INTERCROPPING in semi-arid areas

Report of a symposium held at the Faculty of Agriculture, Forestry and Veterinary Science, University of Dar es Salaam, Morogoro, Tanzania, 10-12 May 1976

Editors: J. H. Monyo, A. D. R. Ker, and Marilyn Campbell

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Monyo, J. H.
Ker, A. D. R.
Campbell, M.
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Intercropping in Semi-Arid Areas

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Farmer's field near Ibadan, Nigeria, showing intercrop of cowpea under maize
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Experiments with Maize–Bean and Maize–Potato Mixed Crops in an Area with Two Short Rainy Seasons in the Highlands of Kenya

N. M. Fisher

Department of Crop Science, University of Nairobi, Nairobi, Kenya

In the tropics, there is good evidence of better returns to land area from mixed crops than from pure stands of their components (43). The objective of mixed cropping research at the University of Nairobi since 1972 has been to examine whether the same would be true under our conditions and, if so, to ascertain the mechanisms by which the crop mixtures utilized the factors of growth more completely or more efficiently.

In one experiment, maize–potato mixtures yielded less than the pure stand comparisons in two seasons and were no different in a third. Maize–bean mixtures were not significantly different in two seasons, significantly worse in one low-rainfall season, and significantly better in one relatively high-rainfall season. A second experiment indicated that even in the season when maize–bean mixtures showed an advantage, this could be explained by the higher population pressure in the mixtures rather than the intrinsic value of mixing the species. Light measurements suggested that mixtures could be more efficient in light interception. Soil–water profiles toward the end of the cropping season showed the capability of maize–bean mixtures to extract water more completely from the rooting zone.

Since the finding of no intrinsic value of mixed cropping at Kabete contrasts markedly with other African work, most especially with that of Willey and Osiru (21) in Uganda, an attempt is being made in the current season to confirm the finding with maize–bean mixtures in a replacement design. In the west of Kenya where rainfall is usually not a major limiting factor, advantages from mixtures comparable with the Uganda results appear to occur with some consistency (45), although they are small if the maize crop is a high-yielding one. If for any reason, the maize is prevented from developing its full yield, the beans can produce a very useful yield without further reducing maize yields. In conjunction with the Kabete results, this suggests that mixed cropping does have an insurance value under most conditions but not necessarily where the major risk is from drought. Under these conditions, maize yields may be reduced more than can be compensated for by the beans.

An original objective of the Kabete work was to study interactions between cropping systems and the physical environment, particularly light interception and water use. At the time, it was assumed that the mixtures would out-yield the pure stands and the aim was to find out how this might come about. Since the yield results were not as expected, it is perhaps not surprising that the data collected suggest that any differences are small.

Light interception was measured with the silicon photocells, banked to give spatial integration, described by Fisher (44). Interception was increased both by
increasing plant density and by mixing the crops. Even in high-density, high-yielding crops, maize has a rather low light interception during the time when these measurements were made, which approximately corresponds to the reproductive and filling phases of the beans. Greater efficiency of light utilization might therefore be expected from the mixtures if beans could utilize the light not intercepted by maize. These considerations, however, become rather academic if competition for water is ever a major factor.

The general finding for soil-water extraction is illustrated by data on soil-water content for 1 Aug 1973 after a dry period following the long rains. Potatoes and beans had already been harvested but the maize was not yet mature. In the upper soil layers, there was no difference between maize, potatoes, and their mixed stands, but in the subsoil, the maize lowered water content significantly more than the potatoes. The mixed plots were not significantly different from either pure stand. Beans lowered topsoil water content more than maize, which no doubt accounts for the severe competitive effect of beans on maize in a poor season. The soil under maize–bean mixtures was also drier than under pure maize. In the subsoil, the water content under mixtures was significantly lower than under either pure stand. It seems probable that rapid water extraction from the topsoil by the beans that establish a closed canopy more rapidly than maize, forced the maize in mixtures to exploit water from deeper layers than was necessary in pure maize stands. Nevertheless, the mixtures were not higher yielding than pure stands, so that in this season, the more efficient water extraction of which the mixture appears to be capable was apparently not of benefit.