



Assessment of the Effects of Farmyard Manure And NPK Fertilizer Application on Banana Yields in Shuuku Town Council, Sheema District, Western Uganda

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ABSTRACT

The Experiment was on the effect of Farmyard Manure and NPK Fertilizer on banana yields in Shuuku Town council, Sheema district. It was guided by three objectives which were, determining the effect of Farmyard Manure and NPK Fertilizer on plant girth, plant height, establishing the effect on leaf and sucker development and also determining hands formation on banana bunches in the 3 selected Sites. The experiment was set using an incomplete Randomized block design to evaluate the effects of Farmyard Manure and NPK fertilizer on banana yields, with an aim of determining the effect of Farmyard manure and NPK fertilizer on plant girth, plant height, establishing the effect on leaf and sucker development and also determining Hands formation on banana bunches in the 3 selected farms. Each block consisted of 30 banana stools, each farm with 4 blocks, one block cattle manure, another for NPK fertilizer, another one for a combination of both and the last one as a control in a randomized form. Data was collected from at least 15 banana stools from each block. Data was used to give conclusions to the experiment objectives. Results indicated the highest plant girth was observed in all the plots with the mixture of cattle manure and NPK, the plant girth of the median sucker at 100cm showed significant improvement when cattle manure and NPK were added, cattle manure and NPK 55.67cm, cattle manure 53.08cm, NPK 50.7 and control 50.83. The results indicated that the average of 41.16cm were obtained from all the plots of cattle manure mixed with NPK for the follower (sword suckers) at 50cm compared to 37.73cm from NPK, 33.73cm from cattle manure and lower results were observed from the control plots (28.67cm), the highest average number of leaves was observed from the plots of a combination of cattle manure and NPK 8.12 leaves, followed by 7.43 from NPK plots. The combination of cattle manure and NPK was significant to the development and growth of leaves on the banana plants

The researcher recommends a combined application of cattle manure and NPK fertilizers in banana production enterprises since they provide different nutrients to the soil at different times hence ensuring increased yields. The researcher recommended utilization of cattle manure for the average farmers. For the farmers involved in commercial production of the banana crop, the researcher recommended cattle manure to enhance plant heights for the maiden plants, the suckers meaning at planting time and a mixture of both cattle manure and NPK fertilizers later for increased banana yields.

Key Words: Effects Farmyard Manure, and NPK Fertilizer Application, Banana Yields

Introduction

Banana is one of the most consumed fruits in the world, exploited in most tropical countries, reaching a world production of 70.7 million tons in 2009; Brazil is responsible for approximately 10% of this total. Brazil has around 500 thousand hectares planted with bananas and an annual production of around seven million tons, nearly all of which is destined for the internal market (Brazilian Institute for Geographical Statistics – IBGE, 2009). Producing bananas under an organic system has appeared as an alternative so the final product can reach a whole segment of specific consumers with greater purchasing powers Brazilian Fruit Year Book (2010), as well as being a means to reduce costs, as chemical Fertilizers have incurred high cost increases over the last few years. In addition, organic fertilization is a more sustainable method of cultivation, creating less impact on the environment.

Even though banana cultivation is of great importance at present to generate income and employment in Shuuku Town Council Sheema District, there is still a shortage of studies related to the use of organic Fertilizer especially Farmyard Manure (cattle manure) for banana nutrition, since the banana crop demands high nutrient inputs and this factor has not always been given due attention, many of the banana producing locations in the Town council have historically been under fertilized, which has led to low production and susceptibility to disease.

Low soil fertility associated with inadequate and inefficient use of fertilizers is one of the most important causal factors of low banana yield in Uganda. Banana yields could be improved by adequate supply of nutrients particularly nitrogen, phosphorus and potassium through fertilizers application. The use of mineral fertilizers by small scale farmers is still limited by their high prices and availability. Therefore more strategies of using farmer available resources are needed to increase yield. These may include incorporation of Farmyard Manure (FYM), Green Manure (GM) and crop residues of high quality into the soil. Therefore the experiment will help to assess the effect of Farmyard Manure and NPK Fertilizer to banana yield in Shuuku Town Council, Sheema District.

According to Uzoma *et al.* (2011), in many developing countries, manure is often considered as important as milk, meat or draught power. Animal manure as a soil amendment and soil conditioner can serve as a low-cost source of organic fertiliser for crop production Okwuagwu *et al.* (2011).

According to Muhereza (2005), cattle manure, either aged or fresh manure is applied prior to crop establishment and by a few farmers in combination with inorganic fertilisers at planting. However, Mazza *et al.* (2010) recommended that fresh manure must be used with caution in the garden because it may contain pathogenic bacteria.

The cumulative effects of negative nutrient balances in SSA are alarming and in the central district of Mukono in Uganda, negative net balances are given. The net annual nutrient depletion was estimated at 68 kg of N, 10 kg of P, and 21 kg of K per ha for the region Muhereza (2012).

Benneh (1997) estimated a lower net loss of about 7 kg N, 1 kg P, and 4.5kg of K per ha of cultivated land in Sub Saharan Africa. Livestock manure can replace soil nutrients; although, concentrations of nutrients vary due to different types of animals, animal weights, diets, livestock production, and nutrients (Hepperly *et al.* 2010).

According to Survey result, (2013), the increase in growth of banana plant was significant at 20 to 30%. Next to the general additional values of harvesting one or more crops, cost savings, savings on chemical fertilizers, and drought resistance, the plant also showed more resistance to diseases such as Banana Bacterial Wilt and insect pests like banana weevils

Favorable conditions increased the nutrient availability and water holding capacity of the soil resulting in enhanced growth and yield (Rashid *et al.* 2013), Leaf area index (LAI) is a crucial growth in dices determining the capacity of plant to trap solar energy for photosynthesis and has marked effect on growth and yield of plant.

Nitrogen, phosphorous and potassium are essential for good growth of plants. In the study conducted by Agnes *et al.* (2012) observed higher plant heights and leaf numbers obtained could also be attributed to better levels of major nutrients (N, P, and K) in the bio-slurry manure, as reflected by higher nutrient levels in the growing medium at the end of each growing season.

Materials and methods

Research design

The design was experimental and it was Incomplete Randomized Block Design (IRBD) with each Block having 30 plants but plants systematically was based on those Suckers that have not flowered conducted in Sheema district 2018. Selection was based on areas of the plantation that were in a poor state and deserved rehabilitation. The rehabilitation based on neglected plantations with local banana cultivars that is Enyeru, mbwazirume, Kibuzi and all other East African highland bananas locally cultivated. The Method of fertilizer application was placement (localized placement) especially where the young sucker originated from. This is also called ring manuring. Farmyard Manure and NPK Fertilizer 25;5;5 (250grammes) was placed per banana stool in a marking of plots 30 plants was cattle manure, 30 plants was both cattle manure and NPK fertilizer, 30 plants was NPK fertilizer, and 30 plants was a control with no any application a tall. The same plots were replicated as shown below in an incomplete Randomized block design; this makes a total of 12 plots.

Data collection

Data was collected using a measuring stick for measuring heights of banana plants, a tape measure for measuring the plant girth. The experiment was based on banana rehabilitation and plants were labeled and tagged for ease in finding while collecting data. The data was taken once every month for consecutive six months from September 2016 to February 2017. However because of an unreliable rainfall some selected banana stools delayed to flower which called for an extension period to seven months.

Materials and methods

Materials used

Data was collected using a measuring stick for measuring heights of banana plants, and a Tape measure for measuring the plant girth.

Methods of Fertilizer application

The method of manure preparation was collection and heaping from cattle kraal and covering with grass to avoid nutrient loss through volatilization.

The method of fertilizer application was placement (localized placement) especially where the young sucker originated from. This is also called ring manuring. The researcher used one wheel barrow of properly decomposed cattle manure per banana stool and half wheel barrow and 150 grammes in plots with a mixture of cattle manure and NPK fertilisers. This is in line with Tirkey *et al.* (2002) who reported that better growth of banana was obtained when inorganic fertilizers 150g NPK per stool was used and 10kgs of Farmyard Manure. The method of fertilizer application was placement (localized placement) especially where the Young sucker originated from. This is also called ring manuring. Farmyard Manure and NPK fertilizer was placed per Banana Stool in a marking of plots 30 plants was cattle manure, 30 plants was both cattle manure and NPK fertilizer, 30 plants was NPK fertilizer, and 30 plants was a control with no any application a tall. The same plots were replicated as shown below in an incomplete Randomized block design; this makes a total of 12 plots.

3.6 Rates of application

For cattle manure two tones were used per each site for two plots, that is a plot of cattle manure and one of the mixtures of cattle manure and NPK fertilizers. For cattle manure at least one wheel barrow has been used per plant. On NPK fertilizers, the total of 7.5kgs per 30 plants at a rate of 250grammes of NPK fertilizers was used alone. For both cattle manure and NPK fertilizer, 10kgs were used on the 30 plants and 4.5kgs of NPK on a mixture respectively.

Experimental layout

Experimental treatments and Layout on three selected sites were randomized as follows.

Control	Cattle Manure	Mixture of Cattle manure and NPK	NPK
Cattle Manure	Mixture of Cattle manure	NPK	Control
Control	NPK	Mixture of Cattle Manure and NPK	Cattle Manure

Agronomic practices

Desuckering, detrashing, weeding, fertilizer application, staking, pest and disease control management were carried out to maintain the plantation in good order.

3.9 Selected trait parameters for measurement included

Plant Height of the Maiden Sucker
Plant girth of the maiden plant at 100cm
Plant height of the sucker at 50cm
Plant girth of the sucker above 50cm
No. of leaves
No. of Peepers
No. of hands

NOTE. MAIDEN SUCKERS were taken to be suckers above 150 cm but have not flowered.

Sampling technique

The researcher used simple random sampling for the banana stools in the blocks taking consideration the guard row not to be sampled in the experiment in Shuuku Town Council, Sheema District. For purposes of effectiveness, reliability, and efficiency, the researcher used tags to easily identify the selected plants; each selected stool provided a maiden sucker and a follower where data was collected.

Research procedure

The researcher presented to the authorities of Shuuku Town Council, Sheema District Production Office his letter indicating his intention to experiment on cattle manure and fertilizers on banana fields and the farmer who provided the plantation for setting up another replication requesting for permission to conduct an experiment in the area and on receiving permission from the relevant authorities and the farmer who provided plantation, the researcher proceeded to the three selected sites with banana plantations where the experiment was set.

Data analysis

Data was collected using prepared paper sheets. It was from randomly selected Banana Stools with un flowered Maiden Plants from each plot under treatment and the follower. Data coded in an Excel program and analyzed using SPSS Programme and data presented in summarized form in tables means and standard deviation. The collected data was edited, tabulated, and coded using a computer (SPSS program) to analyze data and came out with reliable findings. After data processing, it was presented in tables for easy interpretation. The researcher then analyzed data using qualitative and quantitative methods whereby mean and standard deviations were generated for easy data analysis and interpretation.

Results

Assessing the effect of Farmyard Manure and NPK to plant girth and plant height

Plant girth of the maiden plant at 100cm

During the observations carried out in different months, plant girth of the median at 100cm differed in accordance to the different combinations of manure and fertilizers applied in the banana farms. All observed combinations

were colonized in the same terms but the plant girth of the maiden at 100cm differed. Results indicated the highest plant girth was observed in all the plots with the mixture of cattle manure and NPK with the average mean of 55.67cm, and the least was observed in the control plot with 50.83cm.

Table 1: Mean of plant girth of the maiden plant at 100 cm

TREATMENTS	Mean	N	Std. Deviation	Std. Error of Mean
CONTROL	50.83	315	7.802	0.44
CATTLE MANURE	53.08	315	7.374	0.415
NPK	50.7	315	7.105	0.4
CATTLE MANURE AND NPK	55.67	315	10.175	0.573
P-VALUE	<0.001			

Source: Field data, 2016/2017

In general, the plant girth of the median sucker at 100cm showed significant improvement when cattle manure and NPK were added, although the response was much lower in NPK alone as compared with that obtained from the treatments of cattle manure. Average mean of the plant girth of the maiden plant at 100cm under control treatment was 50.83cm.

Further analysis from Anova (appendix ii) indicates that all the combinations of fertilizer and manure were more significant in increasing the plant girth since their corresponding p-values were less than 0.001. These results are in agreement with Vanlauwe and Giller (2006) who pointed out that although organic manures provide a number of nutrients that are essential for plant growth and improve crop yields; this is an indication that the plant girth increased as a result however they are not considered full substitutes for synthetic fertilisers. The combined application of organic inputs and synthetic fertiliser in crop production resulted in synergistic positive effects on crop yield and soil fertility status.

Plant girth of the sucker at 50cm

Plant girth of the follower sucker was also measured to determine the effectiveness of the different combinations of fertilizers on plant girth at different growth rates. Results indicated that plant girth of the follower was higher on plots treated with a combination of cattle manure and NPK than in the sole plots of cattle manure and NPK treatments.

Table 2: Mean of plant girth of the follower sucker at 50 cm

MEAN ± (SE) OF PLANT GIRTH OF THE FOLLOWER SUCKER AT 50CM ALL FARMS IN CM

TREATMENTS	Mean	N	Std. Deviation	Std. Error of Mean
CONTROL	28.67	315	27.962	1.575
CATTLE MANURE	33.73	315	18.174	1.024
NPK	37.73	315	19.599	1.104
CATTLE MANURE AND NPK	41.16	315	19.216	1.083
P.VALUE	>0.001			

Source: Field data, 2016/2017

Also the plant girth of the follower sucker was measured at 50cm to get its variation, the results also indicated that the plant girth of the follower at 50cm was high in the plots where a combination of cattle manure and NPK was applied compared to plots where sole fertilizer(NPK) and farmyard manure(cattle manure) were used. The results indicated that the average of 41.16cm were obtained from all the plots of cattle manure mixed with NPK compared to 37.73cm from NPK, 33.73cm from cattle manure and lower results were observed from the control plots (28.67cm). On the basis of these experimental findings, it is indicated that use of organic and inorganic fertilizers in recommended combinations can give higher yields than the sole application of either of the fertilizer or manure. Further analysis from Anova (appendix ii) indicates that all the combinations of the fertilizer and

manure used in different treatments were more significant since their corresponding p-values were less than 0.001. The mixture of organic and inorganic manure raises the contents of the soil hence increasing on the nutrient availability to the plant increasing the plant parameters like plant height and girth in bananas compared to the control plots.

Plant height

Plant height of the maiden plant in (CM)

Plant height of the maiden plant was also one of the parameters that were measured basing on the different combinations of fertilizers applied to the banana plant.

Table 3: Plant height of the maiden plant at (100cm)

Plant height at 100cm

TREATMENTS	Mean	N	Std. Deviation	Std. Error of Mean
CONTROL	298.97	315	29.613	1.668
CATTLE MANURE	311.44	315	26.144	1.473
NPK	306.48	315	37.158	2.094
CATTLE MANURE AND NPK	322.24	315	33.295	1.876
P. VALUE	p>0.001			

Source: Field data, 2016/2017

From the experiment, it was observed that plant height was higher in all sites of the cattle manure combined with NPK. Lower plant height was observed in all sites of the control experiment. Cattle manure alone was effective on increasing the plant height since it was the second with the average of 311.44cm. Further analysis from Anova (appendix ii) indicates that the all the combinations of the fertilizer and manure used in different treatments were more significant since their corresponding p-values were less than 0.001. The interaction of nitrogen, phosphorus and Farmyard Manures (FYM) also had lower significant effect on plant height next to the control plots. But, treatments that received higher rate of both organic and inorganic fertilizer produced plants with more heights as compared to plants in unfertilized plots.

Table 4: Plant height of the follower sucker at 50 (cm)

TREATMENTS	N	Mean	Std. Deviation	Std. Error
CONTROL	315	144.65	70.146	3.952
CATTLE MANURE	315	186.35	86.953	4.899
NPK	315	191.73	78.821	4.441
CATTLE MANURE AND NPK	315	219.25	97.389	5.487
P. VALUE	P>0.001			

height of the follower sucker at 50 (cm)

TREATMENTS	N	Mean	Std. Deviation	Std. Error
CONTROL	315	144.65	70.146	3.952
CATTLE MANURE	315	186.35	86.953	4.899
NPK	315	191.73	78.821	4.441
CATTLE MANURE AND NPK	315	219.25	97.389	5.487

Source: Field data, 2017/2018

Research findings from table 4 indicate that the average plant height was high in plots of cattle manure combined with NPK. Lower results were obtained in the control plots followed by cattle manure plots. The combination of cattle manure and NPK produced a better increase in height. Further analysis from Anova (appendix ii) indicates that the all the combinations of the fertilizer and manure used in different treatments were more significant since their corresponding p-values were less than 0.001. However the stage of growth is important, for maiden suckers that have grown beyond 150cm where sole fertilizer is to be used it is ideal to use cattle manure for better results.

Assessing the effect of Farmyard Manure and NPK to leaf and sucker development

During the rehabilitation of the banana plantations, counting of the leaves was done on a monthly basis for continuous seven months, results indicated a positive contribution as a result of a combination of cattle manure and NPK fertilizers of an average of 8.12 leaves higher than all other treatments with the least recorded in the control plots.

Number of leaves of the follower sucker

Number of leaves of the sucker was taken into consideration to determine the extent of leaf development of a plant when different combinations of the fertilizers are applied and the mean results were recorded in table 5.

Table 5: Number of leaves of the follower sucker

TREATMENTS	N	Mean	Std. Deviation	Std. Error
CONTROL	315	6.26	1.907	.107
CATTLE MANURE	315	7.14	1.472	.083
NPK	315	7.43	2.144	.121
CATTLE MANURE AND NPK	315	8.12	2.103	.118
P.VALUE	P>0.00			

Source: Field data, 2017/2018

Results from the table5 indicate that the highest average number of leaves was observed from the plots of a combination of cattle manure and NPK 8.12 leaves, followed by 7.43 from NPK plots. The combination of cattle manure and NPK was significant to the development and growth of leaves on the banana plants since the average was also higher on different farms of the combined treatment. However this disagrees with Agnes *et al.* (2012) who revealed that higher plant heights and leaf numbers obtained could be attributed to better levels of major nutrients (N, P, and K) in the bio-slurry manure, as reflected by higher nutrient levels in the growing medium at the end of each growing season. He further revealed similar results of higher plant height in treatments with organic P fertilizer (Organic) compared to control plants, which was attributed to the ability of phosphorus to enhance early plant growth.

These favorable conditions increased the nutrient availability and water holding capacity of the soil resulting in enhanced growth and yield (Rashid *et al.* 2013), Leaf Area Index (LAI) is a crucial growth in dices determining the capacity of plant to trap solar energy for photosynthesis and has marked effect on growth and yield of plant.

Table 6: Number of peepers

TREATMENTS	Mean	N	Std. Deviation	Std. Error of Mean
CONTROL	.91	315	1.431	.081
CATTLE MANURE	1.45	315	1.181	.067
NPK	1.40	315	1.681	.095
CATTLE MANURE AND NPK	1.32	315	1.322	.074
P.VALUE	P>0.001			

Source: Field data, 2017/2018

Results indicated higher average numbers of peepers in the different plots of cattle manure with an average of 1.45 peepers better than NPK which presented an average of 1.40 peepers in sole treatments alone. But the number of peepers varied depending on the banana clone. Results did not show better results in a combination of cattle manure and NPK in relation to sucker development.

Assessing the effect of Farmyard Manure and NPK fertilizer application to hands formation on banana bunches

Table 7: Number of hands at flowering

TREATMENTS	N	Mean	Std. Deviation	Std. Error
CONTROL	45	6.73	1.304	.194
CATTLE MANURE	45	7.67	.853	.127
NPK	45	8.89	1.418	.211
CATTLE MANURE AND NPK	45	8.09	1.328	.198
P-VALUE	P>0.001			

Source: Field data, 2016/2017

Results indicated that on average the plants in the plots with NPK performed better with the highest number of hands, this is an observation in all the three farms with an average of 8.89 hands were analyzed. This is because the synthetic fertilizers are easily taken up by plants when applied than organic manures (cattle manure) that require more time to decompose. In the plots of cattle manure and NPK, numbers of hands were at an average of 8.09 hands. It was observed that numbers of hands were higher in the plots of NPK. The positive response on the cattle manure and NPK hands formation differed with a lower significant different.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The main aim of this study was to assess the effects of Farmyard Manure and NPK fertilizer application on banana yields in Shuuku Town Council Sheema District. The results obtained in this study show that:

Objective one assessed the effect of Farmyard Manure and NPK to plant girth and plant height as a contribution to proper growth.

Results indicated that better results were obtained on a combination of cattle manure and NPK on the plant girth of both maiden and follower sucker as it was observed on increased banana pseudo stems within a combination of cattle manure and NPK treatments.

The research results indicate that there was an increase in plant height of both maiden suckers and follower suckers with combination of cattle manure and NPK fertilizers. However cattle manure produced better results on plant height of the follower sucker than NPK in sole treatment. This is because the residual effect of cattle manure lasts for a longer period than synthetic fertilizers in the soil hence providing the required nutrient to the follower plant than the maiden sucker. This experiment therefore concludes that to achieve an increased pseudo stem size and plant height that can support a reasonable size of the bunch of the banana throughout the growing period, use of a combination of cattle manure and NPK fertilizer is an ideal option.

Assessing the effect of Farmyard Manure and NPK to leaf and sucker development.

Results indicated that there were an increase in the number of leaves in a combination of cattle manure and NPK fertilizers than in sole treatments. This is because the combination provided different nutrient requirements at different times that stimulated the growth and development of more leaves.

Also results from the experiment indicate that there was high development of the peepers at an average of 1.45 with cattle manure application. This is an indication that when cattle manure is well prepared and applied in the recommended rates, peepers can emerge early enough and establish the plantation which ensures sustainable production throughout the production cycle.

Therefore this research concludes that application of a combination of cattle manure and NPK fertilizer increases the number of leaves and the number of peepers on the banana stool.

Objective three assessed the effect of Farmyard Manure and NPK fertilizer application to hands formation on banana bunches.

Results indicated an increase in the number of hands in farms treated with NPK fertilizers. Hands increase with the recommended rates of application of NPK fertilizer when applied in the onset of the rains.

This experiment therefore concludes that application of NPK fertilizer leads to hands formation and bunch size development.

General conclusion

The above study show that both mineral fertilizers and organic manures have their own roles to play in soil fertility management but none can solely supply all the nutrients and other conditions of growth for producing banana yields. Increased growth and yield parameters in this study may be associated with the supply of essential nutrients by continuous supply of a combination of mineral fertilizers and farmyard manures. Therefore enhanced inherent nutrient supplying capacity of the soil and its favorable effect on soil physical and biological properties depends majorly on the different nutrient components that are present in the different types of fertilizers and hence a combination should be used during production in order to have increased banana yields. For this study therefore a combination of cattle manure and NPK was effective in improving banana yields.

Recommendations

Objective one assessed the effect of Farmyard Manure and NPK to plant girth and plant height as a contribution to proper growth.

Results findings indicated that better results were obtained on a combination of cattle manure and NPK fertilizers in increasing the size of the pseudo stem and plant height. The combined application of organic and inorganic Fertilizers should be recommended in banana production provide different nutrients to the soil hence ensuring increased yields.

This study recommends that a combination of cattle manure and NPK should always be used in banana plantation management especially in rehabilitation where the plantation has been neglected.

For the farmers involved in production of the banana crop, they should use cattle manure to enhance plant heights maiden suckers where a single fertilizers to be used in a pure application.

Plant girth of the Banana crop tends to increase when a combination of cattle manure and NPK is used and therefore basing on the results of this particular experiment, banana farmer in farming business should use a combination of cattle manure and NPK for better yields.

Assessing the effect of Farmyard Manure and NPK to leaf and sucker development,

Result findings indicated that the number of leaves can be obtained in a combination of fertilizers especially cattle manure and NPK fertilizers as results showed an increase of more than one leaf. Results further indicated an increase in the number of peepers.

This study recommends that farmers should adopt a combination of cattle manure and NPK fertilizers in order to increase banana leaves as they contribute a lot to hands formation and bunch size. For farmers whose plantations were destroyed by BBW, in order to rehabilitate their plantations they should apply a combination of cattle manure and NPK so that banana suckers can grow vigorously and cover up gaps.

For farmers intending to increase the number of planting materials NPK fertilizer can also be applied as it immersed second in increasing the number of peepers.

Assessing the effect of Farmyard Manure and NPK fertilizer application to Hands formation on banana bunches.

Results indicated better results with a single application of appropriate quantities of NPK especially in increasing in the number of hands.

This study recommends that farmers and all stake holders in banana plantation management should use a combination of cattle manure and NPK fertilizers for balanced results

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