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Proceedings of the Second Symposium on Intercropping in Semi-Arid Areas, held at Morogoro, Tanzania, 4-7 August 1980

Editors: C.L. Keswani and B.J. Ndunguru

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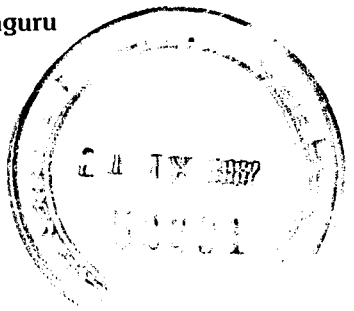

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Contents

ratio was 1.05.

The total number of maize leaves in monoculture was 25% higher than in association with beans. Plant light in both cropping systems, however, was about the same. Stem diameter was 22.7% thinner in association than in monoculture.

The Relative Importance of Above- and Below-Ground Resource Use in Determining Yield Advantages in Pearl Millet/Groundnut Intercropping — Summary

M. S. Reddy and R. W. Willey

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Experiments were carried out at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) to study the growth patterns and resource use of selected intercrop combinations to gain an understanding of the factors that enable intercropping to achieve yield advantages over monocropping. The basic approach is to examine the actual growth pattern in some detail to determine how component crops compete with each other and whether they are able to "complement" each other in space or time.

The experiments were carried out from 1978-1980, during four different seasons, at ICRISAT. The experimental sites were on medium-deep alfisols that have an available water holding capacity of about 100 mm in the top 90 cm of the profile.

All treatments were grown in 30-cm rows in a 1 millet row : 3 groundnut rows arrangement. Within-row spacing for each crop was the same in monocrop and intercrop and was equal to the estimated optimum spacing for the monocrop (15 cm for millet, equivalent to 22.2 plants/m^2 for the monocrop; and 10 cm for groundnut, equivalent to 33.3 plants/m^2 for the monocrop); all intercrop treatments, therefore, were simple "replacement" treatments of 25% millet : 75% groundnut. A basal fertilizer application of 50 kg P_2O_5/ha was applied to all plots. Monocropped and intercropped millet were top-dressed with N at the same rate per row; unless stated otherwise, this was equivalent to 80 kg/ha in monocropping (20 kg/ha in intercropping expressed over the area occupied by both crops). The cultivars used were BK-560 millet (80-85 days duration), which grows to a height of about 1.8 m, and Robut 33-1, a semi-spreading groundnut (110-120 days duration).

Beginning 20-25 days after sowing, samples were collected from an area ranging from 1.8-2.4 m^2 for estimating dry matter and area of green leaf laminae. The sampling interval was 1 week during the 1978 rainy season and 10 days during all other seasons. Plants were dug up but roots were not included in the dry matter estimates. Harvesting areas ranging from 20-50 m^2 were used to obtain a final estimate of total dry matter (still excluding roots), seed, or pod yields, and yield components.

Light interception was measured using tube solarimeters. One solarimeter per plot in monocrop treatments and two solarimeters per plot in the intercrop treatments were placed at ground level and the difference between these and a control solarimeter recording full incident light was measured as integrated daily totals. It was thought that growth in the groundnut rows adjacent to the millet might differ from central groundnut rows, so the two intercrop solarimeters were arranged to give equal weighting to all rows across the 1:3 pattern.

Considering the results of all of the experiments, however, it can be concluded that improved efficiency of light use can occur in this millet/groundnut combination and that it can be an important determinant of the yield advantage. This light factor seems to be less involved under conditions of moisture stress, despite the evidence of higher relative yield advantages under these conditions. In contrast, evidence presented suggests that under conditions of nitrogen stress, improved efficiency of light use may still make an important contribution.

Discussion

Chowdhury (question): Please refer to Tables 1 and 5. It is indicated that you have 25% of the total

sole crop millet population in the intercrops and the yields in intercrop seem to be 50% of the sole crop. Is it possible to get double the yield of cereal due to intercropping?

Reddy (answer): As you have seen, the use of sunlight was a major factor for yields. The yield was double because the number of tillers and heads were double in intercropped millet compared with sole crop tillers.

Mills (question): Why was partitioning done in your intercropping experiment?

Reddy (answer): The main objective of partitioning was to inhibit root interaction. Generally, it is considered that there is a transfer of nitrogen from legumes to cereals; hence, we wanted to confirm it with partition.

Malithano (question): How comparable are the results under artificial water stress to those under conditions of lack of rainfall?

Reddy (answer): We have a rainy season from June to September and during this period the control of moisture stress is not possible. However, it can be done in October. Hence, we can have a moisture stress experiment then.

Wilson (question): Have you ever tried millet and groundnut in the same row, like the farmer does in practice?

Reddy (answer): The farmers grow a bit more groundnut but they do it under mixed cropping.

Effects of Moisture Availability on Intercropping and Yield Advantages — Summary

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In the semi-arid tropics, the availability of water is a major concern. Although there have been specific suggestions that intercropping may result in more efficient use of water, there has been little factual evidence on whether or not the relative advantages of intercropping are affected by changes in water supply. A series of experiments on the effect of moisture regime has been initiated at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and some of the results to date are summarized in this paper.

Three experiments were carried out on alfisols that had a water holding capacity of 100 mm in the 90 cm profile. The three crops involved were groundnut, millet, and sorghum; their monocrop populations in all experiments were 333 000, 333 000, and 150 000 plants per hectare respectively. In the first experiment, the cereal/groundnut intercrops consisted of 50% of the sole cereal population plus 100% of the sole groundnut population, but thereafter all intercrops had simple "replacement" populations as indicated by their row arrangements. All treatments were in 30 cm rows. The basic fertilizer applied was 46 kg P_2O_5/ha and 18 kg N/ha. Nitrogen was top-dressed to the sole cereal plots at a rate of 62 kg/ha, and the same rate per row was applied to all cereals in the intercrops.

During the postrainy season of 1977, stress and no-stress treatments were created in the main plots by flooding twice and four times, respectively, to bring the profile moisture to field capacity each time. Rainfall during the growing period amounted to 75 mm. In addition to the monocrops, intercrop treatments included: 1 row millet: 2 rows groundnut; 1 row sorghum : 2 rows groundnut; and 1 row millet : 1 row sorghum. All monocrops showed a good response to different moisture regimes. The three combinations gave significant advantages ranging between 20-25% in the stress treatment but little or no advantage in the no-stress treatment. Examination of the yields of the individual crop components, however, indicated that in the no-stress situation the balance of competition favoured the dominant component.

During the postrainy season of 1978, no-stress and stress treatments were achieved by irrigating every 10 days and every 20 days, respectively, with a "Perforain" spray. The total amount of water applied through irrigation was approximately 470 mm in the no-stress treatment and approximately 270 mm in the stress treatment.