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# Agronomic and economic evaluation of groundnut (*Arachis hypogaea*) – cereal fodder intercropping during the post-rainy season

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## ABSTRACT

A field trial was conducted on groundnut (*Arachis hypogaea* L.) intercropping during post-rainy seasons of 1996 and 1997 with 3 cereal fodders, maize (*Zea mays* L.), pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend. Stuntz] and sorghum [*Sorghum bicolor* (L.) Moench] to provide green fodder during the dry season, and to assess the profitability of intercropping system over prevailing practice of sole cropping of groundnut in post-rainy season. The green fodder yield was the highest in pearlmillet with 2 cuts. The highest pod yield (24 q/ha) was recorded in sole groundnut. Significant reduction in yields, yield attributes, leaf area, nodule mass of groundnut were recorded when 2 cuts of pearlmillet and sorghum were planned. However, such yield reduction was nullified by high fodder yield and high net returns obtained from 2 cuts of pearlmillet. Thus, 2 cuts of pearlmillet, one at 60 days and the other at 106 days in association with summer groundnut not only provided additional income to the farmer but also mitigated the fodder scarcity to some extent in dry season.

***Key words :*** Intercropping, Resource-use efficiency, Cereal fodder, $N_2$ fixation

Intercropping is practised not only for risk avoidance but also to maximize resource use-efficiency and monetary return. In dry season (summer) groundnut in India is grown in pure stands with irrigation in an area of 1.09 million ha (Damodaram and Hegde, 1999). This summer crop gives almost double the yield and profit of rainy-season groundnut despite a higer cost of cultivation and higher input requirement. On the other hand, India has traditionally been a livestock-rearing country. The increasing population pressure and its ramification resulted in a demand for more food, thus diverting the attention of farmers and rendering the forage farming a secondary priority. This neglect of forage crops led to scarcity of fodder for the livestock. Since fodder availability in summer is scarce and costly, an experiment was conducted to provide green fodder during the dry season, assess the increase in

income from the intercropping system over sole groundnut in post-rainy season, and find out the effect of fodder crops in intercropping system on growth and yield of groundnut.

## MATERIALS AND METHODS

The field experiment was conducted during the dry seasons (summer) of 1996 and 1997 at the National Research Centre for Groundnut, Junagadh, Gujarat. The soil was medium black (pH 7), having 0.52% organic caron, 10.14 kg/ha available P and 245 kg/ha available K. Cereal fodders, viz. maize, sorghum and pearlmillet, were used and sown simultaneously with groundnut cv. 'GG2', spanish bunch, in the first week of February. A row ratio of 3 (groundnut spaced at 30 cm between rows and 10 cm between plants) : 1 (cereal fodder) was maintained. One sole groundnut plot was also maintained for comparison. One cutting for all and 2 cuttings for sorghum and pearlmillet were made. The first cut was taken 60 days after sowing (DAS, flowering stage) and second was at 106 DAS (time of groundnut harvest). Six treatments comprising sole groundnut, groundnut + maize (single cut), groundnut + sorghum (single cut), groundnut + pearlmillet (single cut), groundnut + sorghum (2 cuts) and groundnut + pearlmillet (2 cuts) were tested in completely randomized block design, replicated 4 times. Groundnut received recommended N (25 kg/ha) and $P_2O_5$ (50 kg/ha) in the form of urea and single superphosphate where half N and all P were applied basal and remaining half N at 30 DAS. The cereal fodders received 80 kg N/ha. Twenty kg additional N/ha was applied to the fodder crops after the harvest of the first cut in treatments where 2 cuts were planned. The necessary plant protection, irrigation and other management practices were followed during the crop growth. Five plants of each plot were sampled and dried at 65°C to a constant mass. Leaf area was measured on leaf, area meter (LI-Cur Lincolin, NE, USA) and leaf area-index (LAI) was computed.

## RESULTS AND DISCUSSION

### *Growth parameters*

Sorghum plants attained the highest height in 1996 but pearlmillet in 1997. Pearlmillet produced more number of tillers than that of sorghum but the highest dry matter was recorded in maize (Table 1). The highest dry-matter production/plant, leaf-area index (LAI), nodule number and its mass were recorded in sole groundnut during both the years. All these growth parameters of groundnut were reduced in association with fodder crops (Table 2). Among the growth parameters, biomass of groundnut was affected the most, particularly when 2 cuts of pearlmillet and sorghum were planned. Twenty kg N applied to sorghum and pearlmillet after their first cut for the establishment of the crops caused shedding effect on the groundnut throughout the growth period and hence experienced more competition. However, in the plots where only 1 cut was tried groundnut experenced less competition and shedding, and thus produced more biomass, LAI and nodulation than 2 cuts were tried. Such a reduction in growth in association with pearlmillet and sorghum were also reported by Bandel *et al.,* (1992)

and Ghosh and Devi Dayal (1998). Shedding due to tall cereal canopy significantly reduced LAI of groundnut and nodulation as well during both the years (Table 2). It seems that less amount of light energy received by canopy might be the possible cause of poor nodulation in groundnut in association with cereals. This reduced light energys affect $N_2$-fixation by restricting photosynthesis and so the energy supply to the nodule (Nambiar *et al.*, 1983).

### *Yield and yield attributes*

Mean values showed that green fodder yield was the highest in pearlmillet with 2 cuts followed by pearlmillet with a single cut and sorghum with 2 cuts (Table 1). Superiority of pearlmillet to sorghum and maize was perhaps due to a higher number of tillers. Despite any tiller formation, higher, fodder yield obtained in maize with a single cut than sorghum with a single cut was possibly owing to more accumulation of dry matter in maize.

The highest pod yield was recorded in sole groundnut during both the years. All the fodder crops regardless of number of cuttings reduced the yield of groundnut. However, significant reduction was recorded during both the years when 2 cuts of pearlmillet and sorghum were made. Similar trend was found for haulm yield during both the years (Table 3). All the yield attributes of groundnut were significantly reduced in association with fodders compared sole groundnut during both the years (Table 3). But the magnitude of reduction in yield attributes was more when 2 cuts were planned. To be more specific yield reduction of groundnut due to 2 cuts of pearlmillet was more than that of 2 cuts of sorghum perhaps more number of tiller and biomass exhibited by pearlmillet (Table 1) might have caused more shedding to the groundnut.

Reduction in yield of groundnut due to 2 cuts of pearlmillet and sorghum compared to single cut was evident from reduction in groundnut growth attributes (biomass, leaf area, nodule mass) and yield attributes (pod numbers, pod yield/plant, 100-kernel mass).

**Table 1.** Growth and yield of fodder crops in association with groundnut

| Crop combination and number of cuttings | Plant height (cm) | | Tiller number | | Dry matter (g/plant) | | Fodder yield (tonnes/ha) | |
|---|---|---|---|---|---|---|---|---|
| | 1996 | 1997 | 1996 | 1997 | 1996 | 1997 | 1996 | 1997 |
| G+M (single) | 103.3 | 103.1 | | | 54.7 | 61.1 | 7.04 | 10.97 |
| G + S (single) | 110.3 | 109.0 | 1.9 | 2.1 | 45.2 | 47.3 | 7.81 | 8.15 |
| G + P (single) | 93.6 | 127.0 | 2.8 | 2.4 | 44.0 | 53.0 | 12.13 | 13.50 |
| G + S (2) | 108.5 | 114.0 | 2.3 | 2.6 | 43.1 | 42.6 | 11.95 (7.21*+ 4.74**) | 13.60 (7.34 + 6.24) |
| G + P (2) | 97.1 | 122.3 | 4.2 | 3.2 | 42.7 | 41.2 | 16.75 (11.90 + 4.85) | 16.22 (11.43 + 4.78) |

*I cut, **II cut, G, groundnut; M, maize; S, sorghum; P, pearlmillet

**Table 2.** Growth of groundnut in association with cereal fodder

| Crop | Dry matter (g/plant) | | | | Leaf-area index | | | | Nodules number/plant | | | | Nodule mass (mg/plant) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1996 | | 1997 | | 1996 | | 1997 | | 1996 | | 1997 | | 1996 | | 1997 | |
| | 1st cut | 2nd cut | 1st cut | 2nd cut | 1st cut | 2nd cut | 1st cut | 2nd cut | 30 DAS | 60 DAS | 30 DAS | 60 DAS | 30 DAS | 60 DAS | 30 DAS | 60 DAS |
| SG | 5.91 | 17.52 | 5.33 | 24.18 | 3.98 | 3.23 | 3.51 | 3.43 | 8.2 | 17.2 | 7.2 | 16.9 | 46.2 | 96.0 | 53.5 | 107.9 |
| G+M (Single) | 5.20 | 9.6 | 3.95 | 11.13 | 3.68 | 2.78 | 3.23 | 2.95 | 8.0 | 15.5 | 4.8 | 14.7 | 39.9 | 79.5 | 45.5 | 95.0 |
| G+S (Single) | 3.42 | 11.1 | 4.94 | 12.93 | 3.66 | 2.68 | 3.15 | 2.66 | 7.4 | 16.2 | 6.6 | 14.7 | 38.5 | 83.5 | 42.2 | 93.1 |
| G+P (Single) | 4.10 | 9.5 | 3.94 | 14.50 | 3.62 | 2.71 | 3.97 | 2.48 | 8.1 | 15.1 | 3.7 | 20.4 | 32.3 | 88.5 | 37.4 | 89.3 |
| G + S (2) | 4.78 | 12.2 | 4.35 | 10.74 | 3.60 | 2.74 | 3.17 | 2.61 | 5.2 | 17.1 | 3.0 | 14.3 | 33.1 | 72.5 | 35.4 | 84.5 |
| G + P (2) | 4.20 | 12.4 | 4.32 | 11.94 | 3.53 | 2.72 | 2.93 | 2.51 | 6.5 | 15.8 | 4.6 | 13.9 | 32.2 | 69.8 | 33.9 | 85.2 |
| CD (P=0.05) | 1.10 | 3.70 | 1.79 | 6.91 | 0.173 | 0.151 | 0.166 | 0.132 | 1.48 | 1.07 | 2.00 | 5.57 | 2.71 | 5.95 | 3.12 | 6.25 |

SG, Sole groundnut; G, groundnut; M, maise, P, pearlmillet; DAS, days after sowing; LAI, leaf-area index

Table 3. Yield and yield attributes of groundnut and economics in association with different fodder crops

| Treatment | Pods/ plant | | Pod yield/ plant (g) | | 100-kernel mass (g) | | Pod yield (q/ha) | | Haulm yield (q/ha) | | Net returns (Rs/ha) | | Benefit : ratio | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1996 | 1997 | 1996 | 1997 | 1996 | 1997 | 1996 | 1997 | 1996 | 1997 | 1996 | 1997 | 1996 | 1997 |
| SG | 8.2 | 11.4 | 6.9 | 9.0 | 39.2 | 38.2 | 24.5 | 24.0 | 39.8 | 42.2 | 24,001 | 25,434 | 1.91 | 1.92 |
| G+M (Single) | 5.4 | 6.8 | 4.3 | 4.8 | 36.1 | 39.2 | 23.6 | 22.6 | 38.2 | 36.6 | 31,759 | 33,076 | 2.34 | 2.32 |
| G+S (Single) | 5.2 | 7.9 | 4.8 | 6.3 | 34.9 | 34.2 | 27.7 | 23.1 | 35.2 | 37.7 | 28,008 | 32,113 | 2.08 | 2.26 |
| G+P (Single) | 5.0 | 5.5 | 4.3 | 5.6 | 35.2 | 34.2 | 21.9 | 21.4 | 37.5 | 35.5 | 34,199 | 33,062 | 2.55 | 2.25 |
| G + S (2) | 5.5 | 6.3 | 4.3 | 4.0 | 33.8 | 32.9 | 19.6 | 21.2 | 33.8 | 33.9 | 29,796 | 33,677 | 2.15 | 2.29 |
| G + P (2) | 5.3 | 4.8 | 4.1 | 3.6 | 34.7 | 34.3 | 19.5 | 20.7 | 33.3 | 29.9 | 35,445 | 35,071 | 2.48 | 2.38 |
| CD (P=0.05) | 1.52 | 4.28 | 1.33 | 3.4 | 2.57 | 3.0 | 3.12 | 2.9 | 3.3 | 8.2 | 16,29.6 | 21,891 | 0.101 | 0.188 |

Market price for fresh fodder and groundnut pod, Rs 1 and 15/kg respectively

### *Economics*

Though cereal fodders depressed the yield of groundnut, overall benefit was observed when yield of both the crops were considered together. The results indicated that higher net returns were obtained with 2 cuttings of pearlmillet than with its single cut. It was Rs 1,246 in 1996 and Rs 2,009 in 1997 more with 2 cuts than with its single cut (Table 3). Similar was the case for 2 cuts of sorghum. Thus, groundnut yield reduction due to 2 cuts of pearlmillet and sorghum was nullified by high fodder yield and high net returns. Such yield advantage in groundnut + pearlmillet combination was also reported by Reddy and Willey (1981) and Ghosh and Devi Dayal (1998). Net returns based on current market prices were maximum and so was the benefit : cost ratio when pearlmillet was cut twice (Table 3). The lowest net return and benefit : cost ratio were recorded in sole groundnut. Additional net returns of Rs 11,444 in 1996 and Rs 96,337/ha in 1997 were obtained from the system with 2 cuts of pearlmillet compared to sole groundnut.

The present study, thus, indicates that 2 cuts of pearlmillet, one at 60 days and the other at 106 days in association with summer groundnut not only provide additional income to the farmer but also mitigate the fodder scarcity to some extent during the summer season. The study also gave 2 options for the farmers, i.e. if more groundnut pods are desired, maize could be the choice for stripcropping as it would not be affecting its production greatly but at the same time giving some fodder and, if high monetary returns as well as high fodder yields are desired, pearlmillet with 2 cuts is the best choice.

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