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Influence of the modes and moments of application of bio-waste (hens manure) on the growth and the yield of maize (*Zea mays* L) installed on a ferralsol of Lubumbashi. DR. Congo

Alphonse KASHAT NAWEJ [1], Jean BANZA KALUME[3], Symphorien TUITE MASANGU[4], Jean Claude YAV MANDJANDJ[2]

1. Department of General Agronomy, Higher Institute of Agronomic and Veterinary Studies of SANDOA, SANDOA RD. Congo.
2. Department of Agroveterinary, Higher Institute of Agronomic and Veterinary Studies of SANDOA, SANDOA RD. Congo.
3. Department of General Agronomy, KASEYA Higher Institute of Agricultural Studies, KASEYA RD. Congo.
4. Department of Agroveterinary, Higher Pedagogical Institute of KABONGO, KABONGO RD. Congo

Abstract: The current world population estimated at 7.2 billion will increase to 9.1 billion by 2050. This rapid population growth is stronger in developing countries and will put pressure on the demand for food resources and waste production quadruple in cities. The virtual absence of effective treatment for waste and effluents is currently one of the most serious health problems. In this context, the problem of agricultural recycling of waste and effluents is at the heart of the concerns of our societies. Thus, this work was initiated to evaluate the influence of modes and times of spreading chicken manure on corn yield.Installed at the Kasapa farm (Lubumbashi, DR Congo) in the period from October 2011 to June 2012 following a 2 * 5 factorial device comprising 3 repetitions. The main plots included both spreading methods (by location and landfill) and secondary plots were application times (0, 1, 2, 3 and 4 weeks before sowing).Agronomic characteristics such as density at emergence, number of days at male flowering, height of plant at insertion of male inflorescence and ear, number of ears per foot, average weight of grains per spike, the weight of 1000 grains and the yield were measured. The results show that the different modes and times of application have led to similar effects.
Keywords: agricultural valorization, organic waste, spreading, fertilization, organic matter.

Introduction

Maize is now one of the major cereals whose demand on the world market is increasing faster than in the late eighties (Yuziro et *al*., 1998). Its production is growing in relation to the multiple uses of which it is the object: human consumption, animal consumption and biofuel and the direct or indirect incentives which it has benefited (Soule and Gansar, 2010 cited by Miriama et al., 2016). Its seed, stem, leaves, ears, egret, and silks have in most regions a commercial value, even though the grain remains the most important (Émile, 1977). When considering total world production, maize and rice rank second after wheat. Nearly 66% of all maize is used for livestock feed, 25% for human consumption and 9% for industrial purposes and seed. In sub-Saharan Africa, maize is a first rate cereal; then it deserves attention as a component of human food as well as animal. It is the most widely consumed cereal, either whole grains, semolina or flour in low-income countries (Gomez, 1987). However, as with other crops, its yield is constrained in sub-Saharan Africa by a number of factors including degradation of soil fertility, climate change, poor farming practices and inadequate land selection for its cultivation (Kihara et al. al., 2016; Munene et al., 2017; Van Vugt et al., 2017). In the Democratic Republic of Congo, maize is the staple food for indigenous people, whose self-consumption in the middle of the planter absorbs 75% of local production the quantity marketed or surplus fails to cover the supply needs of large centers . In the tropics, maize remains a large traditional food grain where its use has been for a long time exclusively the food of man (Rouanet, 1984). According to (Kagne et al., 2003), the importance of maize has been attested not only by the extent of the area cultivated but also by the diversity of its use both in human and animal nutrition. Anzala, 2006 confirms that the importance of maize is also reflected in the volume of research directed at this crop. In R & D. In Congo, low crop yields are often explained by the natural nutrient depletion of soils, the most important of which is nitrogen and phosphorus, the use of unimproved varieties and low fertilizer use (Bangata et al. ., 2013). In such soils, agricultural production is low enough especially for cereals such as maize (Zea mays L) to cover the food needs of an ever-growing population (FAO, 1999). In Upper Katanga, particularly in Lubumbashi, maize is consumed in the form of flour and is the staple food of the majority of the population. Despite its place in the diet, maize production is still insufficient in the province of Haut-Katanga with regard to the needs of the population; this situation plunges the province of Upper Katanga into a narrow dependency of Zambia and South Africa for the supply of corn flour.In order to improve this productivity, it is important to remove these obstacles, with priority being given to the first constraint, which is soil poverty. To achieve this, the use of different forms of fertilizer is important. This is the case of chemical fertilizers, organic and various soil improvement techniques (Ilunga et al., 2016). It is also noted that the use of chemical fertilizers is likely to increase the productivity of the soil but poses certain problems related to their difficult accessibility, their high cost compared to the income of the farmers, the degradation of the ecosystems by the pollution, even the risk of disrupting human health. According to Temple, 2002 chemical fertilizers are expensive in our regions but also their cost on the environment is known. Dalgaard et al., 2003 confirms that the excessive use of chemical inputs has a serious and long-lasting impact on soil biology and poses risks to human health. In addition, it requires technical knowledge for their proper use (FAO et al., 2003, Mukendi et al., 2017. The challenge for the next 50 years is to double agricultural production while respecting the rules of sustainable agriculture. low inputs and no risk to public health (Tilman et al., 2002). The application of organic amendments is one of the techniques that can increase agricultural production (Kaho et al., 2011) and is more beneficial because they not only increase fertility; they also improve the physicochemical and biological properties of the soil while securing production by obtaining good quality products with no risk to public health (Mokuba et al., 2013) and also reduce the incidence of diseases. According to Lunze et al. (2007), the best practice for improving soil fertility is the application of organic manure. Several studies report that organic amendment by producers is a crop management alternative to reduce or eliminate synthetic inputs (Abawi and Widmer, 2000). Studies carried out in the wild by Useni et al., 2012, 2013 have shown that adding organic amendments to Katangais soils that are poor and acidic can provide the nutrients needed for feeding, growing and producing plants. cultivated. Thus, through the search for effective solutions that the present work had for objective the management of the fertility of soils by the valorization of the organic waste in order to increase the agricultural production, to clean up the environment and to determine the mode and moment of spreading of hens' manure which pays for the cultivation of maize.

Materials and methods

Middle

This study was conducted during the year 2011-2012 in the Democratic Republic of Congo in the province of Upper Katanga, Lubumbashi city in one of the station of the Faculty of Agricultural Sciences (1274 m average altitude, 11 ° 36'44 " south latitude and 27 ° 28'37 " longitude) from the University of Lubumbashi.Lubumbashi enjoys a climate of CW type according to Koppen, including a rainy season (November-March), a dry season (May - September) and two months of transition (April and October), was chosen as an experimental site. Thanks to its altitude of 1200-1230 m and its latitude of 15 ° 20'-12 ° 00 ', the city of Lubumbashi knows neither very high temperatures nor very low temperatures (Malaise and the white 1978 in Kalimaa, 2011) . The average annual rainfall is 1270 mm with a rainy season of 118 days, while the annual average temperature is around 20 ° C with interannual stability. The average humidity is 62% with a minimum average humidity level of 52% in the dry season (June-August) and a maximum of 80% during the rainy season (November-May). The climatic conditions prevailing during the test are given in Table 1.

Table 1. Climatic data of the period of the test.

Seasons/parameters		2011	2012				
		December	January	February	March	April	May
Quantity of precipitation		170,5	374,6	335,8	173,9	9,2	
Days rain number		16	23	16	13	1	
Temperature	High	27,0	25,9	27,6	27,3	27,9	27,7
	average	21,0	21,9	20,9	21,2	22,1	21,7
	Low	16,9	18,3	17,2	17,4	16,4	14,0
Relative humidity (%)		70.9	75.1	86	86	80	73

The Lubumbashi vegetation consists of three main types of vegetation: savannah, steppe and forest. More than 80% of the forest is forest and has three aspects: the forest, the edaphic forest and the dry forest (Malaise and Leblanc, 1978 in Kalenda, 2011). Before the trial was implanted, the experimental site was colonized by the following species: Imperata cylindrica, Pennisetum digitatum, Tithonia diversifolia, Panicum maximum, Cyperus esculenta and Cynodon dactylon.

The soil cover is of the ferralitic type with a pH at water of 5.2 (Kasongo et *al*., 2013). These soils are very heavy with a clay fraction dominated by montmorillonite; they have average fertility and are difficult to work because they are sticky in the wet state and hard in the dry state. It should be noted that the soil of the experimental medium was of the ferralitic type of brownish color with presence of a laterite curasse.

A composite soil sample was taken from the experimental plots at random at four points at a depth of 0-20 cm to perform analyzes to determine the following characteristics: pH, organic carbon, total nitrogen, exchangeable bases (Ca, Mg, K) and available phosphorus. Soil test results and chicken manure in the laboratory are given in Tables 2 and 4.

Table 2: Soil Sample Analysis Results (%)

Elements	N	Phosphorus(P_2O_5)		S	Ca	Mg	Organic matter
		Total	Available				
Concentration in sol	0,224	0,0224	0,0058	1,030	0,040	0,816	3,354

Source: Agri-Food Research Center (CRAA)

Materials

The biological material used in this study was the improved maize seed (UNILU) that was offered to us by the Faculty of Agricultural Sciences. This improved variety was obtained at the Faculty of Agricultural Sciences at the University of Lubumbashi. It has been retained in the National Research Program because of its ease of adaptation to environmental conditions, resistance to leaf diseases, pests, lodging and its high yield potential (7-8.5%). t.ha-1 at a density of 53333 plants / ha in a controlled environment and 5-6t / ha in a real environment). The morphological and agronomic characteristics of the Unilu variety are shown in Table 3.

Table 3: Agro-ecological characteristics of the Unilu variety

Main morphological characteristics	Main agronomic characteristics
- Cycle in day: 120-140 days - Height of the plant: 161cm - Insertion point of the ear: 67cm - Grain color: white - Grain texture: semi-serrated	- Sowing-flowering duration 68 - Duration sowing immaturity: 120-140 days - Length of the ear - Number of rows per ear - Number of grains per head: 560-570 - Weight of 1000 seeds: 376-380 - Yield in a controlled environment: 7.5-8.5 per hectare and in a real environment 5-6t / ha. - Resistance: to diseases: good for streaking and helminthosporiosis and very good for Sigatoka. - Resistance to lodging: very good - Culture areas: Katanga Province, good adaptation in other ecologies of low and medium altitude.

The hen manures were used as organic manure, they were obtained at the poultry farm DAIPN station Kilobelobe Bélair district. The choice of this site was motivated by the intensive breeding that is practiced there and compared to the low cost of manure (70 kg for $ 4). In addition, a composite sample of manure from 500 g hens was also analyzed at the Agro-Food Research Center laboratory to determine their concentrations of Nitrogen, Potassium, Phosphorus, Calcium and Magnesium. The chemical composition of manures used as organic amendment in this study, which shows their fertilizing value is given in table 3 below.

Table 4: Bio-waste analysis results (%)

Bio waste/elements	*N*	*Ca*	*Mg*	*P*	*K*
Hens droppings	6	1,15	0,83	5,71	0,21

Source: Agri-Food Research Center (CRAA)

Methods

The test was installed according to a factorial device 2 * 5 with 3 repetitions. The plowing was carried out using a tractor and harrowing by hand, Five weeks before burial and locating hens manure. The depth of the plowing was 30 cm and the delimitation of the plots was carried out using a dekameter and stakes. The tools used for these works were the hoe, the machete, the rake, decameter and strings. Corn was sown at one seed per plant and at a density of 53333 plants per hectare; which corresponds to the spacings of 75cmx25cm. Two weeding was done; the first occurred 3 weeks after sowing, and the second 7 weeks after sowing; In order to promote the development of adventitious roots, which are important for increasing the resistance of maize plants to lodging, hilling was carried out during the second weeding.In addition, basic fertilization (chicken manure) was applied 4 weeks before sowing by location and landfill; 3 weeks before sowing; 2 weeks before sowing; one week before sowing more spreading the same day. The main factor included land application (location and landfill) and secondary factor application times (4, 3, 2, 1, and 0 weeks before planting at a rate of 1.75 t/ha). At the beginning of the growth the emergence rate was determined by the ratio of number of plants raised / number of seed sown x100. During the course of vegetation, the days of male and female flowering were determined; the height of the plant and that at the insertion of the spike were measured with a tape measure. At harvest, the number of ears per plant, the number of rows of grains per ear, the average weight of grains per ear, the weight of 1000 grains and the grain corn yield were determined. The statistical analysis of the data was carried out using the software sigma stat version 2.03. Analysis of variance (ANOVA) and separation of means (NEWMAN-KEULS test) were used to determine differences between treatments using SAS software.

Results

Effects of modes and times of bio waste spread on the growth of Zea corn L. var Unilu on the Kassapa farm.

The averages of the vegetative parameters are presented in Table 3. The analysis of variance shows that all the observed vegetative parameters did not undergo the influence of the mode and timing of bio waste and their interactions.

Table 5. Influence of Manure Spreading Modes and Times on Maize Growth. Synthesis of the results obtained on the growth parameters.

Manure application method	Spraying times	Raising rate (%)	Height of plant (m)	Height at spike insertion (cm)	Number of days at male flowering	Number of days at female flowering
Spreading location	4 weeks	72,7±29,5	1,3±0,2	56,3±14,5	71±4	70±0
	3 weeks	65,2±35,0	1,2±0,1	46,5±0,5	71±4	72±1
	2 weeks	90,8±15,8	1,3±0,2	58,2±3,8	74±2	70±1
	1 week	89,5±2,0	1,3±1,8	56,7±9,5	70±2	72±3
	0 week	94,4±2,0	1,4±0,1	40,6±24,2	73±2	74±1
Average application by location		82,5±12,7a	1,3±0,0a	51,6±7,7a	71±1,6a	71±1,6a
Landfill spreading	4 weeks	89,5±8,3	1,1±0,1	43,9±39,2	70±2	72±2
	3 weeks	74,9±21,7	1,2±0,1	17,8±30,4	50±3	73±2
	2 weeks	86,8±1,2	1,2±0,1	54,3±9,0	60±7	70±1
	1week	78,4±9,8	1,2±0,0	51,7±12,1	70±4	71±3
	0 week	54,1±25,2	1,2±0,0	47,4±6,3	68±2	70±2
Average Landfilling		76,6±13,6a	1,1±0,0a	43,0±14,6a	63±8,6a	71±1,3a
Average moments	*4 weeks*	*81,1±11,8a*	*1,2±0,1a*	*50,1±8,7a*	*70,5±0,7a*	*71,0±1,4a*
	3 weeks	*70,0±6,8a*	*1,2±0,0a*	*32,1±20,2a*	*60,5±14,8a*	*72,5±0,7a*
	2 weeks	*88,8±2,8a*	*1,2±0,0a*	*56,2±2,7a*	*67,0±9,8a*	*70,0±0,0a*
	1 week	*83,9±7,8a*	*1,2±0,0a*	*54,2±3,5a*	*70,0±0,0a*	*71,5±0,7a*
	0 week	*74,2±28,5a*	*1,3±0,1a*	*44,0±4,8a*	*70,5±3,5a*	*72,4±2,8a*
P spreading mode		*0,416*	*0,06*	*0,235*	*0,089*	*0,53*
P times of spreading		*0,47*	*0,777*	*0,235*	*0,377*	*0,258*
P interaction		*0,132*	*0,827*	*0,607*	*0,455*	*0,125*

Mean ± Standard deviation. The letters indicate the differences between the averages after comparison by the Ppds (P = 0.05).

The result of the analysis of the variance shows that the raised rate varies between 65.2 ± 35.0% and 94.4 ± 2% with an average of 82.5 ± 12.7% for landfill between 54.1 ± 25.2% and 89.5 ± 8.3% for spreading by location; the results of the analysis of variance indicate that the average rates of emergence are similar as a function of the application timing, the application method and the interaction (P> 0.05).

The height of plants at the onset of male inflorescences varied between 1.2 ± 0.1m and 1.4 ± 0.1m with an average of 1.3 ± 0.0 m for landfilling and between 1 , 1 ± 0.1m to 1.2 ± 0.0 m for spreading by location; the results of the analysis of variance indicate that the average plant sizes at the onset of male inflorescences are similar depending on the timing of application, the application method and the interaction (P> 0). , 05).

The height of plants at the spike insertion ranged from 40.6 ± 24.2 cm to 58.2 ± 3.8 cm for landfilling and from 17.8 ± 30.4 cm to 54.3 ± 9.0cm for spreading by location; the results of the analysis of variance indicate that the average plant sizes at the time of spike insertion are similar depending on the time of application, the application method and the interaction (P> 0.05). The number of days at female flowering ranged from 50 ± 3 days to 70 ± 4 days for land application and 70 ± 2 to 74 ± 2 days for location; the results of the analysis of variance indicate that the mean numbers of days at female flowering are similar depending on the timing of spreading, the application pattern and the interaction (P> 0.05) .

The number of flowering days of male flowers ranged from 60 ± 7 days to 70 ± 2 days for land application and 70 ± 0 days to 74 ± 1 days for location; the results of the analysis of variance indicate that the mean numbers of days at male flowering are similar in terms of application timing, application pattern, and interaction (P> 0.05) .

Effects of bio waste disposal modes and times on yield of Zea corn L. (VARIETE / UNILU).

Influence of the modes and times of bio waste spread on the yield of Zea corn L. var Unilu on the Kassapa farm.

Table 6. Summary of results obtained on performance parameters.

Manure spreading method	Spreading times	Weight of 1000 grains (g)	Yield (t / ha)
Landfill spreading	at 4 weeks	263,8±94,6	3,8±0,8
	at 3 weeks	259,2±100	3,3±0,1
	at 2 weeks	308,6±65,2	3,5±0,5
	at 1 week	294,7±7,4	4,4±1,0
	at à week	343,7±30,0	3,2±1,8
Average Landfilling		294±34,6a	3,6±0,5a
Location spreading	at 4 weeks	283,5±81,4	4,0±1,8
	at 3 weeks	347,2±29,2	3,7±0,9
	at 2 weeks	306,8±19,1	2,8±0,9
	at 1 week	322,8±23,3	2,8±0,3
	at 0 week	334,7±106,7	3,9±0,4
Average spreading by localization		319±24,8a	3,4±0,6a
Average moments	at 4 weeks	273,6±13,9a	3,9±0,1a
	at 3 weeks	303,2±62,2a	3,5±0,2a
	at 2 weeks	307,7±1,2a	3,1±0,4a
	at 1 week	308,7±19,8a	3,6±1,1a
	at 0 week	339,2±6,3a	3,5±0,4a
P Spreading mode		*0,316*	*0,699*
P Spraying moments		*0,579*	*0,836*
P Interaction		*0,737*	*0,370*

Mean ± Standard deviation. The letters indicate the differences between the means after comparison by the ppds (P = 0.05).

The result of the analysis of the variance shows that the weight of 1000 grains varied between 259.2 ± 100 and 343.7 ± 30.0 g for landfilling and between 283.5 ± 81.4g and 347.7. , 2 ± 29.2 g for spreading by location; the results of the variance analysis show that the average weights of 1000 grains are similar depending on the application timing, the application method and the interaction (P> 0.05).

Maize grain yield ranged from 3.2 ± 1.8 to 4.4 ± 1.0 t / ha for landfilling and 2.8 ± 3 to 4.0 ± 1.8 t / ha for spreading by location; The results of the analysis of variance indicate that the average grain corn yields are similar depending on the timing of application, the application method and the interaction (P> 0.05).

Discussion

The results of the analyzes obtained on the influence of mode and times of application of the hens' manures indicate a non-significant difference for the vegetative parameters and the yield parameters.

The rate of emergence has varied from 45 to 86% for all treatments and these results are not interesting since it will be necessary to use an additional quantity of seeds for relining the voids. Indeed, the polygenic and quantitative nature because being governed by several intrinsic factors (the dormancy, the permeability of the testa with water and the oxygen, the quality of the seeds, etc.) and the environmental factors (water, oxygen, temperature, light) (AYA et al., 2011). Nevertheless, the lifting rate of the order of 80% was obtained. The first hypothesis is the delay in sowing compared to the agricultural calendar of the Lubumbashi region. Indeed, the good time of sowing maize in the Lubumbashi region is between November 15 and December 15 while in the present research maize was sown December 28. This period coincides with that of the great proliferation of rodents and other diseases, including the melting of seedlings. This implies that the sowing time must be taken into account to ensure a perfect lift. To reduce these risks, farmers often seek to sow as soon as possible after the rainy season. However, at this time, soils are often waterlogged and rainfall can be significant. Early planting is therefore often carried out in wet conditions, with a significant risk of settlement. To sow under more favorable conditions, seedlings can be delayed, increasing the risk of end-of-life water and heat stress and reducing cycle time, thus decreasing yield potential. The different frequencies of modes and times of spreading but also, the interactions induced similar effects on the average rate of emergence. In other words, plots that were fertilized by location showed the same results as plots fertilized by landfill. At this stage (at 10 days), the nutrients would not be available to the crop.

Mean numbers of days at male and female flowering were similar. The values obtained for this test are in the range proposed by SENASEM (2008). The effects of the modes and times of spreading would be masked by the influence of the genetic heritage. For height parameters at male flowering and height at spike insertion the results of analysis of variance showed that there are insignificant differences between modes, times of spreading and their interactions. This implies that the plots fertilized by localization showed the same results as the plots fertilized by burial whatever the different frequencies of the modes and times of spreading. This seems to be justified by the fact that organic fertilizers mineralize throughout the growing season; their mineralization and nitrogen availability do not always coincide with the Bacyé (1993) crop growth cycle. It has also been shown that the fertilizing efficiency of nitrogen depends on the content of this element of the amendment or fertilizer (N'dayegamiye et al., 2004).

The nitrogen efficiency coefficients of bio-waste also depend on the soil properties (texture, structure, pH) that influence their mineralization (Douglas and Magdoff 1991). These also depend on the type of culture. Recent research (N'dayegamiye et al., 2005, Vagstad et al., 2001) has shown that the fertilizing efficiency of organic waste is higher for crops with a long growing season (cabbage, meadow) and lower for those of short period (barley). As with fertilizer efficiency, nitrate losses can also be associated with the composition of organic fertilizers and their respective application periods. Manures rich in nitrogen and having a C / N <15 ratio can rapidly release nitrogen into the soil, which can be lost through leaching during post-harvest applications in the fall (FAO, 2005) especially in the regions high temperatures such as tropical regions (Mulaji, 2011).

On the other hand, manure and mixed sludge with a C / N ratio> 20 gradually release nitrogen into the soil and thus have a lower risk of nitrate loss (N'dayegamiye et al., 2004). Thus, in addition to the total nitrogen content of organic fertilizers, the following characteristics condition the ability of the organic fertilizer to provide available nitrogen (inorganic nitrogen as NH4). The ratio C / N (ratio between the carbon content and nitrogen of an organic matter). The higher this ratio, the less nitrogen will be mineralized; conversely, the lower the ratio, the faster the organic nitrogen will be mineralized to NH4 under favorable mineralization conditions (N'dayegamiye et al., 2004). The availability of nitrogen is therefore strongly influenced by this ratio and the total NH4 / N ratio. A high ratio indicates that the organic fertilizer is composed of a large proportion of mineral nitrogen (NH4). This nitrogen will be converted to nitrate (NO3) under favorable nitrification conditions. Conversely, there will be accumulation of NH4 in the soil (N'dayegamiye et al., 2004). Thus, when the mineralization conditions are favorable, the spreading of an organic fertilizer, characterized by both a low C / N ratio of its organic fraction and a high total NH4/N ratio, will provide the soil with a large amount of soil. available nitrogen. Indeed, the efficiency coefficients were higher for manure or mixed sludge with low C / N ratios, but were not influenced by the periods of application. Chadwick et al. (2000) found that 40% of the variation in manure nitrogen mineralization was related to their C/N ratio. The organic amendments with very low nitrogen contents and therefore having high C / N ratios, produce a high nitrogen immobilization, as demonstrated by Fierro et al. (2000) for primary deinking sludge. The average yield obtained with the two spreading modes (spreading modes and times and their interactions) was similar. This result would be related to the genetics of the plant. These results show that the factors studied have induced similar effects. The yields obtained for this trial are not within the range proposed by SENASEM (2008), ie 6 to 8 tonnes per hectare in the station. This shows that organic fertilizers alone are insufficient to compensate for the low level of nutrients in tropical soils (Uyoybesere and Elemo, 2000, Muna-Mucheru et al., 2007), their beneficial effects on the physico-chemical and biological properties of the soil. soil would make more efficient the use of modest doses of mineral fertilizers.Nyembo et al. ; 2014, Confirmed that Fallows and organic matter inputs no longer allow the necessary increase of this production. But the success of this strategy will also depend on the quality of the organic material used and the amount of nutrients contained in that material (Kaho et al., 2011). Similar results obtained by N'dayegamiye et al (2004) in Canada showed that total and salable yields of potato did not differ significantly between the fall and spring application periods, but 'have been between organic fertilizer types for total yields.

Conclusion

This work was initiated to evaluate the effects of hen manure modes and times on corn yield. The test leads to the farm Kassapa following a factorial device comprising 3 repetitions. The main plots included both land application and location, and secondary plots were applied at 0, 1, 2, 3, and 4 weeks before planting at 1.75 tonnes / ha.

Agronomic characteristics such as density at emergence, number of days at male flowering, height of plant at insertion of ear, number of ears per foot, average weight of kernels per ear, 1000 grain weight and yield were measured. The results show that the different modes and times of spreading produced similar effects for all the parameters observed. These results suggest that landfilling to one week after burial is advisable with regard to the rate of emergence obtained. Urban waste management is a major problem in the world, especially in developing countries. The economic challenges related to waste management are enormous and the global production of urban waste is expected to triple in the coming years. In this context, agricultural valorization is an effective means for the sanitation of urban environments, obtaining crops with no risk to health and not only allowing the increase in production of food crops.

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