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Comparative study of current agricultural practices in urban agriculture and recommended agricultural practices in the western area of Burkina Faso (West Africa): case of maize growing

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Abstract

Urban agriculture in the western part of Burkina Faso is characterized by mixed systems for the production of legumes, cereals and livestock. This urban agriculture is a big part of people's diet. However, it is not practiced under the recommended conditions. The importance of this study is to show the shortcomings in the practice of agriculture with a view to raising the awareness of producers and urban populations. The objective of this study was to compare the current practices of urban agriculture in the city of Bobo-Dioulasso (Burkina Faso) and the recommended practices. An individual survey sheet was prepared to conduct the interviews. Data collected from 110 farm unit managers involved: soil preparation, rotation and association practice, seeds, and fertilization and herbicide use. The results of this study show that 60% and 80% reinforced producers do crop rotation compared to 0% of conventional producers. 56% of producers apply the association in their corn fields. Less than 50% of conventional producers practice the association. Only 40% of producers are fond of flat plowing. On average, 87.5% of the enhanced producers process their maize seed before sowing versus 15% of conventional producers. Conventional growers use only 50 kg / ha of urea in one feed. Total herbicides are the most used; about 72% of the enhanced producers and 62% of the conventional producers use total herbicides. Practices in urban agriculture are far from practically recommended.

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Introduction

Urban agriculture plays an important role in the developing countries where it is, on the one hand, the receptacle of a large part of the young unemployed and on the other hand a source of fresh agricultural produce. In Senegal, 26% of Dakar's population derive their income from activities related to urban agriculture and 6% of them depend exclusively on it (Sueur, 2011). Still in Dakar (Senegal), this activity provides 70% of the demand for vegetables and where its poultry component represents 33% of the national production, between 65% and 70% of the country's demand (Mbaye, 1999). This is the same trend seen in other cities in sub-Saharan Africa. In Dar-es-Salam (Tanzania) as well as in Bissau (Guinea Bissau), 90% of the demand for leafy vegetables is provided by urban agriculture against 100% of the demand for all vegetables in Bamako (Mali) (Akinbaminjo *et al.*, 2002). In Kampala (Uganda), 70% of poultry and egg meat demand is satisfied by urban agriculture compared to 50% in Bamako and 60% in Cotonou (Benin) (Guèye *et al.*, 2009). In Ouagadougou (Burkina Faso), urban agriculture is the only activity and source of income for 43% of cereal farmers, 83% of vegetable growers and 91% of nursery growers (Kaboré, 2010). Thanks to its high production potential, urban agriculture is participating at the macroeconomic level in reducing the deficit of the trade balance of developing countries by reducing imports of basic foodstuffs (Temple *et al.*, 2003). At the microeconomic level, it is an important source of income for the poorest households in urban areas (Golhor, 1995). The activities covered by urban agriculture in Burkina Faso are: market gardening, cereals, horticulture, arboriculture, livestock farming (Nacro *et al.*, 2006).

In maize crops in urban agriculture, maize occupies the first place and contributes not only to direct feeding but also provides other outlets such as the development of small livestock, export to other countries, various industrial uses, including brewery (Zoma, 2010). This importance of maize is due both to the multiple uses of speculation and to its place in the production system (Mugidhawimana, 2000).

Despite its important role in the economies of developing countries, urban agriculture is threatened by its failure to be taken into account by GAP policies. These practices represent all the techniques combined to drive a crop, including the choice of variety, in order to achieve various objectives, accompanied by the reasons that justify these choices (CIRAD and GRET, 2002). They must be reasoned, coherent and dynamic. Agricultural practice is defined as practices that meet current needs and improve livelihoods, while preserving the environment in a sustainable manner. In other words, it is the use of farming techniques that minimizes risks, maximizes production while ensuring human security (FAO and INERA, 2004). However, when it comes to the essential means that can contribute to the improvement of agricultural production, the adoption of good agricultural practices involving the use of quality seeds, respect for agricultural practices and good crop protection occupy a place of choice and appears to be the keystone of the increase in agricultural productivity (FAO and INERA, 2004). Hence the interest of this study. This study, conducted in western Burkina Faso (West Africa), aims to compare current agricultural practices in urban agriculture with recommended agricultural practices.

Materials et methods

Study area

The study took place in the urban commune of Bobo-Dioulasso (11°06'N, 04 °20'W) and in two villages of the commune. These were the villages of Leguema (04 ° 09.812'W, 11°13.840N) and Tolotama (11°18'06.6"N, 004°10'28.3"W). In the urban commune of Bobo-Dioulasso, four sites (Dogona, Kodéni, Kuinina and Sector 22) were involved in the study. In the study area, the climate is south-Sudanian and located between the 900 and 1100 mm isohyets (Fontes and Guinko, 1995). The climate is characterized by two distinct seasons: a rainy season of 4 to 5 months (May to September) during which the monsoon blows and a dry season (from October to April) where the harmattan blows. Average monthly minimum temperatures range from 18 °C to 25 °C in May.

Mean monthly maximum temperatures range from 29 °C in August to 37 °C in March. Winds blow at an average speed of 2m / s in November to 3.5m in May. The average sunstroke varies from 5.6 hours in August to 8.7 hours in November. The average minimum relative humidity varies from 12% in February to 66% in August. The vegetation of the study area according to Fontes and Guinko (1995) is that of wooded savannah divided into three strata: tree, shrub and herbaceous.

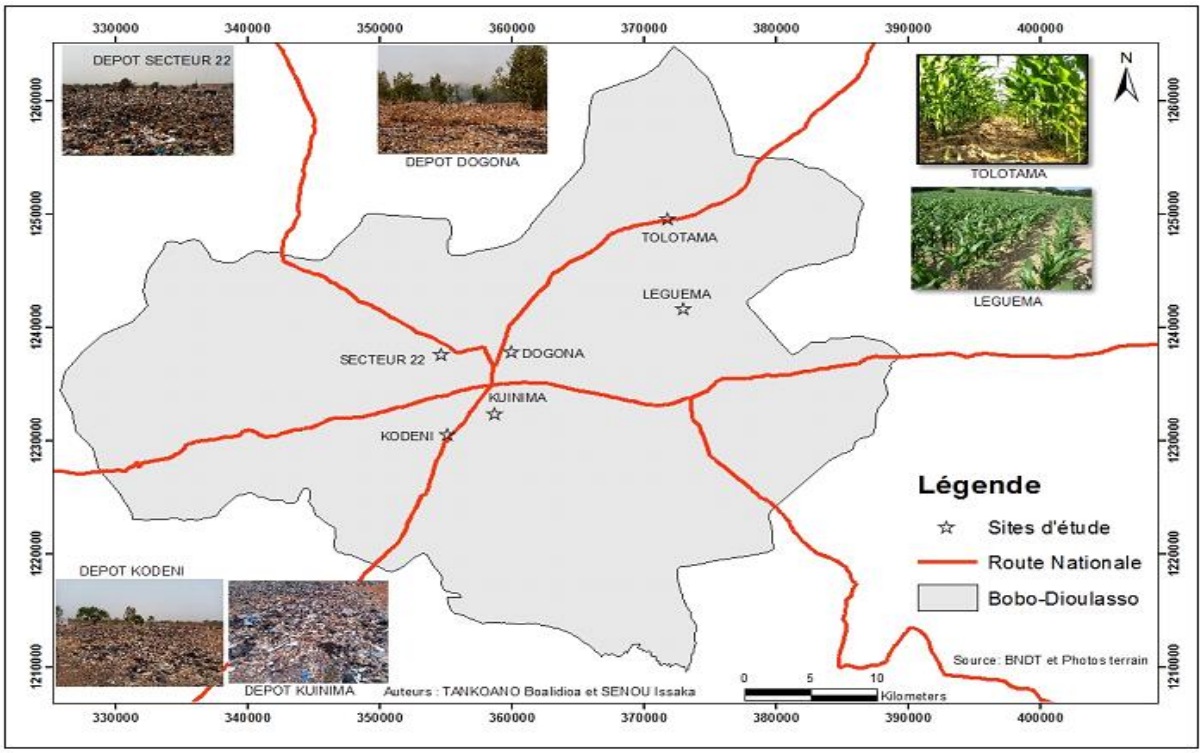

Fig. 1. Map of location of study sites.

The shrub layer consists of Combretaceae and *Piliostigma* species (Hochst), *Daniellia oliveri* (Rolf) Hutch. and Dalz mostly in fallows. The tree layer is composed of species such as *Vitelaria paradoxa* (CF Gaertn), *Khaya senegalensis* (Desr), *Gmelina arborea* (Roxb), *Parkia biglobosa* (Jacq Benth), *Detarium microcarpum* (Guill), *Tamarindus indica* (Linn), *Saba senegalensis* (Prota), *Isoberlinia spp* (Prota).

The discontinuous herbaceous carpet is rich in *Andropogon* spp (Kunth), *Pennisetum* (Trin), *Eragrostis tremula* (Hochst) and *Srylosantes eracta* (Beauv). The dominant soils are tropical ferruginous soils on various materials (sandy, sandy-clay, etc.). They have a good relative humidity, but depending on the season, the pH of soils generally varies between 5 and 6.5 (Pallo *et al.*, 2008). Figure 1 show the location of the study sites.

Criteria for selecting sites

The four sites in the urban commune of Bobo-Dioulasso have been selected on the basis of three criteria: (i) use of municipal solid and / or liquid waste as the main source of organic fertilizers, (ii) the size of the site must exceed 10 ha and (iii) the location of the sites must be such that the city is crisscrossed. For the selection of growers, these were the ones that grew the SR21 intermediate-cycle variety (110 days). Producers' fields in the villages of Leguema and Tolotama met two criteria: (i) field under the supervision of agricultural agents to respond to good practice recommendations and (ii) SR21 maize variety as cultivated speculation.

Survey and data collection method

To follow evolutionary practices of farmers and the technical route of producers, we made a random selection of 110 farms responding to the different criteria.

In the urban commune of Bobo-Dioulasso, 70 so-called "classic" producers who still carry out their usual practices while in the villages of Leguema and Tolotama, 40 so-called "reinforced" producers followed the technical itineraries as well as the recommendations. The theoretical model used is that proposed by Jouve (1986). This model is based on a strong assumption: the farmers are coherent, they have the reasons for choosing the production systems they practice.

The questionnaires made it possible to know the criteria specifying the system (different cultures, technical itinerary). Our approach was global. We used the repetitive method to collect information on technical itineraries and farmer practices. Our survey tool was addressed to the farm managers.

These daily passages made it possible to follow the evolution of the agricultural activities of the production units.

Statistical treatment of data

An analysis was used to define a set of variables in the form of data (qualitative or quantitative) that were processed by Excel 2010.

The collected data was analyzed using the general linear model with Minitab software (V. 14) for Windows (Minitab Inc.). The Microsoft Excel 2010 software was used to generate the tables and graphs.

Results

Rotation and cultural association

Table 1 show that conventional producers do not practice crop rotation in their plots regardless of the site. On the other hand, the reinforced producers do this practice. 60% and 80% of the producers surveyed practice crop rotation in their fields in Leguema and Tolotama respectively. The rotation is annual with an average of 55.37% of producers and biannual with 44.62%.

Table 1. Proportions of farmers practicing rotation by site and type of producer

		Types of producers							
		Conventional Producers (CP)					Reinforced Producers (RP)		
		Dogona	Kodéni	Kuinima	Sector 22	Average (CP)	Leguema	Tolotama	Average (RP)
Percentage		0%	0%	0%	0%	0%	60%	80%	70%
Rotation frequency	Annual	0%	0%	0%	0%	0%	67%	43.75%	55.37%
	Biennial	0%	0%	0%	0%	0%	33%	56.25%	44.62%

The cultural association is more presence at the reinforced producers compared to the classic producers. In the villages of Leguema and Tolotama 56% of the producers apply the association in their fields. Less than 50% of conventional producers make cultural associations (Fig. 2).

Preparation of the seedbed

All the reinforced producers practice flat plowing. This practice is not very common among conventional producers, where only 40% of producers are fond of flat plowing. Only 43% of the reinforced producers apply ridging and 17% zero plowing. In conventional producers, ridging and zero plowing are not practiced as shown in Fig. 3.

Seeding categories, seed treatments and re-seeding practices

The results show that 82.5% of conventional farmers practiced normal sowing against 90% of reinforced producers. Although no early sowing was found among the hardened producers, 8.75% of conventional producers were found to have done this type of sowing (Table 2).

As for late sowing, it is 8.75% and 10% respectively in the sample of conventional and enhanced producers. Almost all Leguema and Tolotama growers process their maize seeds compared to conventional producers.

On average, 87.5% of the enhanced producers process their maize seed before sowing versus 15% of conventional producers. In general, maize seed is more protected than other crops, regardless of the type of producer (Table 3). Reinforced producers re-sowed more (96%) than conventional producers (12%).

Table 2. Seedling categories by site and type of producer.

	Types of producers							
Types of seedlings	Conventional Producers (CP)					Reinforced Producers (RP)		
	Dogona	Kodéni	Kuinima	Sector 22	Average (CP)	Leguema	Tolotama	Average (RP)
Early sowing	20%	10%	0%	5%	8.75%	0%	0%	0%
Normal seedling	70%	80%	90%	90%	82.5%	100%	80%	90%
Late sowing	10%	10%	10%	5%	8.75%	0%	20%	10%

Table 3. Proportion of seed treatment by site and type of producer.

	Types of producers							
Cultures	Conventional Producers (CP)					Reinforced Producers (RP)		
	Dogona	Kodéni	Kuinima	Sector 22	Average (CP)	Leguema	Tolotama	Average (RP)
Maize	8%	12%	23%	16%	15%	90%	85%	87.5%
Other cultures	0%	5%	8%	4%	4.25%	75%	60%	67.5%

The results also show that the amount of seed used for re-seeding is greater in the producers grown (3 kg/ha) than in the conventional producers (1 g/ha) (Fig. 4).

Doses of fertilization and application of herbicides

Conventional producers use an average of 88 kg of NPK /ha, while fortified producers use an average of 135 kg of NPK/ ha. As for urea, the reinforced producers use an average of 108 kg / ha divided into two inputs; however, conventional producers use only 50 kg / ha in a single input (Fig. 5).

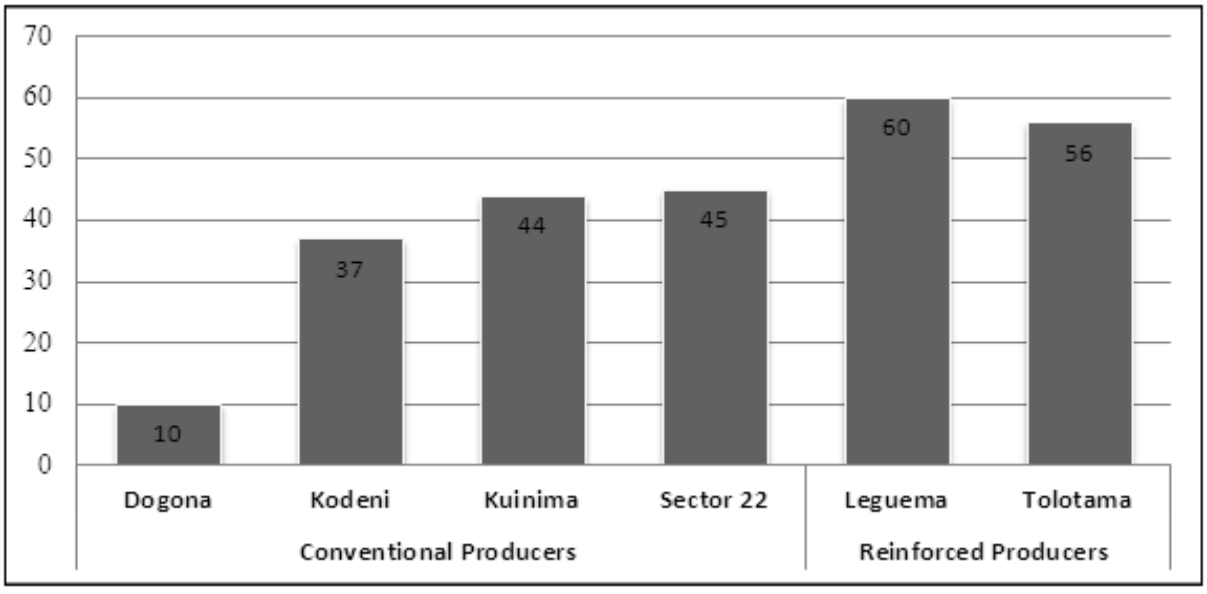

Fig. 2. Proportions of farmers practicing cultural association by site and type of producer.

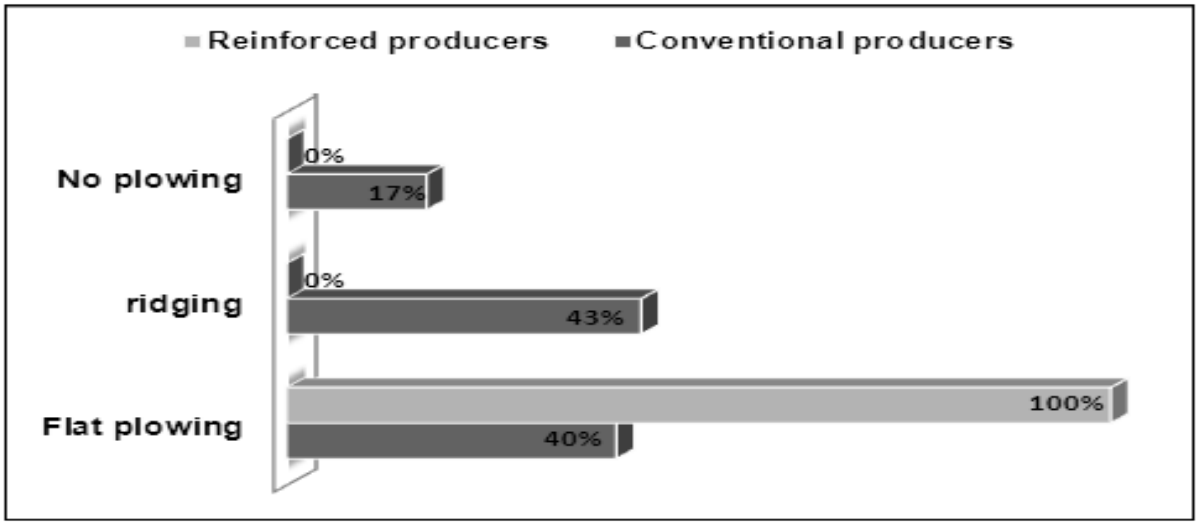

Fig. 3. Methods of preparation of the seedbed by types of producers.

The results of the application of herbicides show that depending on the type of herbicide used, the proportions of use vary. Total herbicides are the most used; about 72% of the enhanced producers and 62% of the conventional producers use total herbicides. Producers use pre-emergence and post-emergence herbicides less. 6% of conventional producers use pre-emergence herbicides and only 15% treat their plots with post-emergent herbicides.

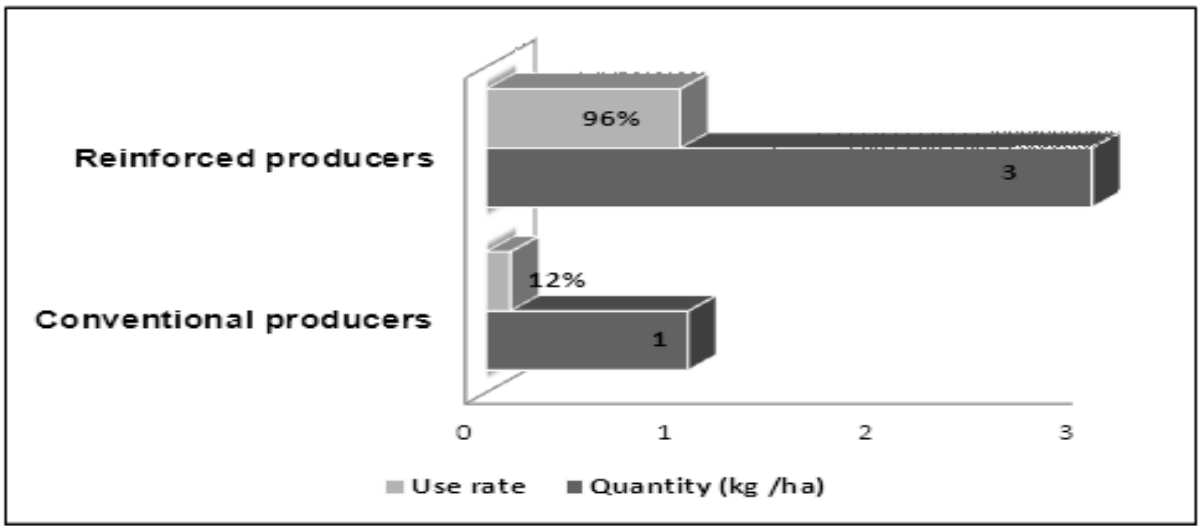

Fig. 4. Re-sowing practices by type of producer.

As for the enhanced producers, 12% and 30% respectively use pre-emergence and post-emergence herbicides (Fig. 6).

Discussion

Rotation and cultural association

The results show large differences between the costly practices encountered in urban agriculture and those recommended. Firstly, crop rotation is not practiced by traditional producers, ie those practicing in urban agriculture.

Since rotation has been considered for decades as an alternative that favors the in situ formation of organic matter (USAID, 2012), the absence of this practice could be explained by a lack of arable land at the level of conventional producers. These producers also mention a rotation constraint that makes it difficult to apply the rotation. On the other hand, more than 70% of the reinforced producers practice crop rotation. There is every reason to believe that the strengthened producers have understood the definite advantage of rotation.

Rotation is a key to soil fertility, and one of the most effective and least costly methods for controlling weeds, diseases and pests. There are indications that good rotation breaks the cycle of Striga spp. (FAO, 2006). This practice has been advocated to maintain plant and soil productivity.

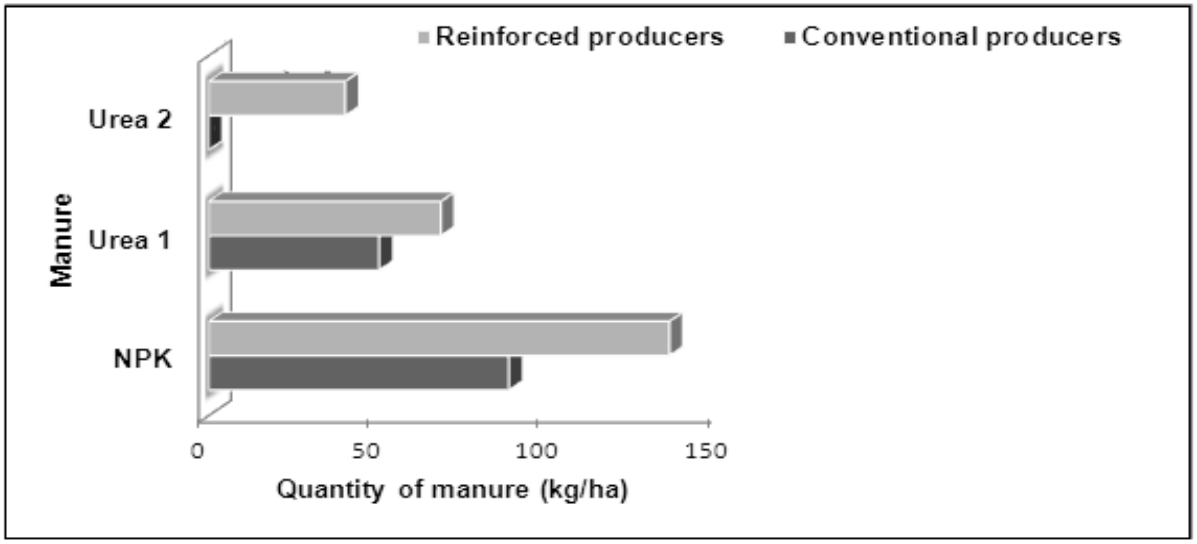

Fig. 5. Average amounts of manure used by types of producers.

These results are consistent with those of Kabore (2014) who showed that about 90% of producers in the western zone of Burkina Faso rotate in their maize field. The cultural association is appreciated variously on the different study sites. However, the increased producers (58%) are more in favor of this practice compared to conventional producers (34.38%). This low proportion of traditional producers to practice the cultural association is explained by the fact that this practice leads to the appearance of diseases, makes the maintenance work difficult and especially the lack of knowledge of the advantages of the cultural association. They explain that the cultural association makes it difficult to maintain fields in the fight against weeds, pests and insects. What conventional producers of cropping associations think is inconsistent with the results of Bacye's (1993) work; Segda (2000); Hiema (2005); Baudron *et al.* (2009); Dao (2014) who showed that cereal-legume combinations favor a decrease in weed pressure and improve the overall productivity of the association system compared to pure cereal culture. In addition, cereal-legume combinations can improve soil nitrogen availability and do not compromise cereal yields (Coulibaly *et al.*, 2012, Coulibaly *et al.*, 2017). These results on the multiple benefits of cultural association could be the motivation of the majority of the producers reinforced to adopt this practice.

In addition, all (100%) reinforced producers are more rigorous in seed bed preparation than conventional ones (40%).

Preparation of the seedbed

The importance of seed bed preparation could be explained by the requirement of growing maize. Indeed, this culture requires reasoning according to the structure of the soil (Sanou, 2011). Conventional growers, preoccupied with a difficult start to the season due to poor distribution of rain, sow after ridging or zero till to be in the recommended period for planting. These practices are not without drawbacks since they are not favorable for good root development and, in addition, make germination more difficult in the event of low rainfall after sowing.

Seeding categories, seed treatments and re-seeding practices

Seed treatment is poorly practiced in conventional producers (15%) compared to the producers grown (87.5%). This could be explained by the lack of awareness of the benefits of treatment and neglect by conventional producers. However, some classical producers explain this by the lack of financial means to be able to buy treatment products. The results of the producers reinforced with seed treatments corroborate those of Kabore (2014) who showed that

in Seguere and Guena (West of Burkina Faso), respectively 90% and 70% of the producers treat their maize seeds before sowing.

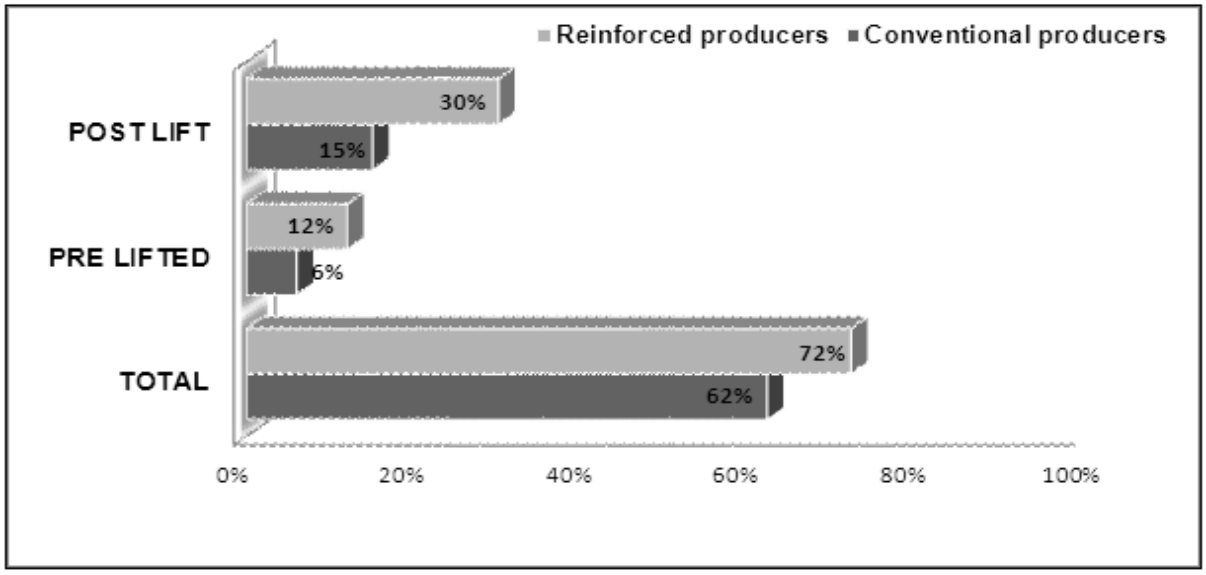

Fig. 6. Use of chemical herbicides by types of producers.

Doses of fertilization and application of herbicides

Mineral fertilizer (NPK and Urea) is moderately used by both types of growers at the recommended corn crop rate. In fact, conventional producers apply an average dose of 88.34 kg / ha in NPK and the dose 50 kg /ha for urea. The doses applied by the reinforced producers exceed those of the conventional producers. They are 134.61 kg/ ha and 108.15 kg /ha respectively for NPK and urea.

These doses are below this recommended globally for maize cultivation. These results are consistent with those of Bado (2002) who showed that producers in Burkina Faso have the lowest consumption of mineral fertilizers. Whatever the type of producer, we note a use of herbicides. However, the total herbicides are the most used with an average of 62% of conventional producers and 70% of the reinforced producers.

These results are similar to those of Kabore (2014) which showed that 70% of the producers reinforced in the western zone of Burkina Faso use the total chemical weed killer in the maize crop. However, there is little use of the pre-emergent herbicide. The very low use of this herbicide is partly due to the unavailability of this type of herbicide on the market. Regardless of the type of herbicide, larger producers are more likely to apply it than conventional producers.

Conclusion

From the analysis of current farming practices in urban agriculture production units in the western zone of Burkina Faso, it appears that these practices differ more or less from the recommended practices. No conventional producer practices crop rotation. The preparations of the sowing bed are made most frequently by plowing but also by ridging. Seeding is commonly done during normal planting periods but with a very small percentage of farmers treating seed before planting. Re-seeding is poorly practiced but also with small amounts of seeds. It also appears that fertilizer doses and chemical weed killer practices do not comply with the recommendations. In addition, the application of urea is unique. Producers of the urban agricultural production units studied would gain in productivity as well as in profitability if they became more concerned and followed the technical itineraries that are recommended to the reinforced producers.

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