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Choosing Suitable Intercrops Prior to Pruning *Sesbania* Hedgerows in an Alley Configuration

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CHOOSING SUITABLE INTERCROPS PRIOR TO PRUNING *SESBANIA* HEDGEROWS IN AN ALLEY CONFIGURATION

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ABSTRACT

In the northern Rwandan Highlands, farming is intensive due to unavailability of land. A study was conducted to choose suitable intercrops with Sesbania for alley cropping prior to cutback of the shrub, a practice that would enable farmers to continuously crop their fields. Potato, pole bean, dwarf bean and maize were tested in 4-m alleys. The study concludes that pole bean is most appropriate while maize is the least preferred intercrop for a 6-month-old Sesbania. Yield losses of intercrops were attributed principally to shading by Sesbania hedges, but competition for nutrients and soil space as well as disease incidence are also possible. Keywords: alley cropping, intercropping, Sesbania, shading.

INTRODUCTION

Hedgerow intercropping is a recommended land-use system on sloping lands (Young, 1984). Sesbania sesban is a promising shrub species for hedgerow intercropping in the Rwandan Highlands primarily because of its fast growth, provision of stakes and nitrogen fixation (Yamoah, 1988).

Normally, hedgerow establishment requires between 12 and 24 months before pruning begins. Available evidence at the Farming Systems Research Program (FSRP) and elsewhere indicates few or no negative effects on intercrops following the first season of shrub establishment, but competition for light becomes an issue during the second season when Sesbania attains a height of 1.5 to 3.0 m.

In the region where the FSRP works, farmers cannot afford the "luxury" of allowing their limited land to lie fallow for more than a season while shrubs become established. Therefore, it is most desirable to find ways of safely integrating the shrubs with intercrops for the period preceding shrub cutback. A practical option may be to plant shade-tolerant crops between the hedgerows. This would allow regular farming practices to continue while the shrubs become established. This study was planned to determine which intercrop is most tolerant to shade created by 6-month-old Sesbania hedgerows in an alley cropping configuration.

MATERIALS AND METHODS

The study was conducted in the northern Rwandan Highlands. Altitude is 2300 m, and mean annual rainfall is 1160 mm with a bimodal distribution. Mean temperatures range from < 13 to 17 C. The soils are classified as Oxisols in the USDA soil taxonomy system (RRAM, 1987). Detailed information on the region where this study was conducted is contained in Franzel et al (1985).

Sesbania hedgerows were planted in April 1987 using 4-month-old seedlings on a field with a slope of 25%. The slope faced north, and the hedgerows followed the contours in an east-west direction. There were four hedgerows giving rise to three alleys, which constituted blocks from the upper to the lower slope. The hedgerows were 24 m long and 4 m apart. On an adjacent block was a control without Sesbania hedgerows. A hedgerow of Sesbania consisted of plants spaced 0.5 m apart within rows and staggered in a zig-zag fashion. Setaria was planted alongside the hedgerows to help check soil erosion.

Intercrops, namely potato (variety Sangema), dwarf beans (variety Rubona 5), maize (variety Bamboo) and pole beans (variety G2333), were assigned randomly to the alleys. Spacings for the intercrops were potato, 0.6 m x 0.4 m (5 rows); dwarf bean, 0.5 m x 0.2 m (7 rows); pole bean, 0.4 m x 0.6 m (8 rows) and maize, 0.6 m x 0.4 m (4 rows). Rows of intercrops were numbered from up-slope and were separated from hedges by a distance of about 0.5 m. Length of a row for each intercrop was 6 m. The above intercrops dominate the cropping systems in the region.

Intercrops were planted 6 months after planting Sesbania. The shrub was not pruned throughout the cropping season. Yield and yield components of the intercrops were assessed at harvest.

RESULTS AND DISCUSSIONS

Potato

Potato plants bordering the hedgerows produced fewer tubers than those in the middle of the alleys and the control, but the difference was not significant (Table 1). There was significant difference in mean weight per tuber between rows with plants in the middle rows producing bigger tubers than those at the borders.

Tuber and vegetative yields at harvest differed significantly between rows; border rows were inferior to middle rows. Plants in the alleys were observed to be heavily infested with late blight virus relative to those in the control plot. The resulting stunted growth and scorched potato leaves culminated in poor vegetative growth and concomitant low yield. Low tuber yield in the alleys could also be ascribed to shading by the Sesbania hedgerows. Relative to control, yields were reduced by more than 50% in the border rows and between 20 and 30% in the middle rows. The yield reduction of potato in the alleys relative to control averaged 40% (Fig. 1a).

Dwarf Bean

Yield and yield components of dwarf bean are shown in Table 2. Number of pods/plants, number of immature plants and pod weight at harvest were significantly affected by Sesbania hedgerows. Middle row plants had more pods per plant, higher pod weight and fewer immature plants than border plants.

The number of plants per row, weight of residue, number of grains per pod and 100-grain weight were unaffected by hedgerows. Relative to the control, yields of border bean plants were reduced by over 70% whereas yields of plants in the middle row were reduced about 45%. Mean yield reduction was 61% (Fig. 1b). Number of plants differed between blocks. Plants/block were 39.5, 48.6 and 64.1 for upper, middle and lower blocks, respectively. A similar trend was found for pod and residue weights at harvest. Perhaps the bean seeds were washed downslope at the onset of rains when the field was virtually bare. Erosion and deposition of top fertile soil downslope might have contributed to good performance of beans in the lower block. This inference is subject to verification.

Pole Bean

Table 3 presents data on yield and its components for pole bean. Number of pods/10 plants and 100-grain weight differed among rows. The middle rows and control produced more pods than those in the border rows. Hundred-grain weight in the control plot was significantly higher than that in the alleys, but the number of grains per pod was not significantly different. This may suggest partitioning of more photosynthate for grain formation in the control plot where light was not limiting.

Residue and pod weights at harvest were indifferent to the presence of the hedgerows in a statistical sense. However, relative to the control, the border rows (1, 2, 3, 6, 7 and 8) suffered a mean reduction in yield of 19.6% whereas the two middle rows (4 and 5) yielded 36% more. Overall yield reduction averaged 15% (Fig. 1c). The comparatively low yield reduction of pole bean as opposed to the dwarf bean could be a result of staking of the latter, which exposed most of its photosynthetic apparatus to solar radiation. Consequently, competition for light was less for pole beans.

As for the dwarf bean, the number of plants differed among blocks. The respective figures for blocks 1, 2 and 3 were 18., 21.6 and 33.6.

Maize

Maize performance was extremely poor. Percent germination after first planting was barely over 50%. Sesbania also attracted birds, causing further damage to the germinated maize. Although the maize was replanted, general growth was less than satisfactory. Figure 1d shows the performance of maize in the alleys relative to control. Total maize yield was reduced by 75%, yield/10 plants by 39% and residue yield by 60%. Low maize yield in alleys was due to poor plant establishment and stunted growth.

CONCLUSIONS

1) Performance of intercrops with 6- to 12-month-old Sesbania decreased in the following order: Pole bean, potato, dwarf bean and maize. In fact, planting of maize in unpruned Sesbania hedgerows should be discouraged unless a farmer is prepared to be present on his farm all the time to chase away birds. Even then, maize, a C4 plant, can hardly withstand shading imposed by vigorously growing Sesbania. Maize is recommended as an intercrop at the very early stages of shrub establishment when there no shading.

2) With the exception of maize where performance was poor,the hedgerows did not adversely affect population of intercrops, i.e number of plants/row. For beans, it was number of pods/plant that was negatively affected by the hedgerows. In the case of potato, yield reduction in the alleys was due to poor vegetative development that might have resulted from shading and late blight infestation.

3) In this study, yield reductions of intercrops in the alleys were blamed principally on shading by Sesbania hedgerows. But competition for nutrients, water and soil space as well as possible disease incidence cannot be exculpated. These are worth investigating.

4) In practice, the 4-m alley width used for this study appears too narrow to be welcomed by farmers (Yamoah and Grosz, 1988). Perhaps by using wider alleys of 6 m or more, additional land could be freed for cultivation, and shading would also be minimized.

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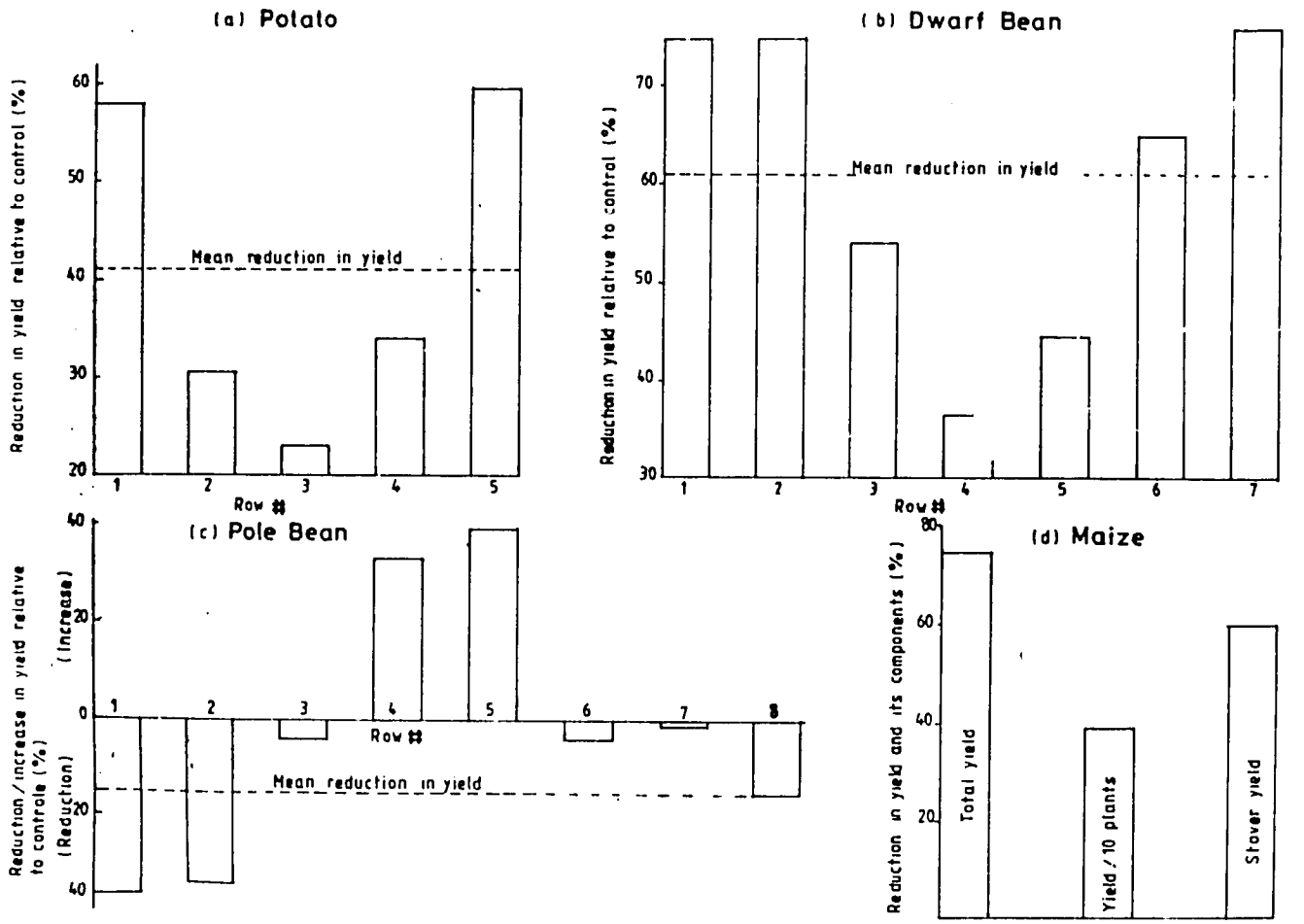

Fig. 1. Percent reduction/increase in yield of food crops relative to control.

Table 1. Effect of Sesbania hedgerows on yield and yield components of potato.

Row	No. of plants/row	Tuber yield /row (Kg)	No. of tubers/row	Residue wt /row (Kg)	Wt/tuber (Kg)
1	9	1.157	32	0.259	0.035
2	9	1.937	32	0.300	0.059
3	10	2.139	41	0.308	0.050
4	9	1.813	34	0.222	0.045
5	9	1.131	24	0.238	0.047
Control	10	2.789	40	0.654	0.069
LSD (0.05)	*NS	0.731	NS	0.214	0.013

*NS = non significant

Table 2. Effect of Sesbania hedgerows on yield and yield components of dwarf beans.

Row	No. of plants/row	No. of pods/ 10 plants	Pod wt/ row (Kg)	Residue wt/ row (Kg)	No. of grains/pod	Wt of 100 grains (g)	No. of immature plants/row
1	53	12	0.112	0.127	2.18	45.66	22
2	49	14	0.110	0.140	2.43	52.00	17
3	48	31	0.202	0.150	2.58	45.66	14
4	52	39	0.280	0.148	2.81	52.00	11
5	49	45	0.244	0.146	2.65	48.66	9
6	48	22	0.153	0.141	2.88	51.33	21
7	51	22	0.103	0.155	2.43	61.00	31
Control	57	47	0.441	0.164	2.55	57.66	16
LSD (0.05)	*NS	11.75	0.091	NS	NS	NS	16

*NS = non significant

Table 3. Effects of Sesbania hedgerows on yield and yield components of pole bean.

Row	No. of plants/row	No. of pods/ 10 plants	Residue wt/ row (Kg)	No. of grains/pod	Wt of 100 grains (g)	Pod weight/ row (Kg)
1	22	36	0.152	6.80	38.33	0.315
2	23	44	0.113	6.70	39.66	0.326
3	24	84	0.163	6.40	39.33	0.477
4	28	76	0.185	6.96	36.00	0.659
5	25	88	0.156	6.93	32.33	0.688
6	27	73	0.127	6.76	37.00	0.475
7	25	43	0.126	6.70	36.00	0.490
8	24	47	0.109	6.70	35.66	0,421
Control	20	70	0.224	6.43	99.00	0.495
LSD (0.05)	*NS	27	NS	NS	4.11	NS

*NS = non significant