villages

	VILLAGE				
	ASSO'OSSENG	DJOP / BIYEYEM	NDENGUE	NKOEMVONE	Overall
Seed color	36.0%	31.3%	30.0%	58.3%	35.2%
High yield	42.3%	83.3%	80.0%	83.3%	72.6%
Sweet taste	42.3%	77.1%	70.0%	91.7%	68.9%
Good adaptation	11.5%	10.4%	75.0%	58.3%	28.3%
Pest and disease resistant	30.8%	20.8%	80.0%	33.3%	35.8%
Kernel size	15.4%	6.3%	35.0%	41.7%	17.9%
Early maturity	34.6%	27.1%	70.0%	58.3%	40.6%
Seed availability	30.8%	50.0%	75.0%	58.3%	50.9%
Grain quality	11.5%	29.2%	65.0%	50.0%	34.0%

Table 5: Farmers' seed selection criteria based on gender

	Gender					
	Male		Female		ALL	
	Num	%	Num	%	Num	%

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Seed color	15	29.4	23	41.8	38	35.8
High yield	42	82.4	36	64.3	78	72.9
Good taste (sweet tasting)	37	72.5	37	66.1	74	69.2
High yield under non fertile soils	17	33.3	13	23.2	30	28.0
Pests and diseases resistant	16	31.4	22	39.3	38	35.5
Good size of grain produce	9	17.6	10	17.9	19	17.8
Late variety	3	5.9	5	8.9	8	7.5
Early variety	22	43.1	22	39.3	44	41.1
Seed availability	29	56.9	25	44.6	54	50.5
Grain quality produce	18	35.3	19	33.9	37	34.6
Other	6	11.8	4	7.1	10	9.3

Farmers view about soil fertility on their farms

During the individual interviews, a question was asked about the view of farmers concerning the fertility of the soil in the village (Table 6). Almost sixty-four percent (64%) of the farmers responded that they had fertile soil while 23% of farmers reported that the soil on their farms was not fertile and only 13% of them with 18% of the female farmers and 7% of male farmers did not know the status of their soil (Table 7).

Table 6: Farmers' views about soil fertility on their farms based on gender

	Gender					
	Male		Female		ALL	
	Number	%	Number	%	Number	%
Do you have fertile soil?						
Yes	39	69.6	39	59.1	78	63.9
No	13	23.2	15	22.7	28	23.0
Don't know	4	7.1	12	18.2	16	13.1
Strategies used to overcome soil infertility						
Lying fallow	38	79.2	46	83.6	84	81.6
Chemical fertilizer	12	25.0	8	14.5	20	19.4
Organic fertilizer	3	6.3	5	9.1	8	7.8
Improved variety	6	12.5	5	9.1	11	10.7
Other	5	10.4	6	10.9	11	10.7
Uses of maize						
Consumption	/	21.7	/	25.0	/	23.3
Commercialization	/	40.2	/	35.0	/	37.8
Other	/	38	/	40	/	39

	.0	.0	.0

Table 7: Farmers' views about soil fertility and their coping strategies across villages

	VILLAGE						
	ASSO'OSSENG	BIYEYEM	DJOP	NDENGUE	NKOEMVONE	OTHER	ALL
Do you have fertile soil?							
Yes	28.6	87.5	81.8	86.2	41.2	0.0	64.2
No	50.0	12.5	18.2	6.9	23.5	33.3	22.8
Don't know	21.4	0.0	0.0	6.9	35.3	66.7	13.0
Strategies							
Lying fallow	62.5	100.0	88.0	96.0	50.0	50.0	81.6
Chemical fertilizer	33.3	5.9	4.0	4.0	70.0	100.0	19.4
Organic fertilizer	20.8	0.0	4.0	0.0	20.0	0.0	7.8
Improved variety	25.0	0.0	4.0	0.0	40.0	0.0	10.7

Strategies used by farmers to overcome poor soil fertility

To overcome the problem of soil infertility, 82% of farmers practiced fallow system of cropping (Table 7). At Biyeyem and Ndengue, farmers did not use organic fertilizer but a high rate of organic fertilizer was applied at Asso'osseng (20.8%) and Nkoemvone (20.0%). Chemical fertilizer was highly used at Nkoemvone (70.0%).

Uses of products from the farm

Farmers mainly grew maize for home consumption, for commercialization and for other use like animal feed. Therefore, 23% of farmers produced maize for consumption, 38% of them produced for commercialization and 39% produced for other uses (Table 6).

Advice received by farmers on agricultural techniques

Forty-six percent of farmers (46%) received advice from the Research Institute (IRAD) which is located at Nkoemvone, Non-Governmental Organizations (NGO) and the Tertiary education level (Table 8). However,

34% of farmers received advice from the ministry (MINADER) while 35% of farmers received their advice from friends and other farmers.

Table 8: Origin of advises received by farmers based on village

		MINADER (post officer, …)	IRAD / NGO / universities	Development agencies (PACA, IITA, CIRAD, ICRAF…)	Friend (other farmers / growers)	Media and other
VILLAGE	ASSO'OSSENG	28.6	52.4	15.0	45.0	5.0
	BIYEYEM	47.6	52.4	4.8	28.6	4.8
	DJOP	50.0	12.5	25.0	12.5	0.0
	NDENGUE	38.1	14.3	4.8	42.9	4.8
	NKOEMVONE	21.4	64.3	7.1	35.7	3.6
	OTHER	28.6	71.4	42.9	28.6	0.0
ALL		34.0	46.2	11.4	35.2	3.8

Information needed by farmers to enhance their productivity

To improve the production per unit area of cropping land, 52% farmers needed information on soil fertility management, 62% of farmers needed information on crop diseases and pest damages, 34% on marketing, 58% on credit and 70% needed information on finance and improved seeds (Table 9).

Table 9: Information needed by farmers to improve their production per gender

	Gender:					
	Male		Female		ALL	
	Number	%	Number	%	Number	%
Soil fertility management	45	48.9	40	54.8	85	51.5
Crop diseases and pests	53	57.6	50	68.5	103	62.4
Marketing	37	40.2	19	26.0	56	33.9
Credit and finance	59	64.1	36	49.3	95	57.6
Improved seed	67	72.8	48	65.8	115	69.7
Other information	2	2.2	1	1.4	3	1.8

Discussion

In the present study, farmers first preferred their local maize landraces "*Obeng bo'o and Zole*", because of the good taste and smooth grain, but they recognized that those local varieties had long period of maturity with low yield per hectare estimated at 0.8 t/ha (ACDIC, 2014). They liked hybrids mostly for commercial purpose. Up to now, 73% of the farmers prefer to grow their local variety compared to the improved variety (71.3% of

CMS 8704 and 7.8% farmers grow ATP SR Y). One of the reasons explaining the negative effect of the adoption of improved varieties was their custom also because older farmers tend to stick to their old production techniques and were usually less willing to accept change. Similar result was reported by Kafle (2010). In the present study, young people were associated with a higher risk-taking behavior than the elderly. Therefore, they could easily accept change and adopt improved varieties if these varieties are available. Some farmers did not produce the improved maize variety especially the acid tolerant composite ATP SR Y which was the most adapted to the area. This was because of the non-availability of the seeds. Moreover, the sweet tasting quality of the OPV (CMS 8704) was why some of the farmers grow this improved variety. Because of the sweetness, the cobs were sold when fresh, boiled or roasted. Additionally, farmers usually eat or sale fresh maize because of the post-conservation challenges. This was because of the high moisture in dried maize which is due to the water content in the air in the humid forest zone, the conservation of dried maize becomes therefore difficult to handle.

The bimodal humid forest zone of Cameroon experiences a very high rainfall regime. The huge quantity of water is washed away the soil surface or deep into the soil profile. In the process, water washes away almost all the essential plant nutrients (Ca, K, P, Mg) from the soil increasing the level of Al toxicity in the soil. This was one of the main causes of Al toxicity in that region. Farmers did not know much about the fertility of their soil even though they used some agricultural systems (like shifting cultivation, intercropping, fallow) to overcome the problem of soil infertility, pests and diseases management and weed control. Similarly, Gegrande and Diguma (2000) reported that farmers in the humid lowland zone of Cameroon did not perceive soil fertility to be a major problem on their land because of their ignorance.

At the beginning of the agricultural campaign, most of the farmers bought maize seeds from the local market, some of them used the remnant seeds or the seeds that they kept from the previous season, and few farmers bought their seeds from the Research Institute when available. Meanwhile, most farmers could use improved seeds if they were aware of their existence and if the seeds were available and largely spread in the market. This could be the role of the seed companies which are not yet spread in the country. Farmers (95%) predominantly grew maize and they displayed strong preferences for local varieties due to their perceived superior quality traits such as grain size, good taste and white flour. This implied that breeding for acid tolerance should aim at developing maize cultivars that will not be only acid tolerant but also possess farmer's preferred traits. Additionally, the use of improved variety will make the yield increase compared to the utilization of the local variety. Therefore, the practice of good agricultural system and the use of improved seed will make maize yield increase significantly and will raise farmers' income considerably.

Conclusions and recommendation

This study examined small – scale farmers' perceptions on maize varieties and production preferences for the adoption of stress tolerant improved cultivars. The results show that the practice of appropriate

agricultural system associated with the utilization of improved and adapted varieties could significantly increase the yield of maize under farmer field area. Smallholder farmers in that area of the country prefer high-yielding maize varieties tolerant to low soil fertility, which produce good quality grain, soft and sweet tasting, and which are pests and diseases resistant with short maturation period if possible. If such hybrid maize could be developed by breeders, farmers would be willing to adopt it.

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References

Banziger, M. & Cooper, M. (2001) Breeding for low input conditions and consequences for participatory plant breeding: Examples from tropical maize and wheat, *Euphytica*, 122, pp. 503-519.

Banziger, M. & Meyer, J. (2002) Collaborative maize cultivar development for stress-prone environments in southern Africa. IN Cleveland, D. A. & Soleri, D. (Eds.) *Farmers, Scientists and Plant Breeding.*, CAB International: 269-296

Bänziger, M., Setimela, S. P., Hodson, D. & Vivek, B. (2004) Breeding for improved drought tolerance in maize adapted to southern Africa *Proceedings of the 4th International Crop Science Congress, 26 Sep - 1 Oct 2004, Brisbane, Australia. Published on CDROM. Web site* www.cropscience.org.au

Danial, D., Parlevliet, J., Almekinders, C. & Thiele, G. (2007) Farmers' participation and breeding for durable disease resistance in the andean region, *Euphytica*, 153(3), pp. 385-396.

Derera, J. (2007) *Genetic effects and associations between grain yield potential, stress tolerance and yield stability in southern african maize (Zea mays L.) base germplasm.Thesis* African Centre for Crop Improvement (ACCI), School of Biochemistry, Genetics, Microbiology and Plant Pathology, Faculty of Science and Agriculture, University of KwaZulu-Natal Republic of South Africa,189.

Kafle, B. (2010) Determinants of adoption of improved maize varieties in developing countries: A review, *International Research Journal of Applied and Basic Sciences*, 1(1), pp. 1-7.

Njomgang, R., Yemefack, M., Nyobe, T., Tchienkoua, M., Ambassa-Kiki, R., *et al.* (2010) Profil du pays sur les besoins en éléments nutritifs des plantes cultivées dans les principales zones agro-écologiques du cameroun: Description sommaire des zones agro-ecologiques (zae) du cameroun, *Organisation des Nations Unies pour l'Alimentation et l'Agriculture (FAO) & Institut de Recherche Agricole pour le Développement (Cameroun)*, p. 6.

Reeves, T. G. & Cassaday, K. (2002) History and past achievements of plant breeding, *Australian Journal of Agricultural Research*, 53, pp. 851-863.

Sibiya, J., Tongoona, P., Derera, J. & Makanda, I. (2013) Farmers' desired traits and selection criteria for maize varieties and their implications for maize breeding: A case study from kwazulu-natal province, south Africa, *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 114(1), pp. 39-49.

The, C., Calba, H., Horst, W. J. & Zonkeng, C. (2001) Maize grain yield correlated responses to change in acid soil characteristics after 3 years of soil amendements. Seventh Eastern and Southern Africa Maize Conference, 222-227.

The, C., Mafouasson H., Calba H., Mbouemboue P., Zonkeng C., *et al.* (2006) Identification de groupes hétérotiques pour la tolérance du

maïs (*Zea mays* L.) aux sols acides des tropiques. , *Cahiers Agricultures*, 15(4), pp. 337-346.