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DECOMPOSITION OF OAT STRAW AND RELEASE OF MACRONUTRIENTS IN DIFFERENT MANAGEMENTS

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ABSTRACT - The present work was aimed in order to evaluate the decomposition process of remaining straw from oat cultivars submitted to different handling during the cultivation of corn for silage intercropped with *Urochloa brizantha* cv. MG13 Braúna. We considered nine oat cultivars named as follows: "IAPAR 61 IBIPORÃ" oat hay (61F), "IAPAR 61 IBIPORÃ" pasture (61P), "IAPAR 61 IBIPORÃ" cover crop (61SM), "Embrapa 139 (Fog)" oat hay (139F),"Embrapa 139 (Fog)" pasture (139P)," Embrapa 139 (Fog)" cover crop (139SM), "Emerald IPR 126" oat hay (EF), "Emerald IPR 126" grazed (EP) and "Emerald IPR 126" cover crop (ESM) from which we evaluated the decomposition of the remaining straw using the method of litter bags. The evaluations were carried out at 0, 15, 30, 60, 90 and 108 days after sowing corn for silage intercropped with *Brizantha brachiaria* cv. MG13 Braúna (*Urochloa brizantha*). Every oat cultivar had three repetitions arranged in a split-plot design. We took into account the quantity of straw, organic matter, carbon, nitrogen, carbon / nitrogen ratio, phosphorus and potassium. The results we got clarify that oat decomposition rate varied with the meteorological factors and initial mass, so that the greater the initial mass is, the longer the straw permanency and mulch effectiveness on the soil. The time the residual oat straw took to be decomposed depended on meteorological factors both during the cover crop developmental stage and the decomposition period itself. The higher the initial mass, the greater the time and effectiveness of mulching.
Keywords: *Avena sativa*, *Avena strigosa*, nutrients releasing, forage management.

DECOMPOSIÇÃO E LIBERAÇÃO DE MACRONUTRIENTES EM AVEIA SOB DIFERENTES MANEJOS

RESUMO - O objetivo do presente trabalho foi o de avaliar o processo de decomposição da palhada remanescente de cultivares de aveia submetidas a manejos no decorrer do cultivo de milho para silagem consorciado com *Urochloa brizantha* cv. MG13 Braúna. O experimento consistiu da avaliação da decomposição da palhada residual de aveia, cultivares "IAPAR 61 IBIPORÃ" fenado (61F), "IAPAR 61 IBIPORÃ" pastejado (61P), "IAPAR 61 IBIPORÃ" para cobertura (61SM), "Embrapa 139 (Fog)" fenado (139F), "Embrapa 139 (Fog)" pastejado (139P), "Embrapa 139 (Fog)" para cobertura (139SM), "Emerald IPR 126" fenado (EF), "Emerald IPR 126" pastejado (EP) e "Emerald IPR 126" para cobertura (ESM), através do método de sacos de decomposição (*litter bags*). Tais avaliações foram efetuadas no decorrer do tempo (0, 15, 30, 60, 90, 108 dias após a semeadura) de cultivo da cultura de milho para ensilagem consorciado com *Urochloa brizantha* cv. MG13 Braúna, com três repetições cada, seguindo assim um modelo de parcelas subdivididas no tempo. Avaliou-se a quantidade de palhada residual, matéria orgânica, carbono, nitrogênio, relação carbono/nitrogênio, fósforo e potássio. Os resultados obtidos permitem afirmar que a taxa de decomposição da aveia foi dependente de fatores meteorológicos e de sua massa inicial, de maneira que quanto maior foi a sua massa inicial, maior foi o tempo e a efetividade de cobertura morta sobre o solo. O tempo de decomposição da palha residual da aveia é dependente de fatores meteorológicos, tanto na fase de desenvolvimento da planta de cobertura bem como no período de decomposição. Quanto maior for a sua massa inicial, maior será o tempo e efetividade de cobertura morta da mesma.
Palavras-chaves: *Avena sativa*, *Avena strigosa*, liberação de nutrientes, manejo de forragem.

INTRODUCTION

The integrated crop-livestock farming (CLF) aims at synergy between agriculture and livestock with a view at maintaining a balance for both activities for a combination that better respond, efficiently and sustainably, as time passes by (BUNGENSTAB et al., 2019). In accordance with Alvarenga et al. (2007) such objectives are viable once CLF allows economical exploration of soil throughout the year. Furthermore, the implementation of CLF system requires some measures which enable soil conservation and adequacy to the cultivation from which it is possible to increase soil quality, improving water and nutrients dynamic through

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the soil profile (BUNGENSTAB et al., 2019; MATTEI et al., 2020).

Considering that Brazil is one of the greatest worldwide agricultural producers and the growing global awareness towards environmental questions, CLF system is becoming an interesting option to attend both demands productive and environmental in Brazilian territory. Oat (*Avena sativa* L.) has been used as the mayor Poaceae specie in CLF systems in **s**outh Brazil and it is characterized as a winter annual forage specie adaptable to the climatic conditions of this region. Oat presents great productive income and quality (MATTEI et al., 2020).

The use of oat as forage in CLF systems is a suitable option since this crop presents drought resistance, fast development and efficient mulching. Its rapid growth and tillering associated to the great development of superficial root promotes better conditions to physical structure and thermo-hydric dynamic in soil (PIANO et al., 2017). It is worthy to point out oat as a means to proportionate allelopathic benefits which suppresses weeds and contributes to maximize their control to the following crops. In addition, oat holds a great source of nutrients to be released for the subsequent crops mainly under tropical weather conditions which is recognized by high temperatures, humidity and intense rainfall, factors that accelerate decomposition of residues (PIANO et al., 2017; MATTEI et al., 2018; VENGEN et al., 2020). Poaceae species present higher carbon-nitrogen ration (C/N) compared to Fabaceae ones ending up with a lower decomposition rate that leads to a better mulching (CRUSCIOL et al., 2008; MATTEI et al., 2018; VENGEN et al., 2020).

The prediction on how well the implementation of CLF system will be depends on many factors, regardless to property size (PIANO et al., 2017). One of them is to find a forage biomass level proper for livestock that simultaneously allows suitable conditions for the following grain crop growing. Having this in mind, mulching decomposition time is a very important factor to be taken into consideration for the best development of the following crop through direct seeding (TERRA LOPES et al., 2009).

Residue decomposition is performed specially by soil microorganisms and has its speed altered by several factors such as nitrogen concentration, the contact between residue and soil, hydric regime, soil temperature, C/N ratio and more (ACOSTA et al., 2014; MATTEI et al., 2018; GONÇALVES et al., 2019). Acosta et al. (2014) observed that the decomposition of black oat, fava bean and wild radish under no tillage system revealed noninfluence of biomass amount of fava bean and wild radish on their respective decomposition rate. The authors attributed these results to the adaptability of microorganisms to a higher offer of carbon, having no limiting conditions for humidity and temperature. Also, there was low decomposition rate associated to higher residue introduced by black oat.

Rossi et al. (2013) evaluated the decomposition of mixed crops, *Brachiaria* + soybean and sorghum + soybean. They noticed lower $T^{1/2}$ for dry matter under rainy period compared to the dry one which led them to conclude that higher rain levels speed up decomposition process by favoring microorganism activity.

Good results derived from no tillage system is directly related to the maintenance of mulching and that's why studies concerning to the decomposition dynamic and nutrients releasing is more than important. In the light of this, the present work aimed to evaluate the remaining straw decomposition and macronutrients releasing from different oat cultivars submitted to different managements throughout the intercropped cultivation between corn silage and *Urochloa brizantha*.

MATERIAL AND METHODS

This work was carried out under field conditions at an experimental field named after "Professor Antonio Carlos dos Santos Pessoa" (latitude 24º 33' 22" S and longitude 54º 03' 24" W, 400 m a.s.l) belonging to the State University of West Paraná (Unioeste) - *Campus* Marechal Cândido Rondon, Paraná State, from April 2017 to May 2018, whose soil was classified as being Eutroferric Red Latosol (LVef) with clayey texture and great drainage (SANTOS et al., 2018).

Chemical and soil granulometry before the experiment establishment is presented on Table 1, as follows.

TABLE 1 - Chemical characteristics and soil granulometry previous to the winter crops implementation.

Layers	P	pH	H+Al	Al^{3+}	K^+	Ca^{2+}	Mg^{2+}	BS	CEC	V
cm	mg dm^{-3}	$CaCl_2$		----------------------		cmol$_c$ dm^{-3}	-------------------			%
0 - 10	22.85	4.40	4.69	0.00	0.27	3.27	1.40	4.94	9.57	51.62
10 - 20	30.38	4.40	4.60	0.35	0.15	3.37	1.40	4.92	10.38	47.40

Mehlich Extractant $^{-1}$; Al, Ca and Mg = KCl 1 mol L^{-1}; H+Al = pH-SMP (7.5).

According to Köppen, the climate of this region is classified as *Cfa*, humid temperate climate with hot summer and rainfall well spread throughout the year. Besides, Nitsche et al. (2019) point media temperatures for the colder trimester ranging from 17 to 18ºC while the hotter one varies from 28 to 29ºC. Its medium annual temperature is around 22.5ºC. The same authors classified the annual pluvial raining normal media ranging from 1600 to 1800 mm and the more humid trimester presents total rainfall from 400 to 500 mm.

Meteorological data for pluvial raining, minimum, medium and maximum temperatures relative to the time this work lasted were obtained from the Automatic Climatological Station of the Experimental Stations Nucleus of Unioeste, *Campus* Marechal Cândido Rondon, located at 100 m from the experimental area and presented by Figure 1.

The following oat cultivars "IAPAR 61 IBIPORÃ" oat hay (61F), "IAPAR 61 IBIPORÃ" pasture (61P), "IAPAR 61 IBIPORÃ" cover crop (61SM), "Embrapa 139 (Fog)" oat hay (139F),"Embrapa 139 (Fog)" pasture (139P)," Embrapa 139 (Fog)" cover crop (139SM), "Emerald IPR 126" oat hay (EF), "Emerald IPR 126" grazed (EP) and "Emerald IPR 126" cover crop (ESM) were evaluated by the decomposition of their remaining straw using the *litter bags* method.

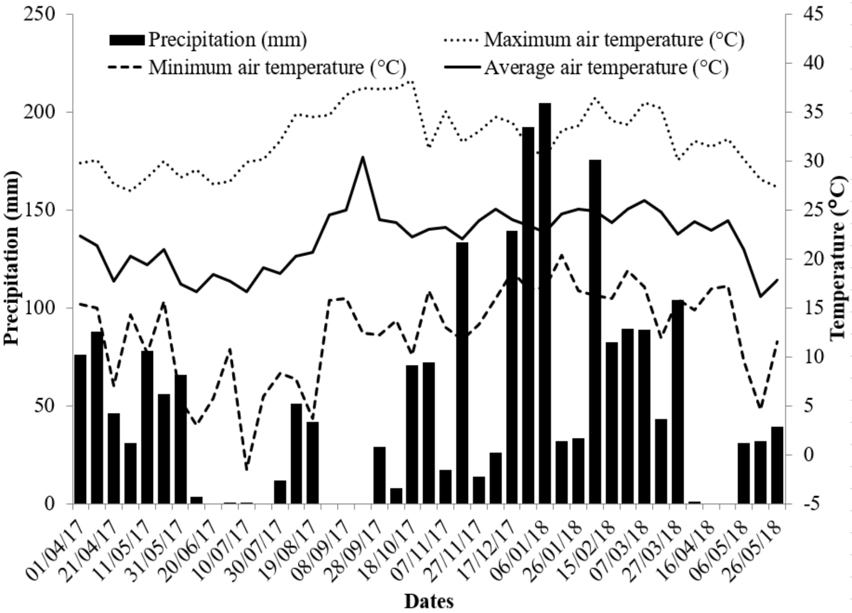

FIGURE 1 - Media of accumulated rainfall; maximum, minimum and medium temperatures at every other 10 days from April, 2017 to May, 2018.

The experiment which generated the decomposition material followed a strip-block scheme, repeated in four blocks. Three oat cultivars were sowed separately in the first set of three strips (12 x 16 m). The first one held the white oat cv. "Emerald IPR 126"; the second held the black oat cv. "IAPAR 61 IBIPORÃ"; the third stripe held the black oat cv. "Embrapa 139 (Fog)". The second set the three stripes of which were transversal to the first one, 4 x 36 m each, were submitted to different managements: cutting for haymaking, pasture and for the formation of remaining straw (not using the forage). Therefore, nine different residues were obtained.

The oat cultivar "Emerald IPR 126" has early cycle until flowering (about 96 days), with an average potential yield of 7182 kg ha^{-1} of dry matter (IAPAR, 2020a). Whereas the black oat cultivar "IAPAR 61 IBIPORÃ" holds a late cycle (about 134 days from emergence to the full emission of panicles), with an average potential yield of 8359 kg ha^{-1} of dry matter (IAPAR, 2020b). And finally, the black oat cultivar "Embrapa 139 (Fog)" has a long cycle (about 125 to 155 days from emergence to maturation), with medium potential yield of 6746 kg ha^{-1} of dry matter (EMBRAPA, 2020).

The above-mentioned cultivars were mechanically sowed at the beginning of the second fortnight of April, 2017, row spacing of 17 cm, and fertilized with 200 kg ha^{-1} of a 10-15-15 formula. Passed 30 days from germination we performed top dressing using 90 kg ha^{-1} of nitrogen (urea). Pasture management was done on the second fortnight of July, 2017 with pregnant Holstein dairy cows whose medium weight is about 650 kg and forage height for animal removal from 0.15 to 0.2m. On the first fortnight of August, 2017 the initial step for haymaking was done in which all the aerial part above 10 cm was removed.

In the summer cycle we mechanically sowed the CD384PW maize hybrid cultivar. Also, *Brachiaria brizantha* MG13 Braúna (*Urochloa brizantha*) was early sowed through throwing about 6 kg ha^{-1} of seeds to be intercropped with corn. Both sowings occurred at 4th October 2017. Basal fertilization of corn crop took 350 kg ha^{-1} of the formula 10-15-15 (N, P_2O_5 and K_2O). Subsequently, supplemental nitrogen fertilization was carried out with two doses of 90 kg ha^{-1} of urea each during the developmental stages of V4 and V8 (20 and 35 days after sowing, respectively). As soon as corn was harvested there was another dose applied in the same amount to make brachiaria tiller and develop.

In order to estimate the amount of initial residual straw deposited per hectare by the cultivars with all the respective managements a collection of initial residual straw was performed one week before corn sowing by throwing a metal square of 0.25 m². The square was randomly thrown in each plot and all the straw contained inside it was collected. After collection, the material was submitted to drying in an oven under forced air ventilation at a temperature of 55ºC to reach constant weight. Then, samples were weighed and the amounts of initial residual straw per hectare were estimated.

For the evaluation of straw decomposition rate to occur the source material was collected one week before intercropping corn with *Brachiaria brizantha*. The samples were homogenized and also dried in an oven. Then stored in litter bags composed of nylon mesh (20x30 cm) organized in three repetitions with an initial residual mass around 20 to 30 g, which were placed in the field right after the intercropped sowing of corn and brachiaria. They were collected passed 0, 15, 30, 60, 90 and 108 days from corn sowing that is to say from sowing to the harvest. The decomposition rate was calculated through the difference between the initial dry matter content and the dry mass measurements for each collection period.

The vegetal material was dried and weighted together with the litter bags. Also, the decomposition rate and the amount of straw remaining per hectare, expressed by kg ha^{-1}, were measured. Later the samples of the vegetal material were ground using a Willey mill and had their concentrations of organic matter (OM), nitrogen (N), phosphorus (P), potassium (K) and carbon/nitrogen ratio (C/N) determined. Finally, the amounts contained in the decaying material were determined and expressed in megagrams per hectare for the organic matter and in kg ha^{-1} for N, P and K.

Carbon concentration derived from the measurement of organic matter through a muffle furnace as describe by Silva and Queiroz (2006). In order to estimate C concentration, the results of organic matter were divided by 1.72 as suggested by Peixoto et al. (2007). Further elements were quantified after sulfuric digestion process from which N content was obtained by distillation using the semimicro-Kjeldahl method. On the other hand, P content was determined by spectrophotometry and K content by flame photometry (EMBRAPA, 2011).

The experiment on decomposition followed the statistical model of split-plot over time. There were nine treatments with three replications each considering all six periods summing up 162 parcels. Data were submitted to variance analysis through the F test ($p < 0.05$) using SISVAR statistical program (FERREIRA, 2011). In case of significance, we chose a mathematical model based on the equation parameters significance and on determination coefficient (R^2), which indicates the level of association between the observed values and the adjusted model. We set the equations using SigmaPlot®13 Software.

RESULTS AND DISCUSSION

We observed significant differences for all parameters observed ($p < 0.05$), the kind of remaining straw, the periods and their interaction. These results are shown from Fig. 2 to Fig. 7 with their respective mathematical model. “Emerald IPR 126” cover crop presented the highest quantity of remaining straw (7.29 mg ha^{-1}) throughout the experiment. Other treatments displayed values for the remaining straw ranging from 0,49 to 2,99 mg ha^{-1} at the beginning of corn cultivation (Figure 2).

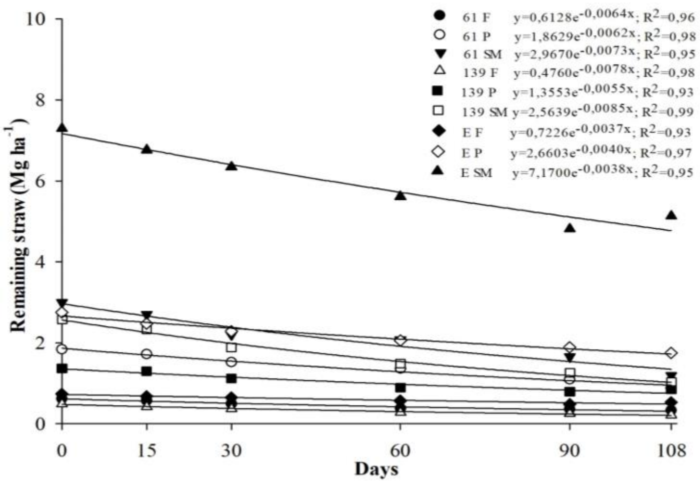

FIGURE 2 - Oat remaining straw (mg ha^{-1}) during the cultivation of corn silage intercropped with brachiaria; “IAPAR 61 IBIPORÃ” oat hay (61F), “IAPAR 61 IBIPORÃ” pasture (61P), “IAPAR 61 IBIPORÃ” cover crop (61SM), “Embrapa 139 (Fog)” oat hay (139F), “Embrapa 139 (Fog)” pasture (139P), “Embrapa 139 (Fog)” cover crop (139SM), “Emerald IPR 126” oat hay (EF), “Emerald IPR 126” pasture (EP) and “Emerald IPR 126” cover crop (ESM).

All oat cultivars we tested present different growth cycle (IAPAR, 2020a; IAPAR, 2020b; EMBRAPA, 2020) of which "Emerald IPR 126" is the most precocious one leading to a faster growth. Cultivars were sowed between April and June, period in which there was suitable water availability (Figure 1). Taking these facts into account it is easy to understand why "Emerald IPR 126" reached higher dry matter content once it grew during plenty water availability.

Other cultivars hold a slower growth cycle therefore their peak of growth matched a period of water scarcity that is to say from July to September (Figure 1) ending up with restricted development. This way, rainfall regime during oat cultivation implied the highest initial mass exhibited by “Emerald IPR 126” (7.29 Mg ha^{-1}) and, based on literature, the smaller-than-expected mass shown by “IAPAR 61 IBIPORÃ” (2.99 Mg ha^{-1}) and “Embrapa 139 (Fog)” (2.58 Mg ha^{-1}).

Although the managements had been carried out at the same time for all cultivars they were under distinct phenological stage as a consequence of the time they need to complete their growth cycle (IAPAR, 2020a; IAPAR, 2020b; EMBRAPA, 2020) thus “Emerald IPR 126” would have been at a stage more advanced. “IAPAR 61 IBIPORÃ” and “Embrapa 139 (Fog)” faced the managements at earlier stages which influenced their growth greatly.

Other important fact comes to the limited ability “IAPAR 61 IBIPORÃ” and “Embrapa 139 (Fog)” showed concerning to the recovery from water stress even though both cultivars present great genetic potential for recovery and mass formation after different pasture management events (IAPAR, 2020a; IAPAR, 2020b; EMBRAPA, 2020). This is the reason why they could not overcome “Emerald IPR 126” outcome nor to be even.

The materials the decomposition rate of which was evaluated presented a high degree of senescence due to the strong water deficit they suffered at the end of their cycles (Figure 1) what probably affected the release of many nutrients being similar to the findings of Piano et al. (2017) mainly when it comes to carbon concentration and its structure once C is involved with plant structure during this period (CASTAGNARA et al., 2014).

It is possible to notice how the values of remaining straw and of organic matter are strongly related (Figure 2 and 3) once both of them presented a continuous and progressive decrease over time in all remaining straw evaluated. It clarifies that decomposition process was stable for all cultivars and managements studied. Thus, it can be assumed that the release of minerals held in the vegetal residue is also released continuously and concomitantly with decomposition.

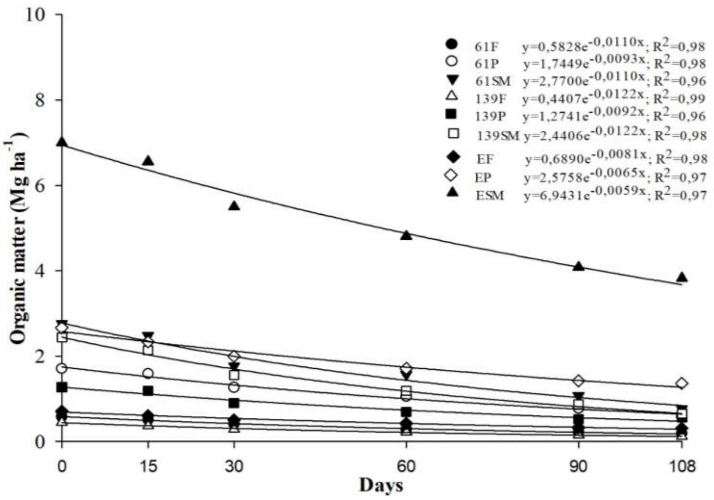

FIGURE 3 - Organic matter (mg ha^{-1}) from oat remaining straw during the cultivation of corn silage intercropped with brachiaria; “IAPAR 61 IBIPORÃ” oat hay (61F), “IAPAR 61 IBIPORÃ” pasture (61P), “IAPAR 61 IBIPORÃ” cover crop (61SM), “Embrapa 139 (Fog)” oat hay (139F), “Embrapa 139 (Fog)” pasture (139P), “Embrapa 139 (Fog)” cover crop (139SM), “Emerald IPR 126” oat hay (EF), “Emerald IPR 126” pasture (EP) and “Emerald IPR 126” cover crop (ESM).

The comparison between the initial matter content and the final one for the white oat cultivar "Emerald IPR 126" differed according to the management, it is to say, 28.73% for oat hay, 28.73% for pasture and 36.38% without management. In turn, the black oat cultivar “Embrapa 139 (Fog)” displayed values of 56.56%, 36.94% and 59.92%, which were respective to the managements above-mentioned. Likewise, the black oat cultivar “IAPAR 61 IBIPORÃ” reached values of 46.92%, 52.45% and 60.14%, respectively.

This demonstrates that despite the quick decrease in the remaining straw, the material with greater volume had a lower decomposition rate (ESM - "Emerald IPR 126" without management) and it provided more effective mulching to protect soil from erosion. Thus, as this treatment had high amount of initial straw it kept the soil covered for longer accumulating more moisture and favoring the performance of microbiota and mesofauna.

With regards to plant material decomposition, it depends on several factors including the nature of the material itself, its volume, the handling given to it, soil fertility and climatic conditions, mainly soil moisture and rainfall. These factors interact and interfere with soil microbiota enhancing the interaction with the mesofauna which acts predominantly in the initial stages of plant material degradation exposing it to greater contact with soil microbial biomass (ALVARENGA et al., 2001; GONÇALVES et al., 2019).

Figure 4 shows how the remaining amount of N was quite variable between treatments, both for the evaluation periods and the reduction rates. It can be associated with the management of nitrogen fertilization as soil microorganisms absorb nitrogen from the environment in order to maximize the decomposition of grass straw. Another factor is nitrogen fertilization through urea which is not always efficient because losses may occur due to edaphoclimatic factors such as soil moisture and solar radiation incidence and, to a lesser extent, the interaction between soil microbiota and the decomposed organic material. Therefore, under some conditions, straw maintains moisture, reduces the loss of N and retains part of the N while mulching soil preventing it from direct solar radiation.

Analyzing the scattered values of the C/N ratio (Figure 5) together with Figures 1 and 2 it is possible to indicate that edaphoclimatic conditions affected the C/N ratio of the source material over time. This variation may be indirectly related to the amount of material produced (Figure 2 and 5), the greater the initial volume of remaining straw is the greater the oscillation of C/N ratio will be. Another condition that may be related to the dispersion of C/N values over time, especially in treatments with greater initial mass, is the interaction between brachiaria and remaining nitrogen applied as top dressing on corn (Figure 4 and 5). Thus, greater mulching can derive from various mechanisms which retain soil moisture for a longer time, retaining and reducing N losses and its interference with the dynamic of material decomposition.

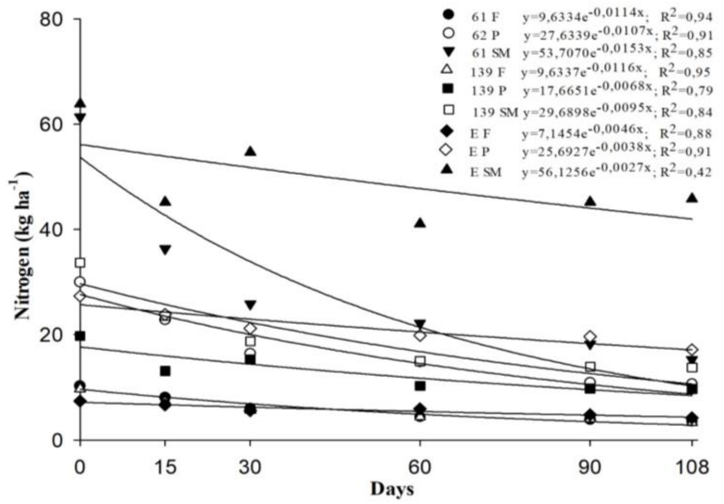

FIGURE 4 - Total amount of nitrogen (kg ha^{-1}) from oat remaining straw during the cultivation of corn silage intercropped with brachiaria; “IAPAR 61 IBIPORÃ” oat hay (61F), “IAPAR 61 IBIPORÃ” pasture (61P), “IAPAR 61 IBIPORÃ” cover crop (61SM), “Embrapa 139 (Fog)” oat hay (139F), “Embrapa 139 (Fog)” pasture (139P), “Embrapa 139 (Fog)” cover crop (139SM), “Emerald IPR 126” oat hay (EF), “Emerald IPR 126” pasture (EP) and “Emerald IPR 126” cover crop (ESM).

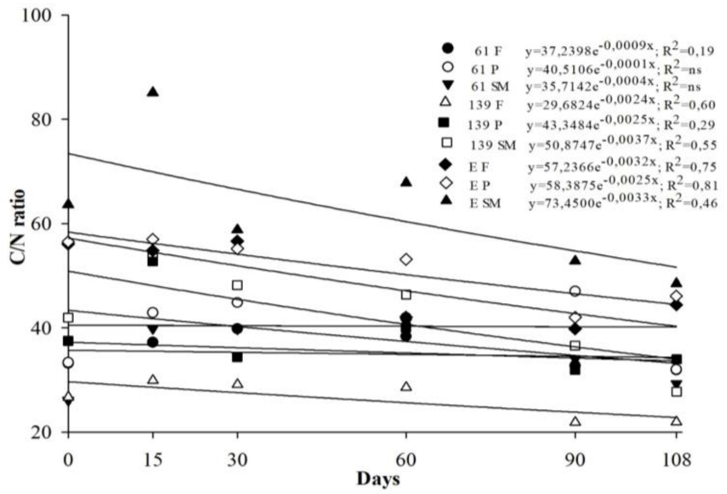

FIGURE 5 - C/N ratio from oat remaining straw during the cultivation of corn silage intercropped with brachiaria; “IAPAR 61 IBIPORÃ” oat hay (61F), “IAPAR 61 IBIPORÃ” pasture (61P), “IAPAR 61 IBIPORÃ” cover crop (61SM), “Embrapa 139 (Fog)” oat hay (139F), “Embrapa 139 (Fog)” pasture (139P), “Embrapa 139 (Fog)” cover crop (139SM), “Emerald IPR 126” oat hay (EF), “Emerald IPR 126” pasture (EP) and “Emerald IPR 126” cover crop (ESM).

The time crop residues keep on the surface of the soil is directly affected by their decomposition rate. Thus, the faster the decomposition, the less protection the material offers to the soil, on the other hand there is an increase in the release of nutrients retained in the material. Such speed is mainly associated with lignin content and C/N ratio of the residual material, the higher both are, the longer will be the time for their decomposition (AITA; GIACOMINI, 2003; TORRES et al., 2008; ACOSTA et al., 2014; GONÇALVES et al., 2019; VENGEN et al., 2020).

The amount of P retained in the residues over time changed more in the treatment with greater volume of straw on the ground (Figure 6), taking into consideration the R^2 of the equation corresponding to that treatment. This result indirectly suggests that P showed an irregular release over time and may have suffered interference from meteorological factors, especially during the cover crop development cycle as well as from the dynamics of other nutrients present in soil with the remaining straw. In the case of P, it is associated with many organic components of cellular tissues (TAIZ et al., 2017). It's worthy to remember that P decomposition process which carried out by microorganisms is directly related to its release (GIACOMINI et al., 2003). Added to this, mineral form of P is highly immobile in the soil being quickly adsorbed by the soil. Thus, nutrient cycling becomes an important source for preserving its availability.

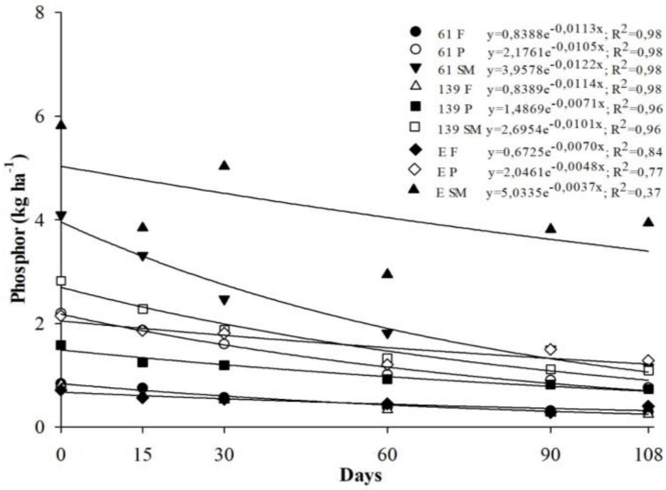

FIGURE 6 - Total amount of phosphorus (kg ha^{-1}) from oat remaining straw during the cultivation of corn silage intercropped with brachiaria; "IAPAR 61 IBIPORÃ" oat hay (61F), "IAPAR 61 IBIPORÃ" pasture (61P), "IAPAR 61 IBIPORÃ" cover crop (61SM), "Embrapa 139 (Fog)" oat hay (139F), "Embrapa 139 (Fog)" pasture (139P), "Embrapa 139 (Fog)" cover crop (139SM), "Emerald IPR 126" oat hay (EF), "Emerald IPR 126" pasture (EP) and "Emerald IPR 126" cover crop (ESM).

Figure 7 shows that there was not a large decline in total K contents even though the opposite was found by Piano et al. (2017). Some possible reasons include the premature senescence plants went into and the extreme mobility K presents in soil so it was likely to be leached out fast before the evaluation period has started.

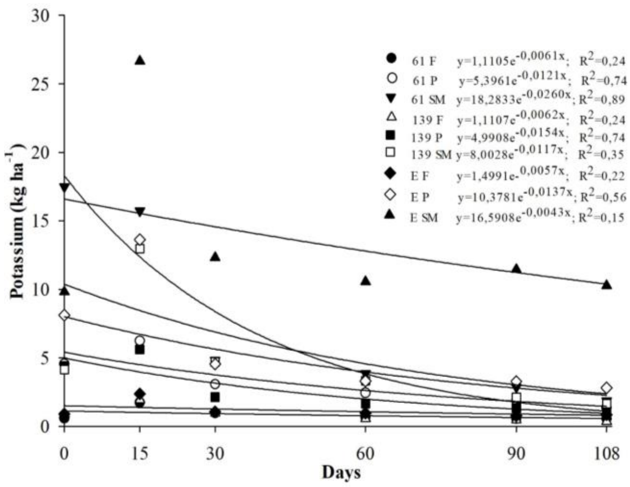

FIGURE 7 - Total amount of potassium (kg ha^{-1}) from oat remaining straw during the cultivation of corn silage intercropped with brachiaria; "IAPAR 61 IBIPORÃ" oat hay (61F), "IAPAR 61 IBIPORÃ" pasture (61P), "IAPAR 61 IBIPORÃ" cover crop (61SM), "Embrapa 139 (Fog)" oat hay (139F), "Embrapa 139 (Fog)" pasture (139P), "Embrapa 139 (Fog)" cover crop (139SM), "Emerald IPR 126" oat hay (EF), "Emerald IPR 126" pasture (EP) and "Emerald IPR 126" cover crop (ESM).

Giacomini et al. (2003) testify that by saying that K variation may happen because this element is extremely mobile, both in the plant and in the soil. Also, K is associated with the osmotic dynamics of cells (TAIZ et al., 2017) being released very quickly what explain, in part, its low initial level. Its increase may be related to the fertilization management of corn with brachiaria, because of K great mobility, it migrates freely from other crop residues or from the soil to straw and vice versa.

CONCLUSIONS

The decomposition time of the residual oat straw depends on meteorological factors, both in the development phase of the cover crop as well as during the decomposition period. The higher the initial vegetal mass is the greater the mulching time and the effectiveness are.

Nutrients release from oat straw varied and also depended on initial mass and on edaphoclimatic conditions.

Phosphorus releasing rate depends directly on the initial amount of coverage material while potassium was released rapidly. In turn, nitrogen was progressively released even though oscillating and its dynamics depended upon other factors.

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