Bean Production under High Temperature and Sub-irrigation: why it is feasible?

M.Thung[1], A. B. Heinemann[2], J. Kluthcouski[1], H. Aidar[1], D. M. Soares[1] and S. C. da Silva[1]

[1]Embrapa Arroz e Feijão. P. O. 179, 75.375-000 St° Ant. de Goiás/GO, Brazil; [2]Embrapa Gado de Leite.

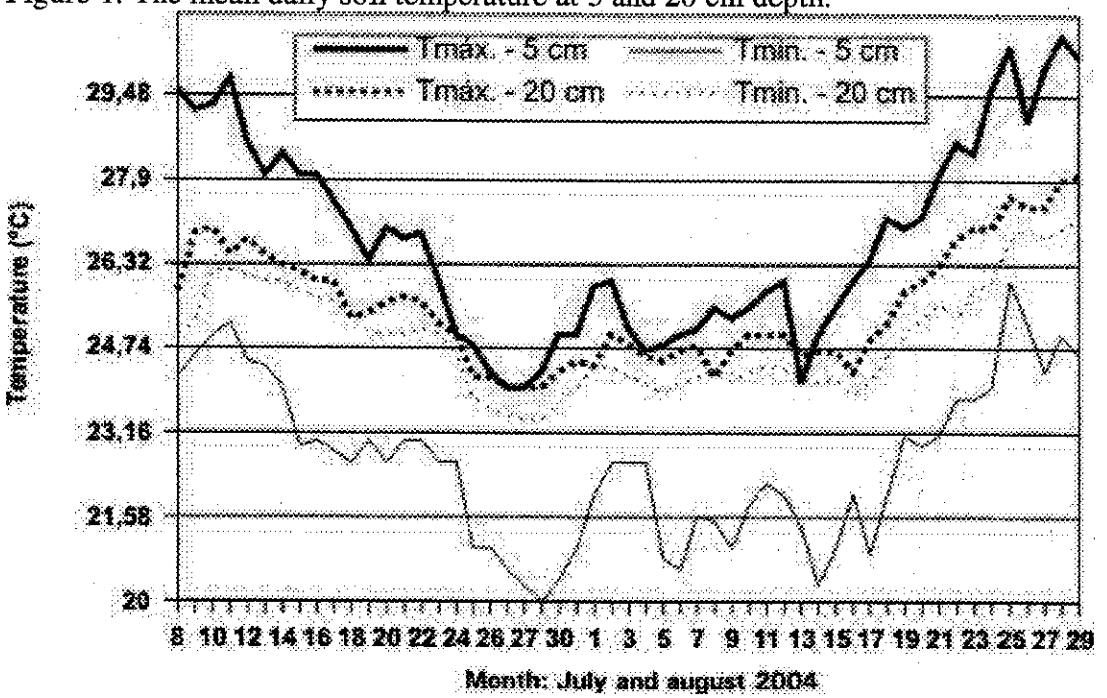
Bean production at high temperature is possible when water is not limiting. Leaf transpiration reduces temperature of the leaves. This makes possible to grow bean seed production in semi desert with irrigation in many part of the world, e.g., along the Snake River/Id or Imperial Valley/CA, where peak temperature reaches beyond 40°C. Common diseases can not proliferate in the lowland tropics when irrigation water is supplied by raising the water table or sub-irrigation and low humidity and no rainfall during the crop season also prevent the contamination of diseases in the field. Furthermore, the soil is inundated for more than 4 months during the rice production in the rainy seasons, eliminating most of disease propagules in the soil. Few or no plant protection chemicals are needed; hence the production cost can be reduced significantly appropriated for seed production or bean production. High temperature modifies physiological and morphological characteristics of beans and only few commercial cultivars can adapt this environment. The bean growth cycle is reduced by 10 days. This shorter growth cycle reduces productivity, when nutrients are not adequately available in early growth stages. The N deficiency can be seen at any growth stage in this lowland tropic, because high quantity of crop residues from the previous rice production and the rapid decomposition by soil microorganisms, that need large quantity of N for its activities. The traditional recommendation for N fertilization, where one third of the total rate is applied at planting and the rest at 15 till 21 days after emergence can not satisfy the high demand of N by the bean plant.

The soil temperature can reach up to 40°C for 6 hours a day in the upland areas in Africa (Lal 1978) and traditional growing areas in Brazil without irrigation soil temperature at the depth of 10 cm is around 26°C (Met. Sta Embrapa Goiania). Information on soil temperature in lowland tropic is not available; therefore in 2004 the soil temperature was monitored at 5 and 20 cm depth. The result was encouraging for bean production in this region. The mean daily soil temperatures in July and August varied between 22.6 and 26.8°C at 10 cm depth and at 20 cm the mean soil temperature is almost constant at 25°C. This optimal soil temperature favors root activities for nutrient uptake and promotes the life of soil microorganisms, e.g. Rhizobium for N fixation. Farmers with rudimentary cultural practices can obtain 2 Mg ha^{-1} using the commercial cultivars from the traditional bean growing areas, but this productivity level is not attractive for large scale bean production.

Earlier experiment conducted by Santos & Silva, 2002 that N rates up to 200 kg ha^{-1} still increased yield. To obtain the optimum rate of N for higher bean yield an experiment in split plot design with four replications was conducted in 2004. The main plots were the N rates (0, 45, 90 and 135 N kg ha^{-1}) applied at planting at 8 cm depth and the subplots were the 4 cultivars (Carioca, ETA, Carioca Pitouco and BRS Valente). Among the four cultivars tested Carioca produced the highest yield with 3871 Mg ha^{-1} at 135 N kg ha^{-1} and planted at 22.5 cm row spacing. Increasing N rate further from 45 to 135 N kg ha-1 increased yield, but the differences were not statistically significantly. The optimum rate was 45 N kg ha^{-1} this region.

It can be concluded that bean yield beyond 3.5 Mg ha^{-1} can be obtained in the tropical lowland with sub-irrigation with adapted cultivars such as Carioca, provided sufficient N is applied at the time of planting. Soil temperature lower than 32°C during the crop season corroborates for bean root activity and yield. Further confirmation of these results will follow in 2005. Cultivars for this specific region must be developed to attend the demand.

Figure 1. The mean daily soil temperature at 5 and 20 cm depth.



Cultivar	N kg ha^{-1}				Mean
	0	45	90	135	
Carioca	2273	2982	3358	3871	2971a
ETA	1692	2685	2682	2492	2387c
Carioca Pitoco	1514	2683	2671	2763	2408c
Valente	1725	3261	3204	3045	2809b
Mean	1801a	2903b	2979b	3043b	2681

CV=13,1%. LSD (5%)=136

Table 1. Yield of 4 bean cultivars as affected by different N rates applied at planting grown with subirrigation system in Lagoa da Confusão-TO. 2004.

Literatures:

Lal, R. 1978. Field Crops Res. 1:127-139.
Santos & Silva. 2002. Manejo do Nitrogênio. In: H.Aidar, J. Kluthcouski and L.F.Stone. Embrapa Arroz e Feijão.p.207-230.