Proof:   
assume the halting problem is undecidable.  
we can constructing a Turing machine that decides L.  
This makes L recursive so its undecidable

Proof: Let the non-recursive language be L.  
If the halting problem for M is TM-decidable (recursive) then there exists a Turing machine M1 such that for any string w, M1 is able to decide whether M running on w will halt  
  
M1 halts in final state if M halts on w  
M1 halts in non-final state if M does not halt on w.  
  
Now a turing machine M2 that decides L  
all w, run M1 on <M, w>  
if M1 halts on final state  
 run M on w  
 if M accepts w, M2 halts and accepts w  
 if M rejects w, M2 halts and rejects w

If M1 halts on a non-final state  
 M2 halts and rejects w

Therefore L is Turing machine decidable aka recursive which is a contradiction