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THE EFFECTS OF GRAFSOLO USE IN FERTILIZER DISTRIBUTION UNIFORMITY

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1. INTRODUCTION

Achieving high productivity in the agricultural sector is dependent on various factors. Among these, some are hard to control (or impossible, given the current technologies, or yet non-economic to control, in face of economic worth), weather and brightness level among them. Other factors are possible to control (among them the crop to be cultivated, its management, irrigation, fertilization, etc.). As production technology use gets optimized, some possible limiting factors on productivity become important, whereas previously, in less optimized systems, these same factors were not relevant and thus went uncontrolled. Therefore, fertilizer distribution uniformity gains agronomic interest in the current technological framework because it directly affects crop productivity since the technological level employed is high. In mechanized agriculture the distribution of seeds and fertilizers is done by machines. Seed distribution is performed avoiding faults and double seeding, and today such distribution is almost perfect to the point that plantings are almost uniform, though regarding some crops (corn and soybean among them), uniform distribution was only achieved through the use of seed lubrication, graphite in this case. As uniform seed distribution went much performed, fertilizer distribution also came to be studied, both from the viewpoint of improving distribution units as well as from better adapting fertilizers in order to improve distribution (granulation). Nonetheless, despite actual advances, the available machinery presents problems regarding fertilizer distribution uniformity, causing unequal quantities of the latter to be applied for the same distances, in addition to distribution pipe obstruction problems, related to fertilizer's grain shape and hygroscopicity (moisture absorbing ability). So as to remedy such deficiency, the effect of adding a solid lubricant to the fertilizer [graphite] was studied. Such study involved increasing

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graphite doses and their effects upon distribution uniformity and reduction of obstructions by assessing the variation of fertilizer quantities applied per square meter.

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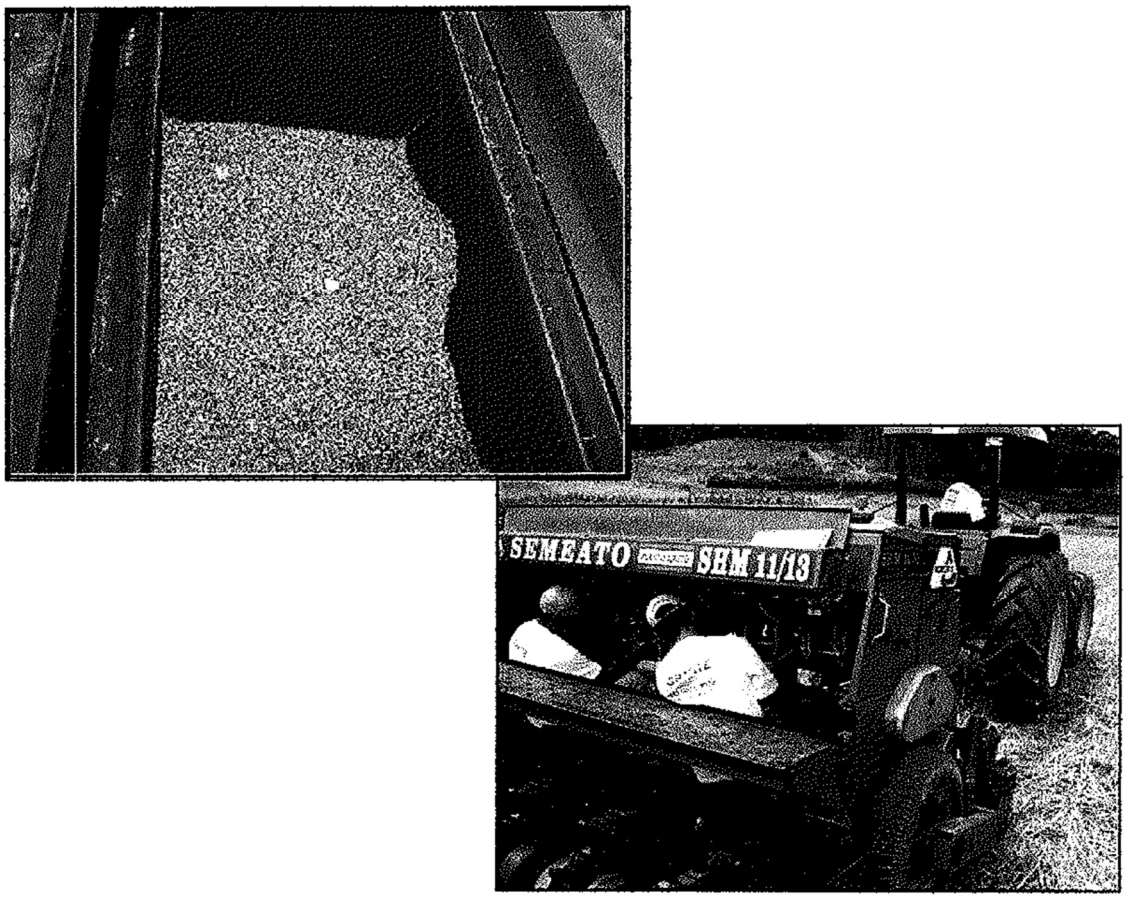
2. GOALS

To check whether the addition of graphite in fertilizers improves their distribution uniformity, at the same time diminishing pipe obstruction issues.



Checking whether the addition of graphite could improve distribution uniformity

3. MATERIAL AND METHODS

Fieldwork was developed in 2 phases. The first one through the addition of increasing Grafsolo doses in granulated, ground-grain and organomineral fertilizers, collecting the fertilizer in plastic bags following 15 repetitions for each dose and fertilizer, in the experimental Diogo Alves de Melo area located in UFV's Department of Phytotechnology Experimental Campus located at 20,45º S latitude and 42,51º W longitude geographical coordinates. The second corn farming phase making use of the Grafsolo dose resulted in greater distribution uniformity for the granulated fertilizer. In this phase - still in progress - the crop's agronomic characteristics shall be assessed. The specified experiments follow below.

3.1. Experiment 1

As mentioned before, this experiment sought to find out whether the addition of Grafsolo to fertilizers improves the distribution uniformity of the latter. The following methodology was followed:

1) Grafsolo was weighed in 50g quantities inside plastic bags, on a Filizola BP15 scales (photo 1), at a precision of +/- 5g, (photo 2);
2) The seed drill used was the Semeato SHM 11/13 for no-till farming (photo 3) driven by a four-wheel-drive John Deere 5.600 tractor (photo 4);
3) The seed runner was prepared by feeding in the granulated (photo 5), ground grain (photo 6) and organomineral (photo 7) fertilizers. The seed runner has got a total of 13 runners for fertilizer distribution, from which 4 runners were taken at randomly chosen positions (3rd, 6th, 8th and 11th) (photo 8). The seed runner was regulated for applying 22.5 g per meter of fertilizer, what would imply the collection of 900 grams of fertilizer on the four runners over the ten meters covered;
4) The person in charge of sample collecting was placed behind the fertilizer feed (photo 9). The runners were tied in pairs (3rd and 6th and 8th and 11th);
5) The experimental area was drilled each 10 m, totaling 15 repetitions (photo 10). The tractor was operated at normal working speed (4 to 5 km/h) and the fertilizer collected from each 10m space (photo 11). Samples were separated and weighed.
6) Data were analyzed statistically and interpreted.

3.2. EXPERIMENT 2

The research currently carried out at Coimbra's Experimental Station comprises corn farming making use of graphiteless mineral fertilizer dosed at 5 g per kg of fertilizer (the best dose as determined by experiment 1) and 10 g per kg (twice the best dose established). The experiment was installed in the area occupied by a permanent experiment (installed in 1985) and run up to present time. This experimental area consists of four randomized blocks and six soil preparation treatments, three of these deemed conventional (plowing by seed drills plus two smashing and leveling runners, plowing through disc harrows and two smashing/leveling and heavy-duty runners followed by two smashing/leveling runners, two systems considered to provide superpreparation treatment (heavy duty runners followed by seed drills, two smashing/leveling runners plus heavy-duty runners followed by disc harrows and two smashing/leveling runners) and a minimum cultivation system, direct sowing. The experiment for the verification of effects due to the use of graphite was performed in bands. Photos 12 to 18 show the procedure for corn farming. The experiment was implemented on 04/26/2008.

Results shall be collected regarding corn crop development and then submitted to a variance and means analysis in the end and finally compared by means of the Tukey test at 5% probability level.

4. RESULTS AND DISCUSSION

4.1 Experiment 1

Table 1 presents field results obtained for granulated fertilizer distribution, starting from not adding Grafsolo and increasingly applying amounts up to 10 g per kg. This table also displays the mean, standard deviation and variation coefficient for each dose tested.

Table 1. Results of grafoil addition to granular fertilizer formulation 8-28-16.

Repetition	Grafsolo dose g per kg										
	0	1	2	3	4	5	6	7	8	9	10
1	890	850	860	875	850	875	820	775	720	680	650
2	655	855	855	895	700	840	835	745	730	630	595
3	810	840	855	855	500	880	845	755	760	655	655
4	840	855	855	865	850	825	850	785	740	675	705
5	935	850	830	850	865	855	850	780	750	690	630
6	875	575	865	865	840	855	835	725	740	645	645
7	630	840	845	850	855	880	850	705	740	690	670
8	740	825	880	860	875	855	850	790	725	660	690
9	650	850	870	875	880	875	835	715	730	670	645
10	875	875	870	855	810	855	845	715	715	665	585
11	870	870	840	895	870	860	835	745	725	670	680
12	680	855	825	865	850	890	845	725	735	685	690
13	645	850	850	835	875	870	835	745	720	670	660
14	645	850	845	880	685	885	850	805	735	675	610
15	645	870	870	840	895	860	835	795	690	700	680
Total	11.385	12.510	12.815	12.960	12.200	12.960	12.615	11.305	10.955	10.060	9.790
Mean	759	834	854	864	813	864	841	754	730	671	653
σ	110	70,3	15	17,1	102,8	17	8,6	31,7	15,8	17,6	34,4
VC %	14,49	8,43	1,73	1,98	12,70	1,97	1,02	4,20	2,16	2,62	5,27

Table 1 demonstrates there was an effect from the addition of Grafsolo to the granulated fertilizer's distribution uniformity, it having been observed that the 5g per kg mixture resulted in the application of 864 grams of fertilizer, which is the closest value to the regulation made for applying 900 g over 40 meters. The addition of increasing Grafsolo doses resulted in better fertilizer distribution uniformity, something that became evident from the decrease in the variation coefficient. One also observes that Grafsolo doses above 6 g per kg resulted in a decrease in applied amounts as well as an increase in the variation coefficient, that is, increased application non-uniformity. The

results presented above demonstrate that the best Grafsolo dose to be mixed to the granulated fertilizer is 5 g per kg since it resulted in the best proximity of the applied value to the value set on the machine, that took place at a low variation coefficient, that is, at good distribution uniformity.

Table 2 presents the field results obtained for the distribution of the bulk fertilizer starting from not adding grafoil and increasing the amount applied up to 5 g per kg. An addition of 25 g per kg was also made due to the addition of up to 5 g per kg having shown no effect over applied amounts and uniformity. This table also shows the mean, standard deviation and variation coefficient for each dose tested.

Table 2. Results of Grafsolo addition to plain bran fertilizer and superphosphate.

	Grafsolo dose g per kg						
Repetition	0	1	2	3	4	5	6
1	70	40	45	25	20	20	20
2	65	25	50	25	40	15	20
3	55	65	40	20	35	25	25
4	50	40	35	15	55	15	25
5	70	90	50	30	35	70	85
6	45	30	25	15	20	30	30
7	45	25	35	20	25	30	15
8	55	40	85	45	170	20	10
9	90	20	40	20	40	75	20
10	45	55	125	30	30	65	70
11	40	25	45	15	20	15	25
12	70	25	30	70	25	20	15
13	35	15	35	45	40	15	60
14	150	40	65	90	20	20	20
15	60	20	80	15	20	15	40
Total	945	555	785	480	595	450	480
Mean	118,125	69,375	98,125	60	74,375	56,25	60

Upon observing Table 2, one verifies there was no effect from the addition of Grafsolo to applied fertilizer amounts, as well as there was no effect over application uniformity. These results were expected since the machine's distribution system used was deemed suitable for the application of granulated, non-bran fertilizer, a kind of fertilizer which requires a different distribution system, whose process is being discontinued. In view of the above, these results have not been assessed.

Table 3 presents field results obtained for the organomineral fertilizer distribution, starting from not adding grafoil and increasing applied amounts up to 10 g per kg. This table also displays mean, standard deviation and variation coefficient for each dose tested.

Table 3. Results of grafoil addition to organomineral fertilizer.

Repetition	Grafsolo dose g per 60kg					
	0	100	200	300	400	500
1	480	475	495	510	490	480
2	490	485	505	485	495	490
3	460	490	490	495	485	460
4	520	490	490	495	460	520
5	500	490	495	500	485	500
6	450	500	490	500	490	450
7	490	490	490	490	505	490
8	500	490	485	500	480	500
9	480	470	480	490	495	480
10	495	495	485	485	495	495
11	450	495	480	485	470	450
12	495	475	485	505	485	495
13	495	470	480	490	505	495
14	450	490	485	505	500	450
15	495	490	485	490	490	495
Total	7250	7295	7320	7425	7330	7250
Mean	483	486	488	495	489	483
σ	20,71	9,03	6,53	7,75	11,76	10,78
VC %	4,29	1,86	1,34	1,6	2,40	2,15

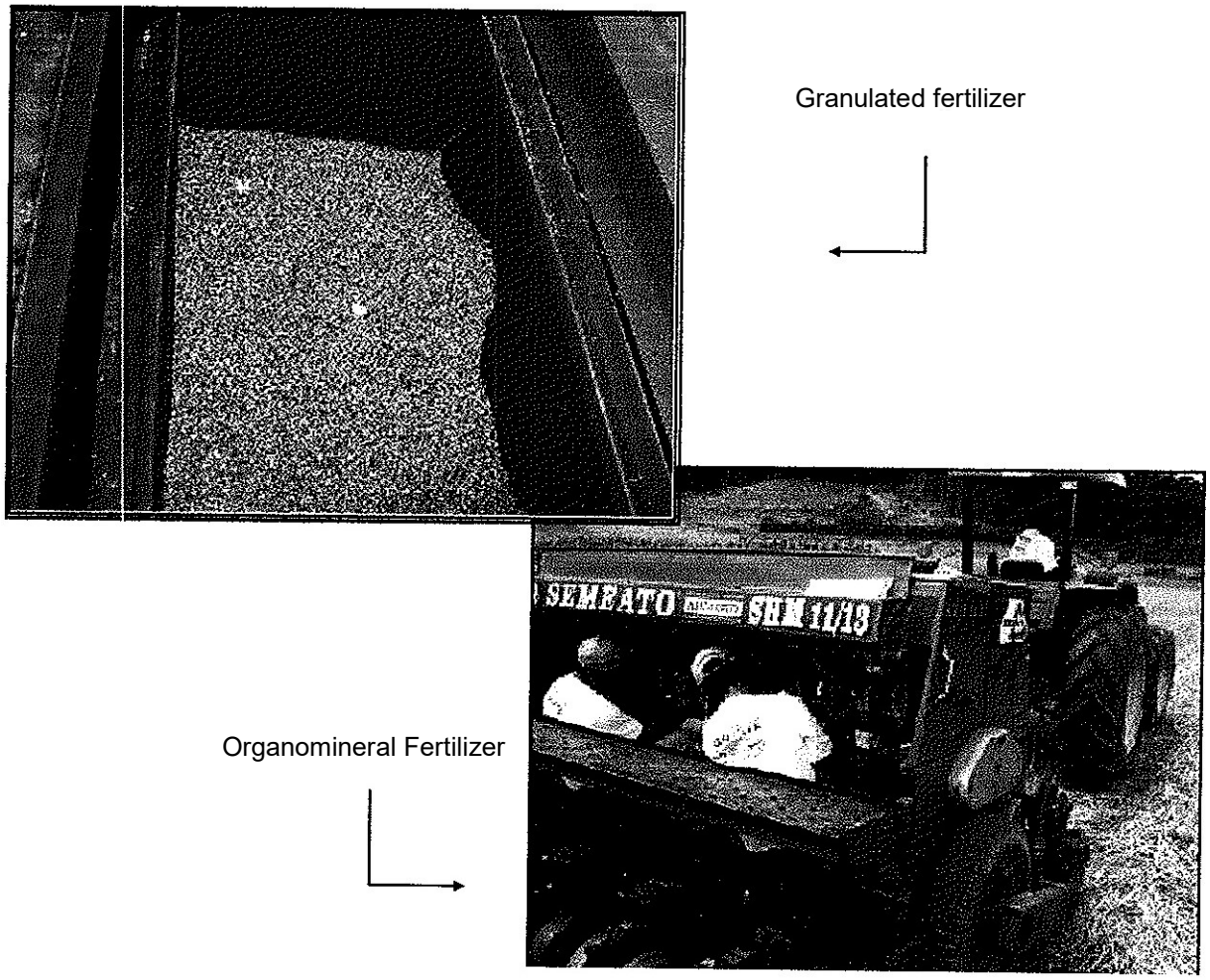
Table 3 shows there was a small effect from Grafsolo addition regarding amounts and distribution uniformity for the organomineral fertilizer. It was verified that a mixture of 5 g per kg (300 g 60 per kg) resulted in the application of 495 fertilizer grams, which is the closest value to the regulation made for the applying 500 g over 40 meters. The addition of increasing Grafsolo doses up to the value of 5 g per kg resulted in better fertilizer distribution uniformity, something that was made evident by a decrease in the variation coefficient. One also observes that Grafsolo doses above 6 g per kg resulted in a decrease in applied amounts as the variation coefficient increased, that is, application non-uniformity increased. The results presented above demonstrate that the

best Grafsolo dose to be mixed with the organomineral fertilizer is 5 g per kg, since it resulted in the best proximity of applied values to the ones set in the machine and this at low variation coefficients at good distribution uniformity.

For granular and organomineral fertilizers, and mainly for the former, graphite addition has reduced obstruction problems in fertilizer conduction pipes, thus reducing the need for equipment downtimes. With respect to the organomineral fertilizer, this effect was not very pronounced, whereas for grapes, although Grafsolo addition resulted in no pipe obstruction, applied amounts were very different from calibrated standards, and it's not recommended to apply such fertilizer type to the machine system employed in the experiment. Experiments carried on machines suitable for bran-type fertilizer application becomes necessary in order to ascertain the effects of Grafsolo addition to this type of fertilizer.

5. CONCLUSIONS

The addition of Grafsolo to granular and organomineral fertilizers resulted in greater applied amounts precision as well as better distribution uniformity. The best dose for both fertilizers was Grafsolo at 5 g per kg and it should be recommended for field application. Grafsolo addition also reduced pipe obstruction, eliminating the need for stopping them, what stresses Grafsolo's addition recommendation to fertilizers.



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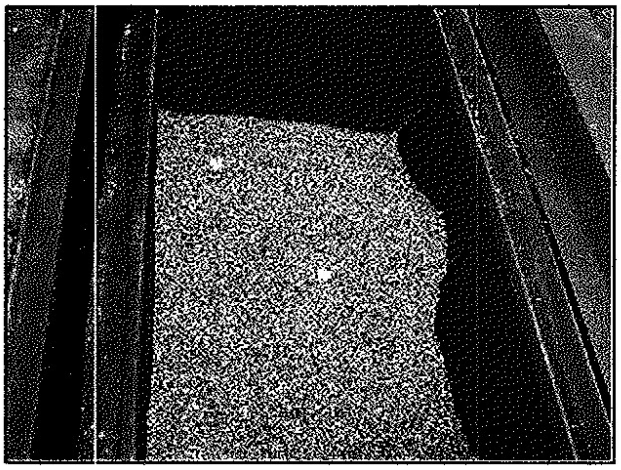
6. PHOTOGRAPHIC RECORDS

Filizola BP15 scales at +/ - 5g precision **(Photo 1)**

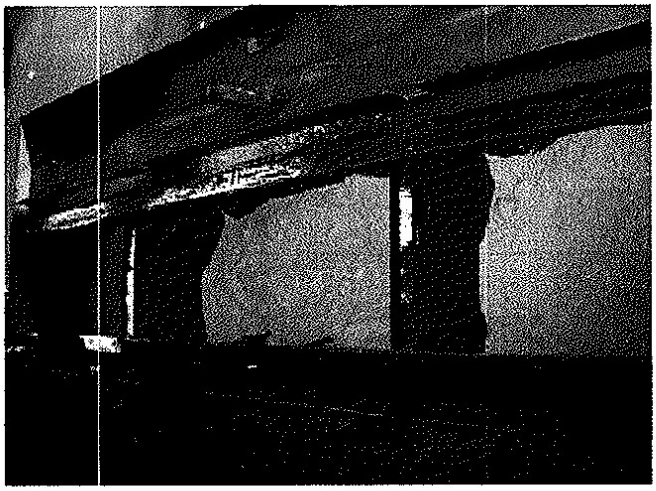
Plastic bags **(Photo 2)**

Seeding machine used - Semeato SHM 11 / 13 for no-till farming **(Photo 3)**

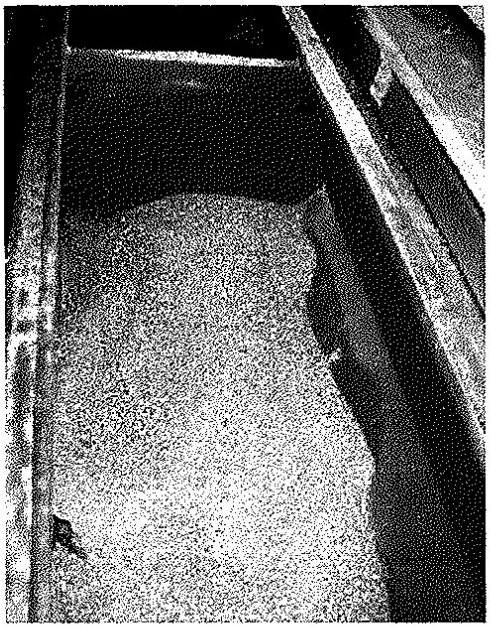
4-wheel-drive John Deere 5.600 Tractor **(Photo 4)**



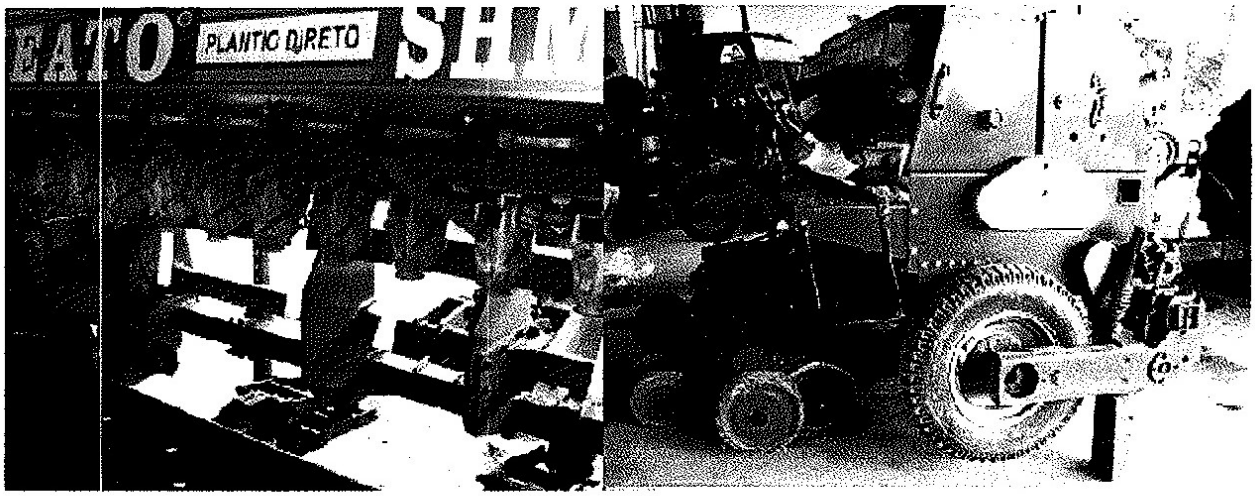
Granulated fertilizer **(Photo 5)**



Bran-type Fertilizer **(Photo 6)**



Organomineral fertilizer **(Photo 7)**



The seed drill has a total of 13 runners for fertilizer distribution from which 4 were taken at randomly chosen positions (3rd, 6th, 8th and 11th) **(Photo 8)**

Personnel in charge of sample collecting were positioned behind the fertilizer distribution operation **(Photo 9).** Runners were tied in pairs (3rd and 6th and 8th and 11th).

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Experimental area was drilled every 10 meters, totaling 15 repetitions **(Photo 10)**

Tractor operated at normal working speed (4 to 5 km/h) and fertilizer was collected each 10 m **(Photo 11)**

SIGNATURES

Nacional de Grafite LTDA

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Subject Matter: Soil and Water Management and Conservation
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