

although to a much lesser extent compared to the no crop residue plots (Table 30). Moreover, properties of soils under continuous mulch, no-tillage maize for 8 years were by no means comparable to that under bush and grass fallow. Planted fallows such as *Lucaena* with both leaves and branches returned as surface mulch compared favorably to that of natural bush fallow; whereas, results of pigeon pea (bush type) were inferior. The latter result is mainly due to severe disease problems that cause the crop to die off after 1 year. Lack of effective ground cover during or before the reestablishment of the new crop may have caused the loss of Ca, Mg and K from the surface soil by eroding and leaching.

Effect on earthworm activity. There was a remarkable difference in earthworm activity between the fallow and cultivated plots. Earthworm activity monitored during a 4-day period in July, 1980 (Table 31), showed that the natural bush fallow plot had a significantly higher *Hyperiodillus* activity (columnar casts) than the 2 planted fallow plots (*Lucaena* and Guinea grass). The extremely low earthworm activity in the continuously cropped plots (8.5 years) is apparently due to many factors. Soil compaction, continued use of pesticides and herbicides and the decline in soil organic matter are probably among the important ones. The results of *Eudrillus* activity (granular casts) taken during the same period were less indicative. Although the difference among the fallow and cropped plots was not statistically significant, the *Eudrillus* activity under *Lucaena* was considerably greater than that under bush and Guinea grass as well as the cropped plots (Table 31).

Role of crop residue mulch on maize yield under no-tillage system. Respectable grain yields under a mulch-no-tillage system on manually cleared land were maintained up to 4 years; but yield declined steadily, thereafter, despite adequate fertilization and plant protection (Fig. 18). The reason for the yield decline is a complex one. The decline in soil biomass activity due to cultivation, soil compaction and possible Mn toxicity due to soil acidification are probably among the more important growth-limiting factors that cannot be simply remedied by conventional fertilization. The beneficial effect of crop residue mulch in the no-tillage maize system is evident, particularly in areas of ustic soil moisture regime and frequent incidences of dry spells during the early cropping season. These results suggest that to avoid permanent degradation of the "superficially" fertile Alfisols in the forest/savanna transition zone of West Africa, cultivated land needs to be returned to an effective fallow or resting period after 4-5 years of cropping under recommended soil management practices, i.e., the mulch no-tillage system.

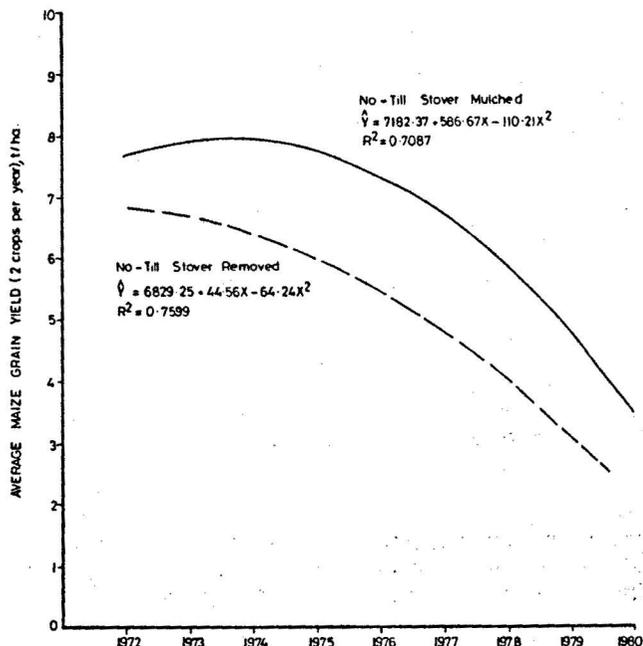


Fig. 18. Calculated yield curves of maize for a period of 9 years under no-tillage with and without stover mulch on a kaolinitic Alfisol.

Mineralization of soil organic matter.

A small-scale, manual, land clearing project (0.25 ha) was carried out to study the soil organic matter decomposition and nutrient release after forest clearing. A secondary objective of the experiment was to demonstrate whether improved soil and crop management practices at the small farmer's level could, in fact, increase the length of the period under cultivation before the land is returned to bush fallow. The improved practices included no burning, no tillage and the use of mulches, fertilizers, preemergence herbicides, pesticides and an improved crop variety. Soybeans were planted immediately after land clearing during the 1979 second season followed by maize during the 1980 first season. Fertilizer was not applied to either crop. Excellent growth of both the soybean and maize was observed, and tissue analysis indicated no nutrient deficiency. Results of weekly monitoring of $\text{NO}_3\text{-N}$ and $\text{NH}_4\text{-N}$ in the surface (0-10 cm) soil are given in Figure 19. Substantial amounts of soil organic N were mineralized during the onset of the rainy season. These data further suggest that, in spite of risking a drought stress, early planting of maize is preferred so that the crop can effectively utilize the high levels of mineralized N in the soil during the second season, both

Table 31. Earthworm activity in fallow and cropped plots taken during a 4-day period in July, 1980 (IITA).

Treatment	Hyperiodillus (columnar cast)		Eudrillus (granular cast)	
	g/250 cm ²	No./250 cm ²	g/250 cm ²	No./250 cm ²
Natural bush	10.46 a	12.98 a	0.01 a	7.66 a
Guinea grass	7.83 ab	10.02 ab	0.04 a	3.22 a
<i>Lucaena</i>	3.98 bc	6.85 abc	2.36 a	29.30 a
Maize/Cassava	2.15 c	5.78 abc	0.01 a	8.48 a
Maize + residue	0.60 c	1.79 c	0.02 a	2.35 a
Maize - residue	0.004 c	0.02 c	0.00 a	2.67 a