Climate Based Parasite Forecast System

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Technology description

Using the Thornthwaite Water Budget (TWB) and 30-year-average monthly climate databases, a climate based parasite forecast system was developed to determine the potential distribution and abundance of two Fasciola species. F. hepatica and F. gigantica are environmentally sensitive diseases and population densities fluctuate with climate and other components of the environment. This technology can be used to define the potential distribution range of F. hepatica and F. gigantica, regional differences in intensity of Fasciola spp. transmission, and seasonal transmission patterns at divergent sites. This information is essential for design of control programs and to determine the most cost-effective time(s) for treatment to minimize the economic loss.

An adaptation of a previously developed climate forecast computer model and digital agroecologic database resources available from FAO for developing countries were used to develop a geographic information system risk assessment model for fasciolosis in East Africa, a region where both E hepatica and F. gigantica occar as a cause of major economic losses in livestock. Regional F. hepatica and F. gigantica forecast index maps were created. Results were compared to environmental data parameters, known life cycle micro-environment requirements and to available Fasciola prevalence survey data and distribution patterns reported in the literature for each species (F. hepatica above 1200m elevation, F. gigantica below 1800m, both at 1200- 1800m). The greatest risk, for both species, occurred in areas of extended high annual rainfall associated with high soil moisture and surplus water, with risk diminishing in areas of shorter wet season and/or lower temperatures. Arid areas were generally unsuitable (except where irrigation, water bodies or floods occur) due to soil moisture deficit andi/or, in the case of F. hepatica,high average annual mean temperature >23"C. Regions in the highlands of Ethiopia and Kenya were identified as unsuitable for F. gigantica due to inadequate thermal regime, below the 600 growing degree days required for completion of the life cycle in a single year. The combined forecast index (F. hepatica-fF. gigctntica) was significantly correlated to prevalence data available for 260 ofthe 1220 agroecologic crop production system zones (CPSZ) and to average monthly normalized difference vegetation index (NDVI) values derived from the advanced very high resolution radiometer (AVHRR) sensor on board the NOAA polar-orbiting satellites. For use in Fasciola control programs, results indicate that monthly forecast parameters, developed in a GIS with digital agroecologic zone databases and monthly climate databases, can be used to define the distribution range of the two Fasciola species, regional variations in intensity and seasonal transmission patterns at

different sites. Results further indicate that many of the methods used for crop productivity models can also be used to define the potential distribution and abundance of parasites.

Application area

Enhanced predictions for Farmers in East Africa regarding:
Potential distribution range of F. hepatica and F. gigantica
Regional differences in intensity of Fasciola spp. transmission
Seasonal transmission patterns at divergent sites
May be adapted to develop similar models for other environmentally sensitive diseases, including tick-borne diseases, trypanosomosis, and other helminth infections
May be applied to other geographic regions including but not limited to the gulf coast and western regions of the USA.

Advantages

Improved forecasting
Reduction in economic losses suffered from Fasciola hepatica and F. gigantica

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