MODELING RESPONSES OF ANNUAL RYEGRASS AS A FUNCTION OF NITROGEN FERTILIZATION

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INTRODUCTION

The action of modeling crop production corresponds to simulate a summary of the mechanisms related to plant growth and development using mathematical functions. These are necessary to identify input parameters, which should be easily accessible or measured. This study aimed to adjust a model of leaf area index (LAI) evolution and biomass accumulation as a function of photosynthetically active radiation being absorbed in annual ryegrass fertilized with nitrogen rates.

MATERIALS AND METHODS

The experiment was carried out at Estação Experimental Agronômica of UFRGS,

Brazil (30°05'52" S, 51°39'08" W). Herbage mass (HM) and leaf area index (LAI) were measured weekly (6/4/08 to 11/12/08) in annual ryegrass (*Lolium multiflorum* Lam.) pasture. Treatments corresponded to four rates of nitrogen application (zero, 50, 100 and 200 kg ha^{-1}) allocated to experimental units according to a complete block design, with three replications. Each time canopy intercepted 95% of the incident light, rapid defoliation (2-4 hours) was performed by heifers (150 kg body weight) just to achieve 30% of interception, simulating rotational grazing. The incident, transmitted, reflected by soil, and reflected by soil+crop photosynthetically active radiation (PAR) fluxes were continuously monitored in order to calculate absorbed PAR. The values of the extinction coefficient (k = 0.91) and maximum efficiency of absorption (β = 0.45 and 0.92, N_{zero} and $N_{\geq 50}$, respectively) were obtained in previous research (Carassai, 2010). LAI and HM evolution were subjected to analysis of variance and regression analysis at 5% probability.

RESULTS AND DISCUSSION

During the crop establishment period, the evolution of LAI as function of accumulated degree-days (DG) was fitted to a logistic model for zero-N treatment and to an exponential model for the other levels of applied N (LAI_{zero} = 1.4778/{1 +exp [-(∑DG - 588.7)/240]}; $LAI_{\geq 50}$ = 0.3008 exp (0.0041 ∑DG)). During the regrowth period, data fitted to a quadratic model on N_{50} treatment, while data from the other N levels were adjusted to a linear model (LAI_{50} = 1.02614 +0.00606 ∑DG -0.00000781 $\sum DG^2$; $LAI_{\geq 100}$ = 1.24475 +0.0075 ∑DG). The accumulation of HM as a function of absorbed PAR (PARa) during the establishment period fitted to different regression models (HM_{zero} = 128.8/{1 +exp [-(∑PARa -118.9)/32.1121]}; $HM_{\geq 50}$ = 35.261 exp (0.00763 ∑PARa)). In the crop regrowth, data from all treatments were also adjusted to different models (HM_{50} = 161/{1 +exp [-(∑PARa -11.0156)/23.5164]}; $HM_{\geq 100}$ = 83.06203 +1.06321 ∑PARa). The models could be used to estimate productivity and interpreting agronomic constraints to plant growth, but need to be tested under different soil and climatic conditions. The refinement of these models can estimate the effect of restrictions on plant development (e.g. water, nutrient management) and productivity.

CONCLUSION

The annual ryegrass model of biomass accumulation as a function of absorbed PAR is dependent of the growth stage and nitrogen availability. During establishment there is no response to N application higher than 50 kg ha^{-1}, while in regrowth evolution remains unchanged above 100 kg ha^{-1}. The accumulation of biomass can be estimated by using parameters describing the time-evolution of LAI, the absorption efficiency of PAR, and the local ratio between the global solar radiation and PAR.

REFERENCES

Carassai, I.J., 2010. Modelagem do crescimento de azevém anual (*Lolium multiflorum* Lam.) submetido a diferentes níveis de nitrogênio, em função da radiação solar absorvida. Porto Alegre: Universidade Federal do Rio Grande do Sul, Tese (Doutorado), 421p.